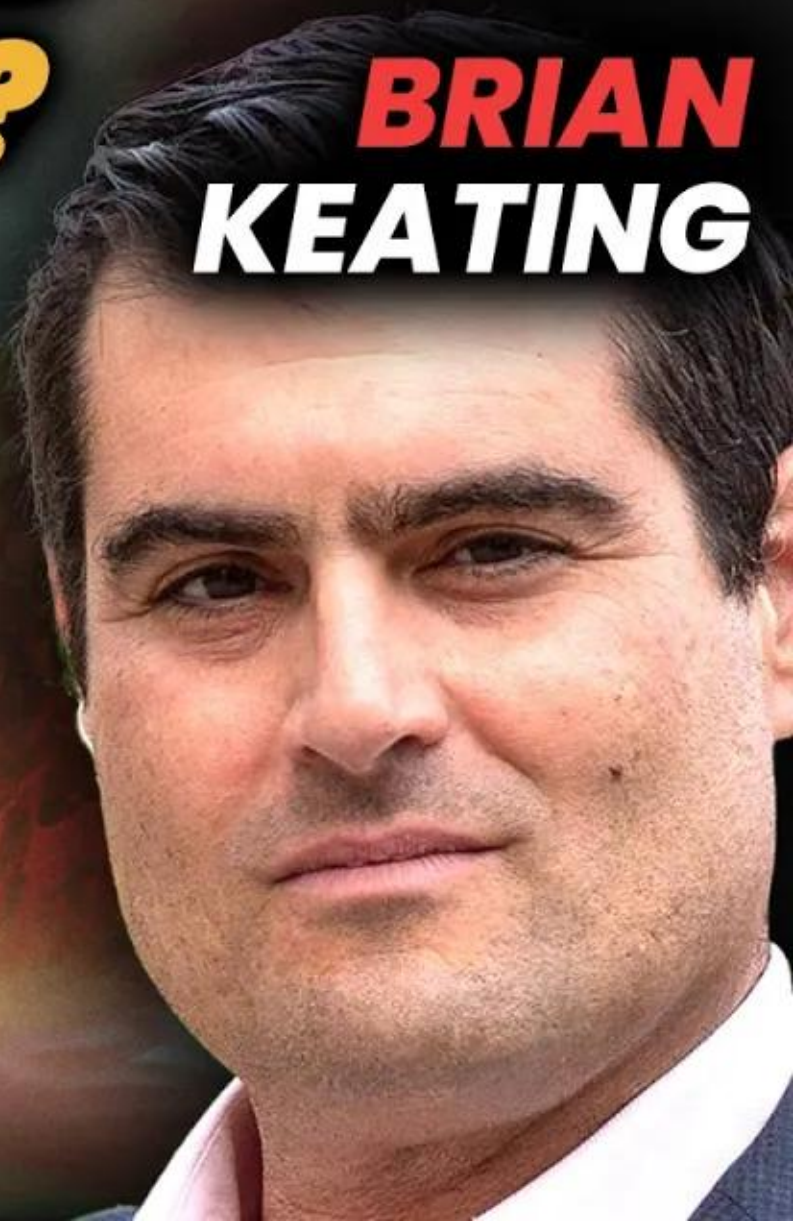
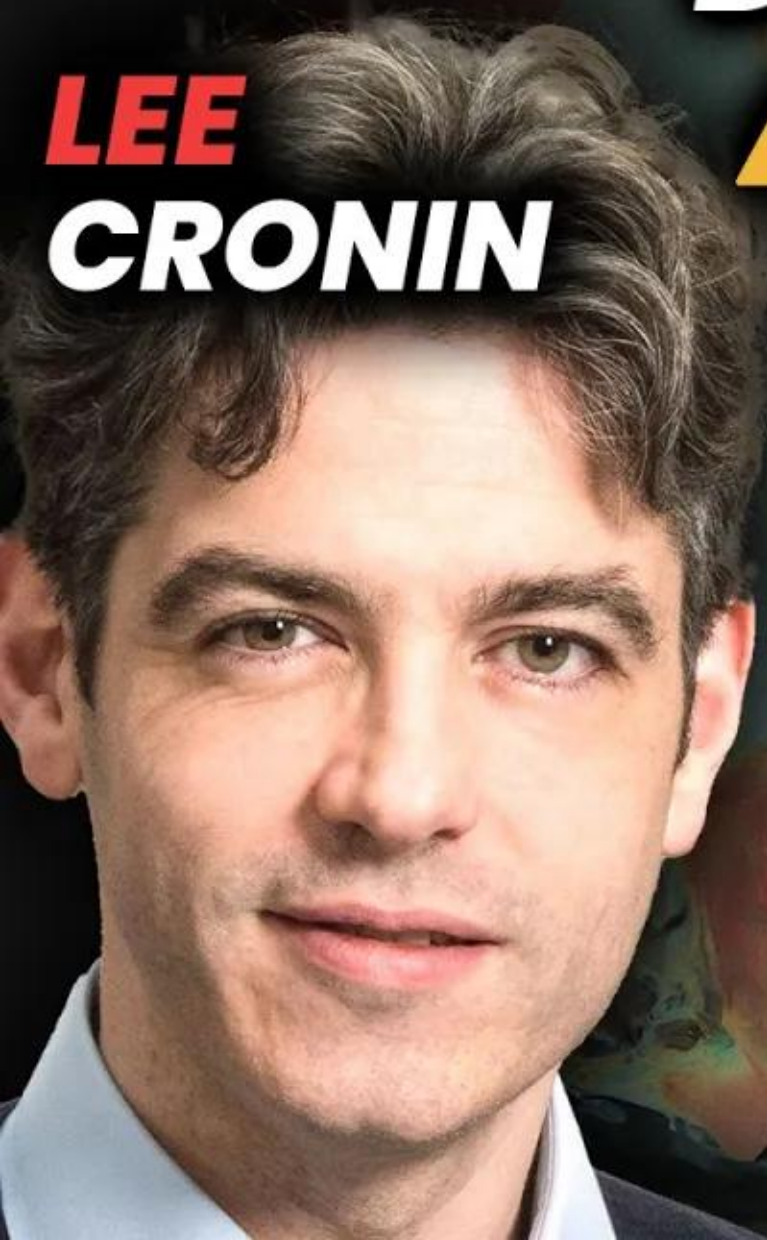


# DID WE FIND ALIEN LIFE?

**LEE  
CRONIN**

**BRIAN  
KEATING**



1  
00:00:03,750 --> 00:00:01,829  
brian keating is a distinguished

2  
00:00:06,230 --> 00:00:03,760  
professor of physics at the university

3  
00:00:08,629 --> 00:00:06,240  
of california san diego and is also a

4  
00:00:10,390 --> 00:00:08,639  
member of avilob's galileo project

5  
00:00:12,470 --> 00:00:10,400  
assisting for the search for alien

6  
00:00:14,870 --> 00:00:12,480  
techno signatures across the cosmos

7  
00:00:16,710 --> 00:00:14,880  
brian also has his own podcast exploring

8  
00:00:18,550 --> 00:00:16,720  
physics from the theoretical end to the

9  
00:00:20,710 --> 00:00:18,560  
experimental end and he has the record

10  
00:00:22,070 --> 00:00:20,720  
of interviewing the most nobel laureates

11  
00:00:24,150 --> 00:00:22,080  
links to his podcast are in the

12  
00:00:26,230 --> 00:00:24,160  
description lee cronin is the regis

13  
00:00:28,310 --> 00:00:26,240

chair of chemistry in the university of

14

00:00:30,950 --> 00:00:28,320

glasgow and in addition to having a

15

00:00:34,310 --> 00:00:30,960

velvety accent that i highly covet he's

16

00:00:36,549 --> 00:00:34,320

published over 450 papers and pioneered

17

00:00:38,709 --> 00:00:36,559

a new quantitative measure of complexity

18

00:00:40,709 --> 00:00:38,719

called assembly theory this allows one

19

00:00:42,470 --> 00:00:40,719

to look at a molecule and categorize its

20

00:00:44,549 --> 00:00:42,480

complexity perhaps even with mass

21

00:00:46,389 --> 00:00:44,559

spectrometry and then determine if it's

22

00:00:48,229 --> 00:00:46,399

sufficiently complicated enough to have

23

00:00:50,229 --> 00:00:48,239

been produced solely as a result of an

24

00:00:51,990 --> 00:00:50,239

evolutionary process or by chance but

25

00:00:54,310 --> 00:00:52,000

you can measure that and thus that

26  
00:00:55,830 --> 00:00:54,320  
greatly aids the search for life outside

27  
00:00:57,430 --> 00:00:55,840  
of earth click on the timestamp in the

28  
00:00:59,910 --> 00:00:57,440  
description if you'd like to skip this

29  
00:01:02,150 --> 00:00:59,920  
intro my name is kirchey mungle i'm a

30  
00:01:04,630 --> 00:01:02,160  
torontonian filmmaker with a background

31  
00:01:07,109 --> 00:01:04,640  
in mathematical physics dedicated to the

32  
00:01:08,870 --> 00:01:07,119  
explication of the variegated terrain of

33  
00:01:10,870 --> 00:01:08,880  
theories of everything from a

34  
00:01:12,789 --> 00:01:10,880  
theoretical physics perspective but as

35  
00:01:14,630 --> 00:01:12,799  
well as analyzing consciousness and

36  
00:01:16,710 --> 00:01:14,640  
seeing its potential connection to

37  
00:01:18,710 --> 00:01:16,720  
fundamental reality whatever that is

38  
00:01:20,630 --> 00:01:18,720

essentially this channel is dedicated to

39

00:01:22,789 --> 00:01:20,640

exploring the underderived nature of

40

00:01:24,469 --> 00:01:22,799

reality the constitutional laws that

41

00:01:26,310 --> 00:01:24,479

govern it provided those laws exist at

42

00:01:28,149 --> 00:01:26,320

all and are even noble to us if you

43

00:01:30,230 --> 00:01:28,159

enjoy witnessing and engaging with

44

00:01:32,710 --> 00:01:30,240

others on the topics of psychology

45

00:01:34,630 --> 00:01:32,720

consciousness physics etc the channel's

46

00:01:36,149 --> 00:01:34,640

themes then do consider going to the

47

00:01:38,310 --> 00:01:36,159

discord and the subreddit which are

48

00:01:41,190 --> 00:01:38,320

linked in the description there's also a

49

00:01:43,030 --> 00:01:41,200

link to the patreon that is patreon.com

50

00:01:45,030 --> 00:01:43,040

kirchimongo if you'd like to support

51  
00:01:46,870 --> 00:01:45,040  
this podcast as the patrons and the

52  
00:01:49,350 --> 00:01:46,880  
sponsors are the only reasons that i'm

53  
00:01:51,270 --> 00:01:49,360  
able to have podcasts of this quality

54  
00:01:53,510 --> 00:01:51,280  
and this depth given that i can do this

55  
00:01:55,270 --> 00:01:53,520  
now full time thanks to both the patrons

56  
00:01:57,590 --> 00:01:55,280  
and the sponsors support speaking of

57  
00:01:59,590 --> 00:01:57,600  
sponsors there are two the first sponsor

58  
00:02:01,030 --> 00:01:59,600  
is brilliant during the winter break i

59  
00:02:02,789 --> 00:02:01,040  
decided to brush up on some of the

60  
00:02:04,950 --> 00:02:02,799  
fundamentals of physics particularly

61  
00:02:06,870 --> 00:02:04,960  
with regard to information theory as i'd

62  
00:02:08,550 --> 00:02:06,880  
like to interview chiara marletto on

63  
00:02:10,229 --> 00:02:08,560

constructor theory which is heavily

64

00:02:11,910 --> 00:02:10,239

based in information theory now

65

00:02:13,270 --> 00:02:11,920

information theory is predicated on

66

00:02:15,589 --> 00:02:13,280

entropy at least there's a fundamental

67

00:02:17,350 --> 00:02:15,599

formula for entropy so i ended up taking

68

00:02:19,430 --> 00:02:17,360

the brilliant course i challenged myself

69

00:02:21,430 --> 00:02:19,440

to do one lesson per day and i took the

70

00:02:22,550 --> 00:02:21,440

course's random variable distributions

71

00:02:24,949 --> 00:02:22,560

and knowledge

72

00:02:26,630 --> 00:02:24,959

uncertainty what i loved is that despite

73

00:02:28,150 --> 00:02:26,640

knowing the formula for entropy which is

74

00:02:30,070 --> 00:02:28,160

essentially hammered into you as an

75

00:02:32,390 --> 00:02:30,080

undergraduate it seems like it comes

76

00:02:34,150 --> 00:02:32,400

down from the sky arbitrarily and with

77

00:02:35,990 --> 00:02:34,160

brilliance for the first time i was able

78

00:02:37,430 --> 00:02:36,000

to see how the formula for entropy which

79

00:02:39,589 --> 00:02:37,440

you're seeing right now is actually

80

00:02:41,430 --> 00:02:39,599

extremely natural and it'd be strange to

81

00:02:43,270 --> 00:02:41,440

define it in any other manner there are

82

00:02:44,790 --> 00:02:43,280

plenty of courses and you can even learn

83

00:02:45,910 --> 00:02:44,800

group theory which is what's being

84

00:02:48,229 --> 00:02:45,920

referenced when you hear that the

85

00:02:50,550 --> 00:02:48,239

standard model is predicated on u1 cross

86

00:02:51,910 --> 00:02:50,560

su-2 cross su 3 those are league groups

87

00:02:53,350 --> 00:02:51,920

continuous league groups visit

88

00:02:55,990 --> 00:02:53,360

brilliant.org

89

00:02:57,670 --> 00:02:56,000  
tow t-o-e to get 20 off an annual

90

00:02:59,830 --> 00:02:57,680  
subscription and i recommend that you

91

00:03:01,670 --> 00:02:59,840  
don't stop before four lessons i think

92

00:03:03,430 --> 00:03:01,680  
you'll be greatly surprised at the ease

93

00:03:05,270 --> 00:03:03,440  
at which you can now comprehend subjects

94

00:03:07,990 --> 00:03:05,280  
you previously had a difficult time

95

00:03:10,149 --> 00:03:08,000  
grokking the second sponsor is algo now

96

00:03:12,149 --> 00:03:10,159  
algo is an end-to-end supply chain

97

00:03:14,149 --> 00:03:12,159  
optimization software company with

98

00:03:16,149 --> 00:03:14,159  
software that helps business users

99

00:03:18,390 --> 00:03:16,159  
optimize sales and operations planning

100

00:03:20,309 --> 00:03:18,400  
to avoid stockouts reduce return and

101

00:03:22,630 --> 00:03:20,319

inventory write downs while reducing

102

00:03:25,830 --> 00:03:22,640

inventory investment it's a supply chain

103

00:03:27,910 --> 00:03:25,840

ai that drives smart roi headed by amjad

104

00:03:30,309 --> 00:03:27,920

hussein who's been a huge supporter of

105

00:03:33,350 --> 00:03:30,319

this podcast since near its inception in

106

00:03:35,190 --> 00:03:33,360

fact amjad has his own podcast on ai and

107

00:03:37,110 --> 00:03:35,200

consciousness and business growth and if

108

00:03:39,030 --> 00:03:37,120

you'd like to support the toe podcast

109

00:03:40,789 --> 00:03:39,040

then visit the link in the description

110

00:03:42,789 --> 00:03:40,799

to see amjad's podcast because

111

00:03:45,190 --> 00:03:42,799

subscribing to him or at least visiting

112

00:03:48,149 --> 00:03:45,200

supports the toe podcast indirectly

113

00:03:49,430 --> 00:03:48,159

thank you and enjoy is that an aura ring

114

00:03:51,910 --> 00:03:49,440

i got mine here

115

00:03:52,789 --> 00:03:51,920

i got i joked this one you see this one

116

00:03:54,149 --> 00:03:52,799

no

117

00:03:56,390 --> 00:03:54,159

that's the fourth generation it's

118

00:03:57,910 --> 00:03:56,400

stealth

119

00:03:59,190 --> 00:03:57,920

oh i get it

120

00:04:03,030 --> 00:03:59,200

do you have any words for me before we

121

00:04:06,869 --> 00:04:05,190

um just no i mean i think we can make it

122

00:04:08,710 --> 00:04:06,879

kind of funny and you know say we're

123

00:04:10,470 --> 00:04:08,720

gonna

124

00:04:12,789 --> 00:04:10,480

say brian is in denial about his alien

125

00:04:14,949 --> 00:04:12,799

abduction

126

00:04:16,629 --> 00:04:14,959

we'll say we'll have a nice clean toe to

127

00:04:18,229 --> 00:04:16,639

toe fight

128

00:04:20,789 --> 00:04:18,239

you know we're gonna have a theory of

129

00:04:22,950 --> 00:04:20,799

everything verse theory of everything

130

00:04:25,350 --> 00:04:22,960

life the universe and everything

131

00:04:26,790 --> 00:04:25,360

okay so if you can see this type rocco's

132

00:04:30,629 --> 00:04:26,800

modern life

133

00:04:36,070 --> 00:04:33,590

this should be live now

134

00:04:37,110 --> 00:04:36,080

brian you can confirm that for me

135

00:04:40,550 --> 00:04:37,120

um

136

00:04:42,710 --> 00:04:40,560

yes it is all right yeah

137

00:04:44,550 --> 00:04:42,720

okay great thank you thank you all for

138

00:04:45,990 --> 00:04:44,560

being here well to the audience and to

139

00:04:48,469 --> 00:04:46,000

especially to professor keating and

140

00:04:50,230 --> 00:04:48,479

professor cronin thank you

141

00:04:51,430 --> 00:04:50,240

it's a pleasure to be here good to see

142

00:04:53,350 --> 00:04:51,440

you lee

143

00:04:54,550 --> 00:04:53,360

yeah hi how's it going guys

144

00:04:56,469 --> 00:04:54,560

how about you both start with your

145

00:04:58,150 --> 00:04:56,479

opening statements brian you can go

146

00:05:03,510 --> 00:04:58,160

first

147

00:05:04,870 --> 00:05:03,520

that this will be a nice clean

148

00:05:05,830 --> 00:05:04,880

toe-to-toe

149

00:05:07,670 --> 00:05:05,840

battle

150

00:05:09,110 --> 00:05:07,680

that we won't resort to any bloodshed

151

00:05:11,270 --> 00:05:09,120

like our last

152

00:05:13,670 --> 00:05:11,280

confrontation with now lee ali has been

153

00:05:16,150 --> 00:05:13,680

on my channel he's a gracious gentleman

154

00:05:18,390 --> 00:05:16,160

i enjoyed having him on i refer people

155

00:05:21,430 --> 00:05:18,400

to uh to check out that conversation

156

00:05:23,590 --> 00:05:21,440

he's given a ted talk that was uh surely

157

00:05:25,749 --> 00:05:23,600

inspirational that came out 10 years ago

158

00:05:28,469 --> 00:05:25,759

on my 40th birthday so you guys can do

159

00:05:30,230 --> 00:05:28,479

some quick math um and league hasn't

160

00:05:33,590 --> 00:05:30,240

changed a bit i've got some some gray

161

00:05:35,670 --> 00:05:33,600

beard hairs as you can see um but the

162

00:05:37,189 --> 00:05:35,680

reason i i suggest kurt said you know

163

00:05:39,909 --> 00:05:37,199

you can have any guests

164

00:05:43,430 --> 00:05:39,919

you know to have a theo locution which

165

00:05:45,830 --> 00:05:43,440

is appropriate for gods like us um in in

166

00:05:47,909 --> 00:05:45,840

man form and i said uh there's no one i

167

00:05:49,670 --> 00:05:47,919

want to go toe-to-toe with more than my

168

00:05:51,189 --> 00:05:49,680

good friend lee cronin because i have

169

00:05:54,310 --> 00:05:51,199

tremendous respect

170

00:05:55,110 --> 00:05:54,320

for his intellect uh for his character

171

00:05:57,430 --> 00:05:55,120

for the fact that he's an

172

00:05:59,909 --> 00:05:57,440

experimentalist he's a chemist not a

173

00:06:01,430 --> 00:05:59,919

physicist but he that's okay some of my

174

00:06:04,150 --> 00:06:01,440

best friends are chemists

175

00:06:05,670 --> 00:06:04,160

and uh he does experimental work and

176

00:06:07,029 --> 00:06:05,680

that's very rare kurt as you know you

177

00:06:08,790 --> 00:06:07,039

have theories in your name of your

178

00:06:10,710 --> 00:06:08,800

podcast we hear a lot more from the

179

00:06:12,950 --> 00:06:10,720

theorists we hear from michio kaku from

180

00:06:15,749 --> 00:06:12,960

our buddy eric weinstein from our

181

00:06:17,670 --> 00:06:15,759

buddies you know brian green and and uh

182

00:06:19,270 --> 00:06:17,680

all the like but we rarely get to hear

183

00:06:22,390 --> 00:06:19,280

from experimentalists so one of the

184

00:06:24,469 --> 00:06:22,400

niches i like to hopefully fill in

185

00:06:25,990 --> 00:06:24,479

is is to bring an experimentalist

186

00:06:28,230 --> 00:06:26,000

standpoint to it which is first and

187

00:06:29,909 --> 00:06:28,240

foremost driven by evidence

188

00:06:32,629 --> 00:06:29,919

and i'm hoping that today

189

00:06:34,150 --> 00:06:32,639

uh if lee agrees that we'll kind of take

190

00:06:35,830 --> 00:06:34,160

a tour through what we know about the

191

00:06:37,029 --> 00:06:35,840

universe what we know we don't know

192

00:06:39,029 --> 00:06:37,039

about the universe specifically

193

00:06:40,469 --> 00:06:39,039

restricted to life which is lee's domain

194

00:06:41,909 --> 00:06:40,479

much more than mine

195

00:06:43,830 --> 00:06:41,919

but i want to bring an experimental

196

00:06:46,550 --> 00:06:43,840

observational astrophysics perspective

197

00:06:48,790 --> 00:06:46,560

to things and even touch upon the things

198

00:06:50,629 --> 00:06:48,800

that inspired me as a 12 year old kid to

199

00:06:52,150 --> 00:06:50,639

get my first telescope which is the

200

00:06:53,110 --> 00:06:52,160

biggest question i think there is even

201

00:06:55,350 --> 00:06:53,120

though i study the origin of the

202

00:06:57,670 --> 00:06:55,360

universe i still think the question of

203

00:07:00,150 --> 00:06:57,680

the origin and evolution of life and the

204

00:07:02,550 --> 00:07:00,160

existence of technological life would

205

00:07:03,990 --> 00:07:02,560

change humanity more than anything else

206

00:07:05,990 --> 00:07:04,000

except for the fact that i don't think

207

00:07:07,830 --> 00:07:06,000

there's anyone else out there so i'm

208

00:07:09,350 --> 00:07:07,840

going to take a contrarian point of view

209

00:07:11,909 --> 00:07:09,360

not a skeptic i don't like the role of

210

00:07:14,390 --> 00:07:11,919

skeptic i think that's kind of overblown

211

00:07:16,070 --> 00:07:14,400

and hyperbolic um and people you don't

212

00:07:18,230 --> 00:07:16,080

want to invite too many skeptics to uh

213

00:07:20,469 --> 00:07:18,240

you know to a fun birthday party uh but

214

00:07:22,790 --> 00:07:20,479

i want to play to play the role of uh of

215

00:07:26,550 --> 00:07:22,800

somebody who would like nothing better

216

00:07:27,270 --> 00:07:26,560

than for aliens for ufos for uaps to all

217

00:07:30,150 --> 00:07:27,280

be

218

00:07:31,510 --> 00:07:30,160

harbingers of unexplored civilizations

219

00:07:34,469 --> 00:07:31,520

that are going to be hopefully

220

00:07:36,870 --> 00:07:34,479

benevolent uh and yet i'm coming to from

221

00:07:38,550 --> 00:07:36,880

a perspective of moderation of my

222

00:07:41,270 --> 00:07:38,560

excitement so that i don't get too

223

00:07:43,670 --> 00:07:41,280

overblown and too optimistic and i hope

224

00:07:45,830 --> 00:07:43,680

that we can have a a very spirited

225

00:07:47,990 --> 00:07:45,840

discussion and as i said there's no one

226

00:07:49,909 --> 00:07:48,000

i'd rather have this friendly

227

00:07:52,070 --> 00:07:49,919

bloodthirsty debate with than uh

228

00:07:53,589 --> 00:07:52,080

professor lee cronin who's a who's a

229

00:07:55,430 --> 00:07:53,599

giant in his field and has already

230

00:07:58,230 --> 00:07:55,440

accomplished a tremendous amount and yet

231

00:08:00,230 --> 00:07:58,240

we differ and and hopefully by the end

232

00:08:03,029 --> 00:08:00,240

we should have a rubric by which we can

233

00:08:05,189 --> 00:08:03,039

apprise for the audience how much we

234

00:08:07,189 --> 00:08:05,199

have learned from each other if i change

235

00:08:09,749 --> 00:08:07,199

my mind if lee changes his mind so maybe

236

00:08:11,909 --> 00:08:09,759

after lee's introduction we'll have kind

237

00:08:13,430 --> 00:08:11,919

of a framing you know the rules of the

238

00:08:15,909 --> 00:08:13,440

fight like kurt you'll be in the middle

239

00:08:18,629 --> 00:08:15,919

of the ring and uh we'll go toe-to-toe

240

00:08:20,390 --> 00:08:18,639

with that turn it over to my buddy lee

241

00:08:23,350 --> 00:08:20,400

lee thanks brian is that okay were you

242

00:08:24,629 --> 00:08:23,360

cut yes please go so yeah i mean this is

243

00:08:26,950 --> 00:08:24,639

i was really looking forward to this

244

00:08:29,589 --> 00:08:26,960

because uh brian and i both shared a

245

00:08:31,350 --> 00:08:29,599

rule of scientific law that um we kind

246

00:08:33,110 --> 00:08:31,360

of like data and we like experiments we

247

00:08:35,909 --> 00:08:33,120

like theory and

248

00:08:38,310 --> 00:08:35,919

um i've listened to brian debate a lot

249

00:08:40,709 --> 00:08:38,320

and he's very poli he's much more polite

250

00:08:42,389 --> 00:08:40,719

and patient than i am so i have a lot of

251

00:08:43,990 --> 00:08:42,399

respect i really have to read between

252

00:08:45,430 --> 00:08:44,000

the lines and i've been involved in some

253

00:08:46,550 --> 00:08:45,440

debates where people just want to catch

254

00:08:48,550 --> 00:08:46,560

me out

255

00:08:50,070 --> 00:08:48,560

and i and i'm no doubt brian's been in

256

00:08:51,190 --> 00:08:50,080

the same place so i would say today is

257

00:08:52,949 --> 00:08:51,200

probably almost going to be too

258

00:08:56,070 --> 00:08:52,959

congenial but i think that's really

259

00:08:57,590 --> 00:08:56,080

important because we're both open-minded

260

00:09:00,550 --> 00:08:57,600

but we're optimistic about different

261

00:09:02,150 --> 00:09:00,560

things now as a chemist

262

00:09:05,350 --> 00:09:02,160

i have a very

263

00:09:07,590 --> 00:09:05,360

intuitive feel for the way chemistry

264

00:09:10,949 --> 00:09:07,600

works on planet earth the rate at which

265

00:09:14,790 --> 00:09:10,959

molecules are made and destroyed

266

00:09:17,509 --> 00:09:14,800

and i'm fascinated by biology and

267

00:09:19,350 --> 00:09:17,519

and actually i'm gonna i describe myself

268

00:09:22,150 --> 00:09:19,360

for full um

269

00:09:23,990 --> 00:09:22,160

disclosure i'm really an experimental

270

00:09:25,990 --> 00:09:24,000

theorist in a way i'm not

271

00:09:28,790 --> 00:09:26,000

i don't think i have the

272

00:09:30,790 --> 00:09:28,800

analytical um brain to be a good

273

00:09:31,750 --> 00:09:30,800

theorist but i'm really good at coming

274

00:09:34,070 --> 00:09:31,760

up with

275

00:09:36,230 --> 00:09:34,080

experiments to develop a theory and i'll

276

00:09:37,269 --> 00:09:36,240

explain a little bit seems a bit weird

277

00:09:39,670 --> 00:09:37,279

but um

278

00:09:43,750 --> 00:09:39,680

i do agree with brian i'm very skeptical

279

00:09:46,150 --> 00:09:43,760

about uh making declarations i i don't

280

00:09:48,150 --> 00:09:46,160

know if i can put a number on and i was

281

00:09:50,550 --> 00:09:48,160

on my computer on about alien life or

282

00:09:51,750 --> 00:09:50,560

not i wrote a paper a few years ago

283

00:09:53,110 --> 00:09:51,760

which is called um

284

00:09:55,110 --> 00:09:53,120

[Music]

285

00:09:56,630 --> 00:09:55,120

quantifying the origins of life on a

286

00:09:58,790 --> 00:09:56,640

planetary scale

287

00:10:01,430 --> 00:09:58,800

and i'll talk about the drake equation

288

00:10:03,670 --> 00:10:01,440

and the fermi paradox and the chemistry

289

00:10:05,590 --> 00:10:03,680

but let's let and i also want to make

290

00:10:07,350 --> 00:10:05,600

this about what brian is doing very well

291

00:10:09,190 --> 00:10:07,360

is saying hey

292

00:10:11,350 --> 00:10:09,200

i don't i don't

293

00:10:12,790 --> 00:10:11,360

know or i'm not i won't paraphrase too

294

00:10:14,710 --> 00:10:12,800

much because i think he's much more

295

00:10:17,030 --> 00:10:14,720

qualified to give his own point of view

296

00:10:19,190 --> 00:10:17,040

given he's here so there is this kind of

297

00:10:20,710 --> 00:10:19,200

gap in his intuition

298

00:10:22,710 --> 00:10:20,720

and i'm going to try and fill that and

299

00:10:23,750 --> 00:10:22,720

say well look i know how easy chemistry

300

00:10:27,590 --> 00:10:23,760

is

301  
00:10:29,030 --> 00:10:27,600  
and i want to make a couple of

302  
00:10:31,269 --> 00:10:29,040  
statements the first thing is we don't

303  
00:10:33,750 --> 00:10:31,279  
really know what life is and i don't

304  
00:10:36,870 --> 00:10:33,760  
mean in some kind of weird kind of um

305  
00:10:38,949 --> 00:10:36,880  
whether we are you know um projections

306  
00:10:42,389 --> 00:10:38,959  
from an astral plane we're clearly

307  
00:10:45,030 --> 00:10:42,399  
material i'm i'm kind of a materialist

308  
00:10:47,829 --> 00:10:45,040  
but to kind of ch cheat on one of a copy

309  
00:10:49,269 --> 00:10:47,839  
of what penrose said in a podcast said

310  
00:10:50,870 --> 00:10:49,279  
i'm a materialist but i just don't know

311  
00:10:52,310 --> 00:10:50,880  
what the matter is

312  
00:10:54,150 --> 00:10:52,320  
right and i think that's kind of

313  
00:10:56,310 --> 00:10:54,160

important to understand that so that's

314

00:10:58,630 --> 00:10:56,320

one point the other point is i would

315

00:11:01,110 --> 00:10:58,640

appeal to at this house at the beginning

316

00:11:03,110 --> 00:11:01,120

i would say there's lots of gaps

317

00:11:06,150 --> 00:11:03,120

in my kind of feeling of how the

318

00:11:07,829 --> 00:11:06,160

universe works so physicists typically

319

00:11:09,990 --> 00:11:07,839

have i think

320

00:11:12,710 --> 00:11:10,000

not have three or four things that they

321

00:11:14,790 --> 00:11:12,720

i find confusing that they conflate to

322

00:11:16,550 --> 00:11:14,800

kind of think that life is odd the first

323

00:11:19,110 --> 00:11:16,560

of all is the origin of the universe how

324

00:11:21,509 --> 00:11:19,120

did the universe get started you'll hear

325

00:11:23,430 --> 00:11:21,519

time and time again for the second law

326

00:11:25,670 --> 00:11:23,440

that is that things get more disordered

327

00:11:27,670 --> 00:11:25,680

over time we have more order at the

328

00:11:29,430 --> 00:11:27,680

beginning so say hey where does that

329

00:11:32,310 --> 00:11:29,440

order come from brian is really well

330

00:11:34,150 --> 00:11:32,320

qualified to to explain that and i'm

331

00:11:36,150 --> 00:11:34,160

hoping that by him explaining some of

332

00:11:37,509 --> 00:11:36,160

the positions i find confusing

333

00:11:39,269 --> 00:11:37,519

i'll be able to explain some of the

334

00:11:41,190 --> 00:11:39,279

positions he finds confusing we might

335

00:11:42,790 --> 00:11:41,200

even find ourselves agreeing which is

336

00:11:44,870 --> 00:11:42,800

not a very good blood spore but let's

337

00:11:46,470 --> 00:11:44,880

let's not prejudge our agreement because

338

00:11:48,790 --> 00:11:46,480

there's lots of disagreement so

339

00:11:50,949 --> 00:11:48,800

physicists think that there needs to be

340

00:11:53,350 --> 00:11:50,959

a um an order at the beginning of the

341

00:11:54,630 --> 00:11:53,360

universe so i find that confusing

342

00:11:56,710 --> 00:11:54,640

and i

343

00:11:58,790 --> 00:11:56,720

the second law for me is baked into the

344

00:12:00,870 --> 00:11:58,800

way i do chemistry so i get this

345

00:12:03,110 --> 00:12:00,880

chemistry all these complex molecules

346

00:12:04,790 --> 00:12:03,120

and they turn into life and hey presto

347

00:12:06,710 --> 00:12:04,800

we get there well actually it's not like

348

00:12:08,870 --> 00:12:06,720

that we don't know what it is

349

00:12:10,629 --> 00:12:08,880

the other gap is that we talk about this

350

00:12:12,389 --> 00:12:10,639

thing called entropy

351  
00:12:13,829 --> 00:12:12,399  
and we also talk about what we call

352  
00:12:16,150 --> 00:12:13,839  
causation

353  
00:12:18,310 --> 00:12:16,160  
and kind of the emergence of information

354  
00:12:19,590 --> 00:12:18,320  
or intention and so in my opening

355  
00:12:22,069 --> 00:12:19,600  
statement i would just like to say there

356  
00:12:23,190 --> 00:12:22,079  
are significant gaps in physics which

357  
00:12:24,389 --> 00:12:23,200  
help us

358  
00:12:26,550 --> 00:12:24,399  
we're precluded from really even

359  
00:12:29,509 --> 00:12:26,560  
understanding why the universe is here

360  
00:12:31,430 --> 00:12:29,519  
so i both sympathize with brian's view

361  
00:12:33,670 --> 00:12:31,440  
but i also would like to go you know

362  
00:12:35,110 --> 00:12:33,680  
straight back at you and say could we

363  
00:12:37,110 --> 00:12:35,120

could

364

00:12:38,470 --> 00:12:37,120

understanding the origin of life which

365

00:12:41,750 --> 00:12:38,480

i'm not so interested in i want to

366

00:12:43,269 --> 00:12:41,760

understand how life forms is a phenomena

367

00:12:45,430 --> 00:12:43,279

um it might even actually help us

368

00:12:47,030 --> 00:12:45,440

understand what the universe is

369

00:12:48,310 --> 00:12:47,040

and so my

370

00:12:50,629 --> 00:12:48,320

real

371

00:12:52,870 --> 00:12:50,639

intuition is that

372

00:12:54,870 --> 00:12:52,880

life is as easy as starting a fusion

373

00:12:56,470 --> 00:12:54,880

reaction in the sky

374

00:12:58,550 --> 00:12:56,480

and there are fusion reactions starting

375

00:13:00,389 --> 00:12:58,560

all the time stars giving birth and

376

00:13:02,310 --> 00:13:00,399

stars dying

377

00:13:03,990 --> 00:13:02,320

and we need to think statistically in

378

00:13:05,590 --> 00:13:04,000

that way to start to reframe the

379

00:13:07,430 --> 00:13:05,600

argument now

380

00:13:09,110 --> 00:13:07,440

does all life turn into intelligent life

381

00:13:10,790 --> 00:13:09,120

we can debate that and talk about it but

382

00:13:13,350 --> 00:13:10,800

i would say that in my opening argument

383

00:13:14,629 --> 00:13:13,360

i think i see no barrier for why life

384

00:13:17,670 --> 00:13:14,639

can't be common

385

00:13:20,389 --> 00:13:17,680

there seems to be no law or no

386

00:13:22,870 --> 00:13:20,399

gotcha in terms of resource but i do

387

00:13:25,269 --> 00:13:22,880

concede we don't know what life is but i

388

00:13:26,629 --> 00:13:25,279

also would kind of say you know we don't

389

00:13:27,430 --> 00:13:26,639

really know how

390

00:13:29,990 --> 00:13:27,440

where

391

00:13:32,310 --> 00:13:30,000

the second law comes from

392

00:13:33,509 --> 00:13:32,320

that we time seems to be optional in our

393

00:13:35,190 --> 00:13:33,519

universe

394

00:13:37,269 --> 00:13:35,200

and we have all this jiggery pokery with

395

00:13:39,750 --> 00:13:37,279

the second law and how things happen

396

00:13:41,590 --> 00:13:39,760

and uh and with that i will close my

397

00:13:43,350 --> 00:13:41,600

opening statement

398

00:13:44,790 --> 00:13:43,360

all right let's agree on some

399

00:13:47,509 --> 00:13:44,800

definitions or let's get them out of the

400

00:13:49,110 --> 00:13:47,519

way so perhaps lee why don't you define

401  
00:13:51,110 --> 00:13:49,120  
i know this is highly contentious but

402  
00:13:52,470 --> 00:13:51,120  
why don't you define what life is and if

403  
00:13:54,150 --> 00:13:52,480  
you can't define it then why can't you

404  
00:13:57,110 --> 00:13:54,160  
define it and then also intelligence so

405  
00:14:00,870 --> 00:13:57,120  
life and intelligence and then brian

406  
00:14:03,030 --> 00:14:00,880  
add to that or tear it down

407  
00:14:05,350 --> 00:14:03,040  
yeah please tear it down so there's more

408  
00:14:07,990 --> 00:14:05,360  
definitions of life than there are life

409  
00:14:09,910 --> 00:14:08,000  
forms on earth thinking about it

410  
00:14:11,670 --> 00:14:09,920  
which will give you some but i'll give

411  
00:14:13,030 --> 00:14:11,680  
you the standard nasa definition and

412  
00:14:15,509 --> 00:14:13,040  
i'll give you a slightly easier one

413  
00:14:17,189 --> 00:14:15,519

which will also blow your mind so nasa

414

00:14:19,430 --> 00:14:17,199

kind of got a committee and got a lot of

415

00:14:21,430 --> 00:14:19,440

really smart people together and really

416

00:14:22,870 --> 00:14:21,440

you know said well okay look what are we

417

00:14:24,470 --> 00:14:22,880

kind of looking for

418

00:14:26,710 --> 00:14:24,480

and i'm going to get this wrong because

419

00:14:29,189 --> 00:14:26,720

i i i don't know if i

420

00:14:31,269 --> 00:14:29,199

wrote but it's roughly saying that life

421

00:14:34,150 --> 00:14:31,279

is a self

422

00:14:35,910 --> 00:14:34,160

reproducing or a sustaining

423

00:14:38,629 --> 00:14:35,920

um um

424

00:14:40,310 --> 00:14:38,639

evolutionary chemical system capable of

425

00:14:42,150 --> 00:14:40,320

darwinian evolution i think i've almost

426

00:14:43,670 --> 00:14:42,160

got it in a line and that's there's a

427

00:14:45,990 --> 00:14:43,680

lot of things in there because it's

428

00:14:48,150 --> 00:14:46,000

saying has to be self-sustaining there's

429

00:14:49,829 --> 00:14:48,160

replication and there's darwinian

430

00:14:50,790 --> 00:14:49,839

evolution there's a kind of a lot of

431

00:14:52,389 --> 00:14:50,800

terms

432

00:14:54,389 --> 00:14:52,399

and the thing for that is that you have

433

00:14:56,150 --> 00:14:54,399

to then get almost like the legislature

434

00:14:59,030 --> 00:14:56,160

out to say you know do you qualify to be

435

00:15:01,590 --> 00:14:59,040

a life form you know are you replicating

436

00:15:04,150 --> 00:15:01,600

okay maybe are you metabolizing and then

437

00:15:06,069 --> 00:15:04,160

you get people saying oh but fire fire

438

00:15:07,990 --> 00:15:06,079

fire kind of does that why is fire not

439

00:15:09,590 --> 00:15:08,000

alive and you get all trapped into

440

00:15:12,790 --> 00:15:09,600

circles and people say are viruses are

441

00:15:14,710 --> 00:15:12,800

they alive so i'm to give you um the

442

00:15:16,470 --> 00:15:14,720

kind of cronin

443

00:15:18,150 --> 00:15:16,480

definition but actually is the probably

444

00:15:20,389 --> 00:15:18,160

more like the walker definition or the

445

00:15:22,150 --> 00:15:20,399

cronin walker definition and i'm i'm

446

00:15:25,509 --> 00:15:22,160

collaborating with a

447

00:15:27,189 --> 00:15:25,519

a colleague at asu sarah walker um who

448

00:15:29,189 --> 00:15:27,199

really has inspired a lot of this and we

449

00:15:30,790 --> 00:15:29,199

kind of we've been developing theory but

450

00:15:32,550 --> 00:15:30,800

i'll come to that later but what i'm

451  
00:15:34,069 --> 00:15:32,560  
going to say and this is for you the

452  
00:15:35,269 --> 00:15:34,079  
people listening

453  
00:15:37,269 --> 00:15:35,279  
that

454  
00:15:40,710 --> 00:15:37,279  
living systems i don't know what they

455  
00:15:42,550 --> 00:15:40,720  
are exactly they're kind of like a bits

456  
00:15:44,629 --> 00:15:42,560  
although they're material there's some

457  
00:15:47,110 --> 00:15:44,639  
weird stuff but what do living systems

458  
00:15:48,310 --> 00:15:47,120  
uniquely do that no other systems do

459  
00:15:50,069 --> 00:15:48,320  
they create

460  
00:15:51,030 --> 00:15:50,079  
complex objects

461  
00:15:53,430 --> 00:15:51,040  
okay

462  
00:15:56,150 --> 00:15:53,440  
in abundance that couldn't form randomly

463  
00:15:58,069 --> 00:15:56,160

so be it this 3d printer tesseract which

464

00:16:00,550 --> 00:15:58,079

i made on my 3d printer

465

00:16:01,749 --> 00:16:00,560

um this nice um

466

00:16:03,430 --> 00:16:01,759

fenix

467

00:16:05,350 --> 00:16:03,440

solar watch which a little lights coming

468

00:16:08,389 --> 00:16:05,360

on at the back so it's all function and

469

00:16:09,990 --> 00:16:08,399

my mouse and my my body and with the

470

00:16:12,150 --> 00:16:10,000

complex objects that um they just

471

00:16:13,350 --> 00:16:12,160

couldn't randomly form now we can define

472

00:16:15,910 --> 00:16:13,360

complexity in a minute but i'm going to

473

00:16:19,030 --> 00:16:15,920

give you kind of one other thing

474

00:16:21,670 --> 00:16:19,040

this thing or kind of says that this is

475

00:16:24,069 --> 00:16:21,680

alive and it kind of is which will blow

476

00:16:26,470 --> 00:16:24,079

your mind this is this is alive

477

00:16:29,350 --> 00:16:26,480

or this is evidence of life and then

478

00:16:31,829 --> 00:16:29,360

people say ah a virus is alive

479

00:16:33,430 --> 00:16:31,839

and the answer is yes viruses are

480

00:16:36,790 --> 00:16:33,440

produced by

481

00:16:38,710 --> 00:16:36,800

um uh evolutionary systems with biology

482

00:16:41,670 --> 00:16:38,720

and that viruses could not

483

00:16:43,269 --> 00:16:41,680

exist without the chain of events which

484

00:16:45,269 --> 00:16:43,279

connects all of us

485

00:16:47,430 --> 00:16:45,279

right back to that origin of life on

486

00:16:50,949 --> 00:16:47,440

earth so i guess i'm saying that's the

487

00:16:53,910 --> 00:16:50,959

definition for some of the aficionados

488

00:16:55,990 --> 00:16:53,920

you know replication metabolism

489

00:16:58,069 --> 00:16:56,000

darwinian evolution

490

00:17:00,150 --> 00:16:58,079

but i would say okay that's really hard

491

00:17:02,470 --> 00:17:00,160

tick box tick box why not look for

492

00:17:05,750 --> 00:17:02,480

things that do complex things that we

493

00:17:08,230 --> 00:17:05,760

wouldn't expect and so that's life

494

00:17:10,390 --> 00:17:08,240

to one degree then intelligence kind of

495

00:17:13,110 --> 00:17:10,400

builds on that because clearly

496

00:17:16,309 --> 00:17:13,120

this was not evolved in in the desert

497

00:17:17,189 --> 00:17:16,319

this required human beings to invent

498

00:17:20,390 --> 00:17:17,199

you know

499

00:17:22,470 --> 00:17:20,400

lithography a turing machine electricity

500

00:17:25,189 --> 00:17:22,480

i mean i am so proud of humanity it

501  
00:17:26,069 --> 00:17:25,199  
might sound a bit like a bit kind of um

502  
00:17:27,750 --> 00:17:26,079  
you know

503  
00:17:29,909 --> 00:17:27,760  
weird but

504  
00:17:31,830 --> 00:17:29,919  
how much creativity went into making

505  
00:17:34,390 --> 00:17:31,840  
this silly little watch there's a solar

506  
00:17:35,990 --> 00:17:34,400  
cell in here there are leds there's a

507  
00:17:37,669 --> 00:17:36,000  
microprocessor there's lithographic

508  
00:17:39,750 --> 00:17:37,679  
defined memory and there's refined

509  
00:17:40,950 --> 00:17:39,760  
titanium i was feeling rich when i

510  
00:17:42,789 --> 00:17:40,960  
bought when i bought this but i wanted a

511  
00:17:45,669 --> 00:17:42,799  
light watch on my list so there's all

512  
00:17:47,669 --> 00:17:45,679  
this cool stuff that we've done and this

513  
00:17:50,390 --> 00:17:47,679

clearly is evidence and i'm going to use

514

00:17:51,990 --> 00:17:50,400

this term and i don't like using it but

515

00:17:54,230 --> 00:17:52,000

i'm going to use it in the way that i

516

00:17:56,230 --> 00:17:54,240

mean it and i'm sure brian will and you

517

00:17:58,150 --> 00:17:56,240

will cut me down if you think i'm being

518

00:18:01,110 --> 00:17:58,160

uh ambiguous this is a result of

519

00:18:03,350 --> 00:18:01,120

intelligent design and what i mean a

520

00:18:06,150 --> 00:18:03,360

human being building abstractions in

521

00:18:08,310 --> 00:18:06,160

their head were able to leap beyond the

522

00:18:09,669 --> 00:18:08,320

confines of evolution

523

00:18:12,230 --> 00:18:09,679

able to think about stuff and

524

00:18:14,950 --> 00:18:12,240

conceptualize not having to die trying

525

00:18:17,029 --> 00:18:14,960

it out and they made the watch so

526

00:18:19,190 --> 00:18:17,039

all the way back definition of life

527

00:18:22,390 --> 00:18:19,200

evolution chemistry

528

00:18:24,230 --> 00:18:22,400

nasa my definition stuff

529

00:18:25,350 --> 00:18:24,240

things that make complex things you

530

00:18:27,510 --> 00:18:25,360

couldn't uh

531

00:18:29,110 --> 00:18:27,520

in abundance with lots of copy numbers

532

00:18:31,510 --> 00:18:29,120

that you wouldn't find

533

00:18:33,110 --> 00:18:31,520

um ordinarily let's say on the moon on

534

00:18:35,270 --> 00:18:33,120

the mars and

535

00:18:37,750 --> 00:18:35,280

intelligent life can make objects are

536

00:18:40,470 --> 00:18:37,760

even more intricate so you have three

537

00:18:43,190 --> 00:18:40,480

epochs you have the random epoch just

538

00:18:45,990 --> 00:18:43,200

laws of physics doing their cool stuff

539

00:18:48,710 --> 00:18:46,000

the biological epoch the distribution of

540

00:18:49,750 --> 00:18:48,720

objects in that in their narrows a bit

541

00:18:54,150 --> 00:18:49,760

and then

542

00:18:55,669 --> 00:18:54,160

produces a delta function the number of

543

00:18:58,710 --> 00:18:55,679

transistors in here that have no

544

00:19:00,150 --> 00:18:58,720

variation almost perfect is a staggering

545

00:19:01,590 --> 00:19:00,160

and that's kind of long-winded but i

546

00:19:03,909 --> 00:19:01,600

think i just wanted to get that out it's

547

00:19:05,590 --> 00:19:03,919

quite precise and will get people

548

00:19:06,950 --> 00:19:05,600

watching and listening to think really

549

00:19:09,350 --> 00:19:06,960

like oh my gosh

550

00:19:12,390 --> 00:19:09,360

this cup is evidence of billion years of

551  
00:19:15,430 --> 00:19:12,400  
life because of no potter no discovery

552  
00:19:17,430 --> 00:19:15,440  
of no clay no cup just imagine how many

553  
00:19:19,669 --> 00:19:17,440  
this this lineage this trajectory this

554  
00:19:21,909 --> 00:19:19,679  
object this is actually made in beijing

555  
00:19:24,470 --> 00:19:21,919  
there's some lovely pictures on here

556  
00:19:25,510 --> 00:19:24,480  
this is evidence of billions of years of

557  
00:19:27,270 --> 00:19:25,520  
progress

558  
00:19:29,990 --> 00:19:27,280  
i'll stop there

559  
00:19:32,150 --> 00:19:30,000  
brian what are your comments on that

560  
00:19:33,990 --> 00:19:32,160  
well yeah you know of course with the

561  
00:19:36,630 --> 00:19:34,000  
definition as

562  
00:19:38,789 --> 00:19:36,640  
maybe one could say flexible as

563  
00:19:41,510 --> 00:19:38,799

all that could you know be said to

564

00:19:42,870 --> 00:19:41,520

entail of course there's there's uh it's

565

00:19:44,710 --> 00:19:42,880

hard to disagree

566

00:19:46,310 --> 00:19:44,720

i was preferring to think about things

567

00:19:48,789 --> 00:19:46,320

you know there was a decision you you

568

00:19:51,029 --> 00:19:48,799

both are not of the united states in

569

00:19:53,270 --> 00:19:51,039

origin uh but there was a famous supreme

570

00:19:54,789 --> 00:19:53,280

court case in the 50s i think where the

571

00:19:56,150 --> 00:19:54,799

court was asked to describe what is

572

00:19:58,710 --> 00:19:56,160

pornographic

573

00:20:01,029 --> 00:19:58,720

and the upshot was that you know it when

574

00:20:03,430 --> 00:20:01,039

you see it and i think you know we can

575

00:20:05,270 --> 00:20:03,440

we can kind of uh you know debate about

576

00:20:07,190 --> 00:20:05,280

things that we know for sure aren't

577

00:20:09,750 --> 00:20:07,200

alive and we can debate about things

578

00:20:11,270 --> 00:20:09,760

that we could all say are alive and i

579

00:20:13,510 --> 00:20:11,280

think leads on to something that there

580

00:20:15,590 --> 00:20:13,520

may be a deep and

581

00:20:18,230 --> 00:20:15,600

maybe unassailable

582

00:20:19,990 --> 00:20:18,240

interplay between the

583

00:20:21,350 --> 00:20:20,000

notion of the conscious being that's

584

00:20:23,590 --> 00:20:21,360

defining life

585

00:20:26,230 --> 00:20:23,600

and the order and structure

586

00:20:30,310 --> 00:20:26,240

by which he or she ascribes that feature

587

00:20:32,630 --> 00:20:30,320

to be indicative of a biological process

588

00:20:34,950 --> 00:20:32,640

normally what i hear is well life it

589

00:20:36,470 --> 00:20:34,960

depends and even what is consciousness

590

00:20:37,909 --> 00:20:36,480

it depends and as you know kirk there

591

00:20:40,149 --> 00:20:37,919

are people that believe you know the

592

00:20:42,149 --> 00:20:40,159

quarks in the cup that lee was holding

593

00:20:44,870 --> 00:20:42,159

up are a lot or have consciousness in

594

00:20:47,270 --> 00:20:44,880

the pan cyclist format i don't know if

595

00:20:49,270 --> 00:20:47,280

lee believes that or not uh but uh but i

596

00:20:51,669 --> 00:20:49,280

i would suspect not yes he's shaking his

597

00:20:53,350 --> 00:20:51,679

head so i think uh what i think is

598

00:20:57,190 --> 00:20:53,360

important is that we all sort of can

599

00:20:59,669 --> 00:20:57,200

recognize the boundary cases um as not

600

00:21:01,029 --> 00:20:59,679

or or yes certainly affirming to be of

601  
00:21:02,950 --> 00:21:01,039  
life and it's kind of like you know

602  
00:21:04,549 --> 00:21:02,960  
these debates about you know uh like

603  
00:21:06,789 --> 00:21:04,559  
think about abortion abortion is really

604  
00:21:08,470 --> 00:21:06,799  
controversial here in america um nobody

605  
00:21:11,590 --> 00:21:08,480  
would say before your parents met each

606  
00:21:13,669 --> 00:21:11,600  
other uh that you were an organism you

607  
00:21:15,590 --> 00:21:13,679  
were a baby and nobody would say after

608  
00:21:17,990 --> 00:21:15,600  
you know ten months out of the womb that

609  
00:21:19,430 --> 00:21:18,000  
you're not a living being so it's in the

610  
00:21:21,350 --> 00:21:19,440  
it's in the superposition the

611  
00:21:23,029 --> 00:21:21,360  
schrodinger state where it can be is it

612  
00:21:25,190 --> 00:21:23,039  
alive is it that's where the ambiguity

613  
00:21:28,149 --> 00:21:25,200

comes in and the human brain as lee

614

00:21:30,950 --> 00:21:28,159

knows and you know too uh kurt

615

00:21:32,470 --> 00:21:30,960

hates ambiguity we force patterns on top

616

00:21:34,710 --> 00:21:32,480

of things the ambiguity bias is a

617

00:21:37,669 --> 00:21:34,720

well-known psychological affair so the

618

00:21:38,789 --> 00:21:37,679

question is not are the edge cases alive

619

00:21:41,029 --> 00:21:38,799

um

620

00:21:43,110 --> 00:21:41,039

but are the you know how do we how do we

621

00:21:45,430 --> 00:21:43,120

parse and split with granularity that's

622

00:21:47,830 --> 00:21:45,440

sufficient to provide the satisfaction

623

00:21:49,830 --> 00:21:47,840

morally and and intellectually that

624

00:21:52,470 --> 00:21:49,840

we're actually making progress so i like

625

00:21:54,549 --> 00:21:52,480

that lee began or you know uh originally

626  
00:21:55,669 --> 00:21:54,559  
he mentioned the drake equation

627  
00:21:57,350 --> 00:21:55,679  
and we should we should actually go

628  
00:21:59,270 --> 00:21:57,360  
through that and what that entails

629  
00:22:00,789 --> 00:21:59,280  
because i think in that realm my field

630  
00:22:03,909 --> 00:22:00,799  
not me specifically i don't study the

631  
00:22:06,710 --> 00:22:03,919  
origin of life or technology et cetera

632  
00:22:08,470 --> 00:22:06,720  
it has has brought the most to bear

633  
00:22:10,710 --> 00:22:08,480  
the field of astrophysics again not what

634  
00:22:12,630 --> 00:22:10,720  
i do but the many terms in the drake

635  
00:22:14,630 --> 00:22:12,640  
equation have been reduced in their

636  
00:22:17,190 --> 00:22:14,640  
uncertainty has come from astrophysics

637  
00:22:19,029 --> 00:22:17,200  
not from chemistry not from biology et

638  
00:22:20,390 --> 00:22:19,039

cetera you know from discoveries that

639

00:22:22,310 --> 00:22:20,400

have been made by my colleagues not by

640

00:22:24,870 --> 00:22:22,320

me again so i think what's what's

641

00:22:27,029 --> 00:22:24,880

important is that we we all can first

642

00:22:27,990 --> 00:22:27,039

agree on the baseline definitions on the

643

00:22:30,070 --> 00:22:28,000

pitch

644

00:22:32,549 --> 00:22:30,080

which is that you know living things we

645

00:22:34,870 --> 00:22:32,559

we have some vague notion of what living

646

00:22:36,310 --> 00:22:34,880

things are and i think the only thing i

647

00:22:37,750 --> 00:22:36,320

was a little discouraged and what lee

648

00:22:40,149 --> 00:22:37,760

said originally was he doesn't want to

649

00:22:41,669 --> 00:22:40,159

talk about the origin of life and i feel

650

00:22:43,270 --> 00:22:41,679

like all these things are kind of

651  
00:22:45,990 --> 00:22:43,280  
interrelated there are classic chicken

652  
00:22:46,789 --> 00:22:46,000  
or egg type problems you know and and i

653  
00:22:49,430 --> 00:22:46,799  
think

654  
00:22:51,350 --> 00:22:49,440  
life chemistry etc has has a great deal

655  
00:22:54,310 --> 00:22:51,360  
to say and i'm i'm doubly surprised

656  
00:22:57,110 --> 00:22:54,320  
because in leigh's phenomenal ted talk

657  
00:23:00,470 --> 00:22:57,120  
from 2011 september 9th 2011 my 40th

658  
00:23:02,549 --> 00:23:00,480  
birthday uh he goes on and tells chris

659  
00:23:04,070 --> 00:23:02,559  
anderson in front of a live audience

660  
00:23:06,789 --> 00:23:04,080  
that within two years he's going to be

661  
00:23:09,669 --> 00:23:06,799  
able to make life in his laboratory and

662  
00:23:12,149 --> 00:23:09,679  
i don't think necessarily that you would

663  
00:23:14,470 --> 00:23:12,159

claim that to be a successful bet at

664

00:23:16,789 --> 00:23:14,480

this point lee but i'd love to know what

665

00:23:18,710 --> 00:23:16,799

what is and i'm not criticizing you uh

666

00:23:21,190 --> 00:23:18,720

merely bringing up the fact that there

667

00:23:23,350 --> 00:23:21,200

is a tendency mostly in my field to have

668

00:23:26,630 --> 00:23:23,360

things like the god equation the god

669

00:23:28,710 --> 00:23:26,640

particle uh the mind of god and the god

670

00:23:30,630 --> 00:23:28,720

all these things the hype that we have

671

00:23:32,149 --> 00:23:30,640

in the field of cosmology kurt is

672

00:23:33,430 --> 00:23:32,159

unparalleled

673

00:23:36,710 --> 00:23:33,440

and i worry

674

00:23:38,630 --> 00:23:36,720

that if we um if we don't avoid that in

675

00:23:40,950 --> 00:23:38,640

kind of the essence of describing the

676

00:23:42,230 --> 00:23:40,960

origin of life evolution of life aliens

677

00:23:43,990 --> 00:23:42,240

ufos all the things we're going to talk

678

00:23:45,669 --> 00:23:44,000

about today i hope we will because it's

679

00:23:47,110 --> 00:23:45,679

so fascinating and has driven me since i

680

00:23:48,710 --> 00:23:47,120

was a kid

681

00:23:50,230 --> 00:23:48,720

nevertheless there is a tendency and a

682

00:23:52,710 --> 00:23:50,240

propensity for us to believe what we

683

00:23:55,430 --> 00:23:52,720

want to believe and maybe put things in

684

00:23:56,390 --> 00:23:55,440

the file drawer that we find discrepant

685

00:23:58,230 --> 00:23:56,400

and so

686

00:24:00,149 --> 00:23:58,240

i would just say i think it is important

687

00:24:01,510 --> 00:24:00,159

that we talk about the origin of life i

688

00:24:02,870 --> 00:24:01,520

think that's a crucial question and i

689

00:24:05,190 --> 00:24:02,880

think there's no one better on earth to

690

00:24:06,950 --> 00:24:05,200

talk to than lee

691

00:24:09,510 --> 00:24:06,960

i'm sure there are many better people to

692

00:24:11,350 --> 00:24:09,520

talk to let's unpack it then unpack it

693

00:24:13,110 --> 00:24:11,360

so yeah the ted talk i really enjoyed

694

00:24:13,990 --> 00:24:13,120

doing the ted talk i was the first staff

695

00:24:15,590 --> 00:24:14,000

at the

696

00:24:17,590 --> 00:24:15,600

tech global that year the first start

697

00:24:19,190 --> 00:24:17,600

from the start of origins um i actually

698

00:24:21,190 --> 00:24:19,200

meant what i meant

699

00:24:23,269 --> 00:24:21,200

and what i said before and it sounds

700

00:24:24,870 --> 00:24:23,279

like a cop-out politician you know

701

00:24:28,230 --> 00:24:24,880

you know boris johnson's like i didn't

702

00:24:29,510 --> 00:24:28,240

know it was a party um i i i met so what

703

00:24:31,750 --> 00:24:29,520

i was trying to make is two important

704

00:24:33,909 --> 00:24:31,760

points and number one is that uh that i

705

00:24:35,590 --> 00:24:33,919

think the origin of life is fast

706

00:24:37,350 --> 00:24:35,600

and once i've worked out how to set up

707

00:24:38,710 --> 00:24:37,360

the engine i'm building a uh

708

00:24:41,110 --> 00:24:38,720

evolutionary engine it will take a

709

00:24:42,950 --> 00:24:41,120

couple of years i stand by that

710

00:24:44,470 --> 00:24:42,960

and it has been two years it's been 10

711

00:24:45,830 --> 00:24:44,480

years but in the 10 years i've had to

712

00:24:48,070 --> 00:24:45,840

design a programming language for

713

00:24:49,510 --> 00:24:48,080

chemistry in lab and find the money and

714

00:24:52,070 --> 00:24:49,520

when i went to get money from people and

715

00:24:54,310 --> 00:24:52,080

i said hey guys do you want to invest in

716

00:24:56,230 --> 00:24:54,320

the origin of life their eyes glaze over

717

00:24:57,830 --> 00:24:56,240

and they said and i said okay

718

00:24:59,909 --> 00:24:57,840

do you want to invest in drug discovery

719

00:25:01,750 --> 00:24:59,919

oh yeah good so what i've been doing

720

00:25:03,430 --> 00:25:01,760

over the years is actually building this

721

00:25:04,710 --> 00:25:03,440

technology now exists in the lab and i'm

722

00:25:06,710 --> 00:25:04,720

super excited

723

00:25:08,630 --> 00:25:06,720

now i made a major error

724

00:25:10,870 --> 00:25:08,640

many major errors i mean i completely

725

00:25:12,230 --> 00:25:10,880

conceived i wasn't over hyping saying it

726

00:25:13,830 --> 00:25:12,240

was j you can watch a video i was

727

00:25:15,110 --> 00:25:13,840

generally like i wasn't expecting that

728

00:25:17,830 --> 00:25:15,120

question i was like i don't know two

729

00:25:18,789 --> 00:25:17,840

years why not that's cool let's let's go

730

00:25:24,710 --> 00:25:18,799

um

731

00:25:27,510 --> 00:25:24,720

had an intuition

732

00:25:30,149 --> 00:25:27,520

um about what what to look for but i

733

00:25:32,870 --> 00:25:30,159

didn't really have an experiment okay

734

00:25:34,950 --> 00:25:32,880

um i didn't have a theory

735

00:25:37,269 --> 00:25:34,960

i didn't have a model

736

00:25:38,549 --> 00:25:37,279

and i didn't have a threshold and i was

737

00:25:42,149 --> 00:25:38,559

like

738

00:25:43,750 --> 00:25:42,159

what do you mean by threshold you didn't

739

00:25:45,510 --> 00:25:43,760

have a threshold i'll come to that in a

740

00:25:46,630 --> 00:25:45,520

second so i was like holy i have

741

00:25:48,070 --> 00:25:46,640

nothing

742

00:25:50,470 --> 00:25:48,080

right and then you think then i looked

743

00:25:52,789 --> 00:25:50,480

at cern and how they did it so nasa

744

00:25:54,870 --> 00:25:52,799

nasa couldn't find the origin of life

745

00:25:56,310 --> 00:25:54,880

that oh sorry alien never life dependent

746

00:25:58,230 --> 00:25:56,320

on it because they're like oh is it is

747

00:26:00,710 --> 00:25:58,240

it green is it a micro tube is it

748

00:26:01,830 --> 00:26:00,720

fostering is it actually to be fair nasa

749

00:26:04,230 --> 00:26:01,840

didn't say anything about phosphate

750

00:26:07,830 --> 00:26:04,240

we'll come to that but inspired by the

751

00:26:09,669 --> 00:26:07,840

machine that is was the lhc

752

00:26:11,830 --> 00:26:09,679

they have the one of the best press

753

00:26:14,630 --> 00:26:11,840

officers ever they had the standard

754

00:26:17,190 --> 00:26:14,640

model it was a beautiful model

755

00:26:19,190 --> 00:26:17,200

they had them uh they had a theory sorry

756

00:26:20,710 --> 00:26:19,200

which gave rise to the standard model

757

00:26:22,630 --> 00:26:20,720

they were able to simulate the standard

758

00:26:24,630 --> 00:26:22,640

model work out what energy range in

759

00:26:28,029 --> 00:26:24,640

which to find the higgs so then had an

760

00:26:31,110 --> 00:26:28,039

experiment build a collider go to

761

00:26:34,390 --> 00:26:31,120

138.5 gev you have a better memory for

762

00:26:36,070 --> 00:26:34,400

this than i do but there find a peak

763

00:26:40,070 --> 00:26:36,080

get it 11 sigma

764

00:26:42,230 --> 00:26:40,080

higgs job done um you've got it so what

765

00:26:43,990 --> 00:26:42,240

i was going to say is to reassure brian

766

00:26:45,350 --> 00:26:44,000

or to make him decide

767

00:26:47,350 --> 00:26:45,360

we're not just going for the origin of

768

00:26:48,789 --> 00:26:47,360

life we're going for the phenomena that

769

00:26:50,950 --> 00:26:48,799

produces life

770

00:26:53,029 --> 00:26:50,960

in general think of it like up when you

771

00:26:54,950 --> 00:26:53,039

when you look up in the sky let's just

772

00:26:56,310 --> 00:26:54,960

imagine that we

773

00:26:57,990 --> 00:26:56,320

i don't know

774

00:27:00,149 --> 00:26:58,000

it's a few hundred thousand years from

775

00:27:01,990 --> 00:27:00,159

now and humans have emerged slightly

776

00:27:03,990 --> 00:27:02,000

later and they look up in the sky and

777

00:27:05,430 --> 00:27:04,000

all they see is the sun they don't see

778

00:27:06,789 --> 00:27:05,440

any other stars

779

00:27:08,710 --> 00:27:06,799

what they would do they'd be obsessing

780

00:27:10,549 --> 00:27:08,720

about the origin of the sun how did it

781

00:27:12,390 --> 00:27:10,559

come there's fusion where were those

782

00:27:14,789 --> 00:27:12,400

hydrogen atoms those damn hydrogen atoms

783

00:27:16,789 --> 00:27:14,799

how did it happen and then fusion came

784

00:27:17,990 --> 00:27:16,799

but now we look up and say there's a sun

785

00:27:20,149 --> 00:27:18,000

that's cool and they go over there

786

00:27:22,149 --> 00:27:20,159

there's a sun look one's just died ones

787

00:27:24,230 --> 00:27:22,159

have started one's died so what i'm

788

00:27:26,310 --> 00:27:24,240

trying to say is of course i'm studying

789

00:27:27,830 --> 00:27:26,320

the origin of life but i'm not just

790

00:27:29,430 --> 00:27:27,840

studying the origin of life i'm under

791

00:27:32,070 --> 00:27:29,440

understanding the emergence of life in

792

00:27:33,909 --> 00:27:32,080

general so i can do statistics and all i

793

00:27:35,190 --> 00:27:33,919

can do in my lab is build the experiment

794

00:27:37,669 --> 00:27:35,200

so now

795

00:27:40,549 --> 00:27:37,679

i like okay i need to build a life

796

00:27:42,390 --> 00:27:40,559

a life generator so what i need to build

797

00:27:45,110 --> 00:27:42,400

a simulator of planet earth have a lot

798

00:27:46,950 --> 00:27:45,120

of pots load of warm ponds programming

799

00:27:49,269 --> 00:27:46,960

language pumps and valves doing all the

800

00:27:51,750 --> 00:27:49,279

chemistry for you know but i don't have

801  
00:27:53,190 --> 00:27:51,760  
a planet or 200 million years i have

802  
00:27:55,909 --> 00:27:53,200  
some grad students

803  
00:27:57,909 --> 00:27:55,919  
brilliant grad students 25 of them

804  
00:27:59,909 --> 00:27:57,919  
and and four years so then i'm

805  
00:28:01,750 --> 00:27:59,919  
multiplexing it so i've got i've got a

806  
00:28:04,630 --> 00:28:01,760  
kind of theory which is comp

807  
00:28:06,630 --> 00:28:04,640  
unreasonable complexity that's my theory

808  
00:28:08,870 --> 00:28:06,640  
my model is to go and then

809  
00:28:11,830 --> 00:28:08,880  
generate networks of molecules that will

810  
00:28:14,149 --> 00:28:11,840  
produce that unreasonable complexity

811  
00:28:16,789 --> 00:28:14,159  
i then have a threshold which i can talk

812  
00:28:19,269 --> 00:28:16,799  
about which is i kind of i published a

813  
00:28:20,630 --> 00:28:19,279

paper last year alien meter that kind of

814

00:28:23,350 --> 00:28:20,640

works for life

815

00:28:24,630 --> 00:28:23,360

and i now should go run it and i you

816

00:28:26,630 --> 00:28:24,640

know i mean i've done this as time

817

00:28:29,350 --> 00:28:26,640

stamped as 2022 we're getting old all

818

00:28:31,750 --> 00:28:29,360

the time but i will let you know i will

819

00:28:32,789 --> 00:28:31,760

tweet when the experiment is ready to

820

00:28:34,630 --> 00:28:32,799

start

821

00:28:36,549 --> 00:28:34,640

and i'm going to connect my complexity

822

00:28:37,590 --> 00:28:36,559

to twitter and it's just going to talk

823

00:28:39,430 --> 00:28:37,600

right there the chemistry that comes out

824

00:28:40,950 --> 00:28:39,440

says be random and what you need to do

825

00:28:43,350 --> 00:28:40,960

is look at that twitter account and when

826

00:28:45,430 --> 00:28:43,360

when it starts writing or when you see

827

00:28:48,230 --> 00:28:45,440

patterns in the tweets you'll know a

828

00:28:50,389 --> 00:28:48,240

life form has emerged in glasgow so yes

829

00:28:53,510 --> 00:28:50,399

we are doing origin of life

830

00:28:56,310 --> 00:28:53,520

um but i want to frame it more broadly

831

00:28:57,990 --> 00:28:56,320

and i also think that um

832

00:29:00,950 --> 00:28:58,000

i would like to kind of just suggest

833

00:29:02,549 --> 00:29:00,960

that you know the it's a it is quick so

834

00:29:05,190 --> 00:29:02,559

the two years i promised that the ted

835

00:29:07,110 --> 00:29:05,200

talk is correct and as brian knows from

836

00:29:09,269 --> 00:29:07,120

doing big experiments political and all

837

00:29:10,950 --> 00:29:09,279

sorts of things which two years are the

838

00:29:12,870 --> 00:29:10,960

most important

839

00:29:15,110 --> 00:29:12,880

that's right they always say you know x

840

00:29:17,990 --> 00:29:15,120

experiment you know our x discovery is

841

00:29:20,310 --> 00:29:18,000

is uh ten years uh from now and it will

842

00:29:22,070 --> 00:29:20,320

always be so uh but lee let me you know

843

00:29:24,630 --> 00:29:22,080

i love you and i'm gonna keep uh harping

844

00:29:26,950 --> 00:29:24,640

on that fact um so nature's under no

845

00:29:29,590 --> 00:29:26,960

obligation to you know fulfill things on

846

00:29:31,750 --> 00:29:29,600

our grant schedules on our on our you

847

00:29:33,669 --> 00:29:31,760

know biological clocks which is a kosher

848

00:29:35,430 --> 00:29:33,679

form of clock as far as i'm concerned

849

00:29:37,350 --> 00:29:35,440

but um but i want to take you back to

850

00:29:39,750 --> 00:29:37,360

1854

851  
00:29:41,590 --> 00:29:39,760  
when a fellow scotsman a brilliant lad

852  
00:29:43,190 --> 00:29:41,600  
just like yourself sir

853  
00:29:45,269 --> 00:29:43,200  
and he was working away and he

854  
00:29:47,269 --> 00:29:45,279  
discovered these four laws that are

855  
00:29:49,590 --> 00:29:47,279  
eponymously named at the maxwell

856  
00:29:51,510 --> 00:29:49,600  
equations and james clerk was working

857  
00:29:54,190 --> 00:29:51,520  
away and he discovered that and he said

858  
00:29:56,710 --> 00:29:54,200  
these imply and impute the laws of

859  
00:29:59,350 --> 00:29:56,720  
electromagnetic radiation

860  
00:30:01,750 --> 00:29:59,360  
and how can they propagate through the

861  
00:30:03,830 --> 00:30:01,760  
seeming void that separates us from the

862  
00:30:06,310 --> 00:30:03,840  
sun from all these objects that lee's

863  
00:30:08,470 --> 00:30:06,320

already described well it must be the

864

00:30:11,190 --> 00:30:08,480

luminiferous ether the vitreous the

865

00:30:13,590 --> 00:30:11,200

virtuous electromagnetic ether

866

00:30:15,190 --> 00:30:13,600

and he said well how does that work and

867

00:30:17,990 --> 00:30:15,200

he went through it and he had this

868

00:30:20,149 --> 00:30:18,000

system of vortices gears pulleys and

869

00:30:21,750 --> 00:30:20,159

ropes and so forth on a microscopic

870

00:30:24,310 --> 00:30:21,760

level which is totally laughable so now

871

00:30:26,070 --> 00:30:24,320

imagine leave twitter existed back then

872

00:30:28,470 --> 00:30:26,080

or how about if twitter existed when

873

00:30:31,590 --> 00:30:28,480

darwin wrote his letter to was it huxley

874

00:30:33,029 --> 00:30:31,600

uh leo correa about the warm little pond

875

00:30:35,029 --> 00:30:33,039

and he said oh it's an if and it's a

876

00:30:37,110 --> 00:30:35,039

very big if and what if you know there

877

00:30:39,190 --> 00:30:37,120

was a twitter you know bot connected to

878

00:30:42,389 --> 00:30:39,200

darwin's warm little pawn in the 1840s

879

00:30:46,070 --> 00:30:42,399

1850s or what if miller yuri by the way

880

00:30:48,549 --> 00:30:46,080

yuri was stanley uh was was uh uh lee uh

881

00:30:50,950 --> 00:30:48,559

yuri who was harold urie rather who was

882

00:30:52,549 --> 00:30:50,960

at uc san diego a mile from my office

883

00:30:53,830 --> 00:30:52,559

here and he at our chemistry

884

00:30:55,750 --> 00:30:53,840

department's named yuri hall and he

885

00:30:57,430 --> 00:30:55,760

worked as grad student stanley miller

886

00:30:59,269 --> 00:30:57,440

and they came up with this famous miller

887

00:31:01,029 --> 00:30:59,279

yuri experiment which sounds an awful

888

00:31:04,149 --> 00:31:01,039

lot except for the existence of a of a

889

00:31:05,750 --> 00:31:04,159

computing machine next to it 1951. and

890

00:31:07,269 --> 00:31:05,760

uh and you could have turned it on and

891

00:31:09,669 --> 00:31:07,279

and maybe connected it to a turing

892

00:31:11,350 --> 00:31:09,679

machine that could then tweet uh and and

893

00:31:13,029 --> 00:31:11,360

that would then you know here we are

894

00:31:15,110 --> 00:31:13,039

here's the uh here's the you know

895

00:31:16,870 --> 00:31:15,120

prototype of life coming out and it's

896

00:31:19,669 --> 00:31:16,880

now it's doing something complex

897

00:31:21,750 --> 00:31:19,679

organized reducing of entropy collecting

898

00:31:23,269 --> 00:31:21,760

information and providing surprise i

899

00:31:25,350 --> 00:31:23,279

think that's important

900

00:31:26,789 --> 00:31:25,360

and it'd be totally far off from the way

901  
00:31:28,389 --> 00:31:26,799  
we actually believe and correct me if

902  
00:31:29,669 --> 00:31:28,399  
i'm wrongly but

903  
00:31:31,990 --> 00:31:29,679  
i'm going to be bold because kurt's

904  
00:31:33,990 --> 00:31:32,000  
paying us you know handsomely to be

905  
00:31:36,389 --> 00:31:34,000  
aggressive and i'm gonna say i don't

906  
00:31:37,990 --> 00:31:36,399  
think we've made any progress in this

907  
00:31:40,870 --> 00:31:38,000  
type of field

908  
00:31:42,630 --> 00:31:40,880  
of miller yuri darwinian warm little

909  
00:31:43,909 --> 00:31:42,640  
pools since

910  
00:31:46,230 --> 00:31:43,919  
you know since those original

911  
00:31:48,230 --> 00:31:46,240  
conjectures i think they've been shown

912  
00:31:49,750 --> 00:31:48,240  
to be wrong not you know scientific

913  
00:31:51,909 --> 00:31:49,760

fraud but

914

00:31:53,029 --> 00:31:51,919

there's no evidence that those chemicals

915

00:31:54,789 --> 00:31:53,039

even if they could be providing

916

00:31:56,630 --> 00:31:54,799

sterilized little beakers that i get at

917

00:31:58,149 --> 00:31:56,640

my chemistry stockroom and you get in

918

00:31:59,909 --> 00:31:58,159

your chemistry stockroom with pipettes

919

00:32:01,269 --> 00:31:59,919

that are cleaned and connected to it to

920

00:32:04,310 --> 00:32:01,279

an autoclave

921

00:32:06,230 --> 00:32:04,320

that even so they can reproduce actual

922

00:32:07,990 --> 00:32:06,240

living organisms correct me if i'm wrong

923

00:32:11,269 --> 00:32:08,000

i'm ready for the arrows

924

00:32:13,509 --> 00:32:11,279

no i mean look so i i don't want to so

925

00:32:15,509 --> 00:32:13,519

there's i'm stuck here as a chemist i

926  
00:32:17,909 --> 00:32:15,519  
mean chemists have made an incredible

927  
00:32:21,029 --> 00:32:17,919  
achievement since the time of mili yuri

928  
00:32:22,710 --> 00:32:21,039  
right i think the the the the

929  
00:32:23,990 --> 00:32:22,720  
the problem is

930  
00:32:26,549 --> 00:32:24,000  
um

931  
00:32:29,509 --> 00:32:26,559  
the let me yeah so the the experiments

932  
00:32:30,710 --> 00:32:29,519  
that meliuria did was a bit like um

933  
00:32:32,630 --> 00:32:30,720  
you doing

934  
00:32:33,669 --> 00:32:32,640  
the bicep one pro

935  
00:32:36,230 --> 00:32:33,679  
project

936  
00:32:37,830 --> 00:32:36,240  
in 1950 and the technology wasn't there

937  
00:32:39,669 --> 00:32:37,840  
you kind of you we kind of understood

938  
00:32:40,470 --> 00:32:39,679

polarization we understand about light

939

00:32:42,389 --> 00:32:40,480

we didn't know anything about the

940

00:32:44,230 --> 00:32:42,399

microwave background so they were they

941

00:32:46,070 --> 00:32:44,240

were kind of they were kind of visionary

942

00:32:47,990 --> 00:32:46,080

and that they had a hint that life

943

00:32:49,430 --> 00:32:48,000

existed oh sure whereas you know the

944

00:32:50,950 --> 00:32:49,440

physicists were like

945

00:32:52,789 --> 00:32:50,960

there's no you know there's no big bang

946

00:32:54,470 --> 00:32:52,799

there's just this steady state model and

947

00:32:56,310 --> 00:32:54,480

all this stuff so they were kind of head

948

00:32:57,990 --> 00:32:56,320

of the physics at that time and so what

949

00:33:00,310 --> 00:32:58,000

they did they were a victim of their own

950

00:33:03,750 --> 00:33:00,320

naivety of simplification

951  
00:33:05,430 --> 00:33:03,760  
and so and so the the the progress that

952  
00:33:06,710 --> 00:33:05,440  
was made there is they just said okay

953  
00:33:08,789 --> 00:33:06,720  
we'll just take some very basic

954  
00:33:09,909 --> 00:33:08,799  
molecules and put them in a flask and

955  
00:33:11,909 --> 00:33:09,919  
heat them so the middle of your

956  
00:33:15,430 --> 00:33:11,919  
experiment is literally

957  
00:33:17,110 --> 00:33:15,440  
a big bell jar with a cycle or circuit

958  
00:33:21,190 --> 00:33:17,120  
we've got a heater and you have some

959  
00:33:22,710 --> 00:33:21,200  
water methane hydrogen ammonia okay and

960  
00:33:25,029 --> 00:33:22,720  
these are the elements you need for most

961  
00:33:27,750 --> 00:33:25,039  
amino acids which will have carbon

962  
00:33:29,110 --> 00:33:27,760  
hydrogen nitrogen oxygen some have

963  
00:33:30,870 --> 00:33:29,120

sulfur in it but let's leave those out

964

00:33:32,950 --> 00:33:30,880

here they didn't put any sulfur in and

965

00:33:35,029 --> 00:33:32,960

so what they showed was something that i

966

00:33:37,430 --> 00:33:35,039

i am i love mathematics i'm a much

967

00:33:38,789 --> 00:33:37,440

better kind of a computer scientist and

968

00:33:40,789 --> 00:33:38,799

mathematician and i am a kind of

969

00:33:42,870 --> 00:33:40,799

historical chemist so for me when

970

00:33:45,830 --> 00:33:42,880

someone says oh here's some glycine

971

00:33:47,990 --> 00:33:45,840

glycine is the simplest amino acid um

972

00:33:50,630 --> 00:33:48,000

conventory it's easy to get it's like

973

00:33:52,789 --> 00:33:50,640

maybe flicking three or four heads in a

974

00:33:55,669 --> 00:33:52,799

row with a coin flip

975

00:33:58,070 --> 00:33:55,679

okay so and and they did this with a lot

976  
00:33:59,830 --> 00:33:58,080  
of the amino acids and so the chemists

977  
00:34:01,750 --> 00:33:59,840  
kind of they made this and it was still

978  
00:34:03,669 --> 00:34:01,760  
remarkable because whoa

979  
00:34:05,990 --> 00:34:03,679  
these simple things can make amino acids

980  
00:34:08,230 --> 00:34:06,000  
amino acids are in proteins is there a

981  
00:34:10,470 --> 00:34:08,240  
link well of course there's a link in so

982  
00:34:12,550 --> 00:34:10,480  
far as the atoms in that jar can find

983  
00:34:15,030 --> 00:34:12,560  
their way into amino acids but we know

984  
00:34:16,470 --> 00:34:15,040  
that life isn't about amino acids

985  
00:34:19,109 --> 00:34:16,480  
life is something

986  
00:34:21,030 --> 00:34:19,119  
different right and so i don't think

987  
00:34:23,990 --> 00:34:21,040  
they've failed i think the chemists have

988  
00:34:26,790 --> 00:34:24,000

been asked to develop a philosophy or

989

00:34:27,829 --> 00:34:26,800

develop a an ontology that just didn't

990

00:34:29,669 --> 00:34:27,839

exist

991

00:34:31,030 --> 00:34:29,679

and i think that that so i you know and

992

00:34:32,310 --> 00:34:31,040

i think the chemists are doing brilliant

993

00:34:34,389 --> 00:34:32,320

things now what's happened in the 50

994

00:34:35,909 --> 00:34:34,399

years well chemists have gone on and

995

00:34:37,349 --> 00:34:35,919

cured disease and made interesting

996

00:34:39,510 --> 00:34:37,359

molecules and we all know that i'm not

997

00:34:40,629 --> 00:34:39,520

here to defend them but the analysis has

998

00:34:41,750 --> 00:34:40,639

got better

999

00:34:43,430 --> 00:34:41,760

but leo

1000

00:34:45,030 --> 00:34:43,440

aren't you guys still now with things

1001  
00:34:47,190 --> 00:34:45,040  
like the rna world which we have to

1002  
00:34:49,909 --> 00:34:47,200  
discuss i mean isn't it just redux this

1003  
00:34:52,069 --> 00:34:49,919  
this you know redux reaction now what

1004  
00:34:54,149 --> 00:34:52,079  
was the miller uri amino acid now oh now

1005  
00:34:55,750 --> 00:34:54,159  
we know the secret is rna

1006  
00:34:58,230 --> 00:34:55,760  
so i would say

1007  
00:35:02,950 --> 00:35:00,069  
within every field so i'm going to try

1008  
00:35:05,190 --> 00:35:02,960  
and do this as delicately as possible um

1009  
00:35:07,589 --> 00:35:05,200  
with every field you have a field that

1010  
00:35:09,190 --> 00:35:07,599  
gets stuck and they are and the origin

1011  
00:35:11,270 --> 00:35:09,200  
of life chemists are really interested

1012  
00:35:14,550 --> 00:35:11,280  
in commentary or chemistry the easiest

1013  
00:35:16,630 --> 00:35:14,560

route to x y and z and then and they see

1014

00:35:18,790 --> 00:35:16,640

a series of smoking guns and the thing

1015

00:35:21,030 --> 00:35:18,800

is i'm sure that brian and i readily

1016

00:35:23,430 --> 00:35:21,040

agree that rna is not the answer to the

1017

00:35:24,870 --> 00:35:23,440

origin of life but i think i have an

1018

00:35:26,870 --> 00:35:24,880

understanding of the underlying

1019

00:35:29,510 --> 00:35:26,880

theoretical framework and that's what

1020

00:35:32,230 --> 00:35:29,520

i'm going to push brian on in just one

1021

00:35:33,910 --> 00:35:32,240

moment so life has little to do with the

1022

00:35:37,030 --> 00:35:33,920

actual specific molecules it's a bit

1023

00:35:38,790 --> 00:35:37,040

like saying i can only make a motor car

1024

00:35:41,270 --> 00:35:38,800

that's you know i don't know let's take

1025

00:35:43,430 --> 00:35:41,280

a bmw i discover a bmw or then i

1026

00:35:45,589 --> 00:35:43,440

discover a tesla right

1027

00:35:47,910 --> 00:35:45,599

the only the you know the the ora does

1028

00:35:50,069 --> 00:35:47,920

say there's the origin of automobiles on

1029

00:35:52,310 --> 00:35:50,079

planet out there and it's it you know

1030

00:35:53,990 --> 00:35:52,320

there's no space for tesla it's just bmw

1031

00:35:55,829 --> 00:35:54,000

or there's no space for a bmw it's just

1032

00:35:57,750 --> 00:35:55,839

tesla there's only one way of doing it

1033

00:35:59,109 --> 00:35:57,760

or kurt's lamborghini or curtis and

1034

00:36:01,589 --> 00:35:59,119

lamborghini

1035

00:36:03,910 --> 00:36:01,599

my son is into ferrari it's like that is

1036

00:36:06,790 --> 00:36:03,920

like ferrari all the way he's getting a

1037

00:36:08,150 --> 00:36:06,800

midlife crisis at age 10.

1038

00:36:09,589 --> 00:36:08,160

there's not one way of solving that

1039

00:36:11,270 --> 00:36:09,599

chemical problem and why i'm here to

1040

00:36:13,990 --> 00:36:11,280

reassure brian on he's like whoa

1041

00:36:16,150 --> 00:36:14,000

chemistry is special like it's not

1042

00:36:19,109 --> 00:36:16,160

the problem that chemists have

1043

00:36:21,430 --> 00:36:19,119

is that they um they're they are playing

1044

00:36:22,870 --> 00:36:21,440

around in the mess in the middle so here

1045

00:36:25,589 --> 00:36:22,880

let me just frame the whole discipline

1046

00:36:27,430 --> 00:36:25,599

i'm my my ambition in my lifetime is not

1047

00:36:29,670 --> 00:36:27,440

only to get to solve the origin of life

1048

00:36:32,150 --> 00:36:29,680

and make artificial life and find aliens

1049

00:36:33,190 --> 00:36:32,160

those three things are needed i think

1050

00:36:34,630 --> 00:36:33,200

together

1051  
00:36:37,270 --> 00:36:34,640  
um because not one of them is going to

1052  
00:36:39,430 --> 00:36:37,280  
be acceptable i think and also as the

1053  
00:36:40,710 --> 00:36:39,440  
alien discussion is going in our popular

1054  
00:36:42,710 --> 00:36:40,720  
culture right now this is something that

1055  
00:36:44,630 --> 00:36:42,720  
sarah walker has pointed out to me many

1056  
00:36:47,270 --> 00:36:44,640  
times it's really interesting that

1057  
00:36:49,270 --> 00:36:47,280  
people are excited about aliens and i

1058  
00:36:51,109 --> 00:36:49,280  
kind of disagree with brian a little bit

1059  
00:36:52,950 --> 00:36:51,119  
he says if people just get

1060  
00:36:54,790 --> 00:36:52,960  
find an alien life form they won't care

1061  
00:36:57,349 --> 00:36:54,800  
they will but it needs to be framed

1062  
00:36:59,990 --> 00:36:57,359  
properly because people want to know

1063  
00:37:01,829 --> 00:37:00,000

they want meaning um so going back to

1064

00:37:02,790 --> 00:37:01,839

this origin of life and why is it wrong

1065

00:37:04,710 --> 00:37:02,800

well

1066

00:37:07,190 --> 00:37:04,720

physicists deal with

1067

00:37:09,270 --> 00:37:07,200

low memory systems right that's why we

1068

00:37:10,790 --> 00:37:09,280

call them low memory systems physicists

1069

00:37:12,310 --> 00:37:10,800

themselves are very high memory

1070

00:37:14,390 --> 00:37:12,320

individuals right they have to be good

1071

00:37:16,390 --> 00:37:14,400

at mathematics and modeling and so on

1072

00:37:20,150 --> 00:37:16,400

low memory systems that means a few

1073

00:37:21,190 --> 00:37:20,160

equations can broadly tell show you how

1074

00:37:22,470 --> 00:37:21,200

things work

1075

00:37:24,630 --> 00:37:22,480

not precisely

1076  
00:37:25,910 --> 00:37:24,640  
then you go into chemistry and chemistry

1077  
00:37:27,270 --> 00:37:25,920  
is a bit messier there's lots more

1078  
00:37:29,349 --> 00:37:27,280  
compounds in may more common to

1079  
00:37:31,109 --> 00:37:29,359  
explosion but again chemists alchemists

1080  
00:37:33,349 --> 00:37:31,119  
whatever we can make new materials

1081  
00:37:36,230 --> 00:37:33,359  
molecules and so on then you get to

1082  
00:37:38,470 --> 00:37:36,240  
biology and that's a medium memory when

1083  
00:37:41,510 --> 00:37:38,480  
you get to biology you have all this

1084  
00:37:43,030 --> 00:37:41,520  
contingency and evolution cambrian

1085  
00:37:45,190 --> 00:37:43,040  
explosion there are legs popping up

1086  
00:37:47,589 --> 00:37:45,200  
everywhere eyes everywhere things calm

1087  
00:37:50,470 --> 00:37:47,599  
down you get to where we we are on earth

1088  
00:37:53,270 --> 00:37:50,480

with dinosaurs a chance it comes a

1089

00:37:55,670 --> 00:37:53,280

dinosaur goes extinct mammals

1090

00:37:59,349 --> 00:37:55,680

run around and suddenly we have human

1091

00:38:02,150 --> 00:37:59,359

beings uh building iphones and youtube

1092

00:38:03,109 --> 00:38:02,160

and and whatever and and i think that

1093

00:38:05,910 --> 00:38:03,119

that

1094

00:38:08,230 --> 00:38:05,920

me the memory in those increases like

1095

00:38:10,390 --> 00:38:08,240

dramatically we can't even conceive

1096

00:38:11,910 --> 00:38:10,400

because physics has not

1097

00:38:14,150 --> 00:38:11,920

i would say it's all physics fault right

1098

00:38:16,150 --> 00:38:14,160

i'm have to i'm not i'm in defense of

1099

00:38:17,829 --> 00:38:16,160

the chemist physics that doesn't doesn't

1100

00:38:21,589 --> 00:38:17,839

understand entropy it's wrong the

1101

00:38:24,069 --> 00:38:21,599

definition of entropy is wrong um sadly

1102

00:38:26,550 --> 00:38:24,079

this is huge this is really huge kurt um

1103

00:38:28,390 --> 00:38:26,560

so lee has a very provocative unorthodox

1104

00:38:29,829 --> 00:38:28,400

and not necessarily accepted within phys

1105

00:38:31,349 --> 00:38:29,839

it doesn't mean he's wrong but i think

1106

00:38:32,630 --> 00:38:31,359

we should put a pin in that and

1107

00:38:34,550 --> 00:38:32,640

definitely want to you yeah yeah

1108

00:38:36,150 --> 00:38:34,560

audience your audience needs to hear his

1109

00:38:38,310 --> 00:38:36,160

perspective and they hopefully will want

1110

00:38:39,510 --> 00:38:38,320

to hear my rebuttal too but but lee go i

1111

00:38:41,109 --> 00:38:39,520

don't want to interrupt you is this

1112

00:38:42,790 --> 00:38:41,119

related to assembly theory or is it

1113

00:38:44,790 --> 00:38:42,800

different yeah yeah it's a bit about

1114

00:38:45,829 --> 00:38:44,800

assembly i'm unsure how a definition can

1115

00:38:47,349 --> 00:38:45,839

be wrong what do you mean by the

1116

00:38:49,430 --> 00:38:47,359

definition of entropy is wrong that

1117

00:38:51,349 --> 00:38:49,440

entropy is trying to capture something

1118

00:38:53,349 --> 00:38:51,359

and the definition doesn't capture that

1119

00:38:55,589 --> 00:38:53,359

let's define entropy for a second and so

1120

00:38:57,829 --> 00:38:55,599

it's it's not the definition isn't wrong

1121

00:38:58,790 --> 00:38:57,839

it's what we need to the whole concept

1122

00:39:00,390 --> 00:38:58,800

is wrong

1123

00:39:02,069 --> 00:39:00,400

so highly it's quite it's like these are

1124

00:39:03,270 --> 00:39:02,079

career ending words right there would be

1125

00:39:05,270 --> 00:39:03,280

all the the

1126

00:39:07,190 --> 00:39:05,280

thermodynamicists out there canceling me

1127

00:39:08,630 --> 00:39:07,200

but because thermodynamicists are pretty

1128

00:39:09,670 --> 00:39:08,640

cool guys and they're like the stats

1129

00:39:11,670 --> 00:39:09,680

they're not going to cancel me they

1130

00:39:14,710 --> 00:39:11,680

might take pity on me and teach me some

1131

00:39:16,630 --> 00:39:14,720

statistical mechanics so what do i mean

1132

00:39:18,710 --> 00:39:16,640

so if you uh what is entropy first of

1133

00:39:20,069 --> 00:39:18,720

all entropy very loosely is a measure of

1134

00:39:22,790 --> 00:39:20,079

disorder

1135

00:39:24,550 --> 00:39:22,800

so and and and what we say in general i

1136

00:39:27,030 --> 00:39:24,560

take it for a process to be

1137

00:39:28,310 --> 00:39:27,040

sorry i don't think that's the case do

1138

00:39:31,190 --> 00:39:28,320

you think that's the case brian that

1139

00:39:33,030 --> 00:39:31,200

it's a measure of disorder it is yeah i

1140

00:39:35,109 --> 00:39:33,040

know that's colloquially what it is no

1141

00:39:36,470 --> 00:39:35,119

no i squirt if you the entrance so if

1142

00:39:38,550 --> 00:39:36,480

you want to calculate the entropy of

1143

00:39:40,230 --> 00:39:38,560

something you look at the state you look

1144

00:39:41,750 --> 00:39:40,240

at the actual state versus the

1145

00:39:43,910 --> 00:39:41,760

microstate versus the number of possible

1146

00:39:45,190 --> 00:39:43,920

states look at the fraction of those and

1147

00:39:47,109 --> 00:39:45,200

and basically

1148

00:39:48,870 --> 00:39:47,119

at the when you look at the entropy the

1149

00:39:50,710 --> 00:39:48,880

value it tells you how much disorder you

1150

00:39:52,550 --> 00:39:50,720

have the lower the number the lower the

1151  
00:39:54,230 --> 00:39:52,560  
disorder the more order the higher the

1152  
00:39:55,510 --> 00:39:54,240  
number the higher the disorder the

1153  
00:39:57,910 --> 00:39:55,520  
higher the number of arrangements that

1154  
00:39:59,990 --> 00:39:57,920  
is the price precise definition of

1155  
00:40:01,990 --> 00:40:00,000  
entropy it goes from the molecular level

1156  
00:40:03,349 --> 00:40:02,000  
or the atomic level all the way up to

1157  
00:40:05,190 --> 00:40:03,359  
the macro level kurt i should say that

1158  
00:40:06,630 --> 00:40:05,200  
john von neumann said nobody understands

1159  
00:40:08,630 --> 00:40:06,640  
entropy so if you ever discover

1160  
00:40:10,550 --> 00:40:08,640  
something call it entropy there's like

1161  
00:40:13,030 --> 00:40:10,560  
what lee eight different shannon entropy

1162  
00:40:14,630 --> 00:40:13,040  
von neumann oh no but let's

1163  
00:40:16,069 --> 00:40:14,640

i know how you're using it i i don't i

1164

00:40:18,230 --> 00:40:16,079

don't i fundamentally disagree kurt i

1165

00:40:19,990 --> 00:40:18,240

don't this the tricky part lee i'd like

1166

00:40:21,750 --> 00:40:20,000

to some clarification is that when

1167

00:40:23,349 --> 00:40:21,760

people use the word order we have a

1168

00:40:25,030 --> 00:40:23,359

certain meaning in our everyday life in

1169

00:40:26,950 --> 00:40:25,040

our vernacular but then when we use the

1170

00:40:28,710 --> 00:40:26,960

word entropy it has a specific meaning

1171

00:40:30,230 --> 00:40:28,720

that isn't necessarily tied to order

1172

00:40:31,990 --> 00:40:30,240

though it's correlated with it and you

1173

00:40:34,150 --> 00:40:32,000

can see this with no no no we have to

1174

00:40:36,230 --> 00:40:34,160

let's go back because brian will back me

1175

00:40:38,390 --> 00:40:36,240

up here the entropy that's used in

1176

00:40:41,190 --> 00:40:38,400

information theory is not correct right

1177

00:40:43,990 --> 00:40:41,200

it is a it is a colloquialism it is not

1178

00:40:45,510 --> 00:40:44,000

anchored in physical reality what is

1179

00:40:48,390 --> 00:40:45,520

anchored in physical reality is the

1180

00:40:49,990 --> 00:40:48,400

basic idea the idea of a heat engine

1181

00:40:51,349 --> 00:40:50,000

okay so i want to talk about the heat

1182

00:40:53,510 --> 00:40:51,359

engine so basically what the

1183

00:40:55,750 --> 00:40:53,520

thermodynamic dynamicist realized if you

1184

00:40:57,750 --> 00:40:55,760

want to get maximum efficiency out of

1185

00:40:59,349 --> 00:40:57,760

your heat engine you maximize the

1186

00:41:01,030 --> 00:40:59,359

temperature difference between the two

1187

00:41:03,349 --> 00:41:01,040

parts right and then you can know if

1188

00:41:05,270 --> 00:41:03,359

it's exactly yeah sorry that's a carnal

1189

00:41:06,950 --> 00:41:05,280

efficiency right exactly and so and

1190

00:41:09,510 --> 00:41:06,960

brian is agreeing because it's right

1191

00:41:11,990 --> 00:41:09,520

it's how it works right there now

1192

00:41:13,990 --> 00:41:12,000

boltzmann came along and he realized

1193

00:41:17,270 --> 00:41:14,000

that he could derive the existence of

1194

00:41:19,829 --> 00:41:17,280

molecules of atoms from this approach

1195

00:41:22,150 --> 00:41:19,839

it's like abenitio it was amazing right

1196

00:41:23,510 --> 00:41:22,160

so you could infer that these molecules

1197

00:41:25,030 --> 00:41:23,520

are moving around and they have these

1198

00:41:26,790 --> 00:41:25,040

energies associated with them and they

1199

00:41:28,710 --> 00:41:26,800

could be added up and they would give

1200

00:41:30,630 --> 00:41:28,720

you what you measure right in by

1201

00:41:32,870 --> 00:41:30,640

experiment now

1202

00:41:36,550 --> 00:41:32,880

that's that's out there what i'm saying

1203

00:41:37,990 --> 00:41:36,560

here is human beings create the boundary

1204

00:41:40,550 --> 00:41:38,000

conditions of the engine we build the

1205

00:41:43,190 --> 00:41:40,560

engine we do work we in we interact on

1206

00:41:44,710 --> 00:41:43,200

the on the boundary conditions to make

1207

00:41:46,150 --> 00:41:44,720

things happen and then we label the

1208

00:41:48,710 --> 00:41:46,160

beginning and the end and the way we

1209

00:41:51,829 --> 00:41:48,720

label things we label things in such a

1210

00:41:53,430 --> 00:41:51,839

way as an observer that we we kind of

1211

00:41:55,750 --> 00:41:53,440

stack the deck so we always see the

1212

00:41:57,030 --> 00:41:55,760

entropy change so let's pause there

1213

00:41:59,030 --> 00:41:57,040

because that's quite a deep thing we

1214

00:42:01,109 --> 00:41:59,040

have to dig down and brian will attack

1215

00:42:03,270 --> 00:42:01,119

it in a good way because it needs

1216

00:42:05,430 --> 00:42:03,280

clarification now let's go to

1217

00:42:07,510 --> 00:42:05,440

information and entropy

1218

00:42:08,790 --> 00:42:07,520

this is where things get confusing

1219

00:42:11,349 --> 00:42:08,800

shannon

1220

00:42:14,069 --> 00:42:11,359

wanted to quantify the amount of noise in

1221

00:42:15,349 --> 00:42:14,079

a channel if we're speaking right and he

1222

00:42:17,910 --> 00:42:15,359

wanted to think about the number of

1223

00:42:20,230 --> 00:42:17,920

possible states how surprising is it if

1224

00:42:21,829 --> 00:42:20,240

i get this bit do i get that bit right

1225

00:42:23,589 --> 00:42:21,839

and what shannon was able to do is come

1226

00:42:25,750 --> 00:42:23,599

up with a very nice mathematical

1227

00:42:29,950 --> 00:42:25,760

formalism that look very similar to

1228

00:42:32,069 --> 00:42:29,960

entropy okay um on a channel but people

1229

00:42:34,309 --> 00:42:32,079

misunderstood and said that everything

1230

00:42:36,710 --> 00:42:34,319

is a communication channel but no

1231

00:42:38,630 --> 00:42:36,720

shannon says there has to be an encoder

1232

00:42:39,910 --> 00:42:38,640

and a decoder and then shannon

1233

00:42:41,829 --> 00:42:39,920

information

1234

00:42:43,910 --> 00:42:41,839

is can be used

1235

00:42:45,910 --> 00:42:43,920

only under those circumstances no

1236

00:42:47,829 --> 00:42:45,920

encoder no decode the no shannon

1237

00:42:49,510 --> 00:42:47,839

information okay

1238

00:42:51,270 --> 00:42:49,520

that's what i mean so i really wanted to

1239

00:42:53,270 --> 00:42:51,280

take that very carefully and define

1240

00:42:55,430 --> 00:42:53,280

those to the best of my ability and i'm

1241

00:42:56,790 --> 00:42:55,440

very happy for brian to correct anything

1242

00:42:58,950 --> 00:42:56,800

because he's a better teacher than i am

1243

00:43:01,190 --> 00:42:58,960

and i think on this we broadly agree

1244

00:43:03,109 --> 00:43:01,200

what the definition is i think just for

1245

00:43:04,950 --> 00:43:03,119

for kurt and for the audience who's

1246

00:43:07,030 --> 00:43:04,960

incredibly erudite second only to the

1247

00:43:08,470 --> 00:43:07,040

into the impossible podcast audience in

1248

00:43:10,069 --> 00:43:08,480

terms of eridition brilliance and

1249

00:43:11,829 --> 00:43:10,079

alacrity of brain power no i'm just

1250

00:43:13,190 --> 00:43:11,839

kidding there's a podcast that brian

1251  
00:43:14,950 --> 00:43:13,200  
hosts for those who are watching called

1252  
00:43:16,150 --> 00:43:14,960  
into the impossible and i recommend you

1253  
00:43:17,589 --> 00:43:16,160  
check that out i'll leave a link in the

1254  
00:43:20,230 --> 00:43:17,599  
description

1255  
00:43:21,990 --> 00:43:20,240  
and and kurt is my uh he is my thesis

1256  
00:43:23,270 --> 00:43:22,000  
advisor and all things in youtube has

1257  
00:43:26,309 --> 00:43:23,280  
really helped me tremendously and i have

1258  
00:43:28,069 --> 00:43:26,319  
gratitude for him um so so lee is

1259  
00:43:29,750 --> 00:43:28,079  
eminently correct here i think this is

1260  
00:43:32,550 --> 00:43:29,760  
this is absolutely something that we can

1261  
00:43:35,109 --> 00:43:32,560  
we can orient uh towards and and that

1262  
00:43:36,470 --> 00:43:35,119  
only highlights again this this very

1263  
00:43:39,750 --> 00:43:36,480

delightful and delicious you have to

1264

00:43:41,990 --> 00:43:39,760

understand kurt um me and lee share one

1265

00:43:44,790 --> 00:43:42,000

thing in common the curiosity depends on

1266

00:43:46,710 --> 00:43:44,800

us being mystified stymied and perhaps

1267

00:43:48,550 --> 00:43:46,720

even deceived by nature at certain times

1268

00:43:50,710 --> 00:43:48,560

our job is to not deceive ourselves or

1269

00:43:52,950 --> 00:43:50,720

other people to get money attention fame

1270

00:43:54,790 --> 00:43:52,960

etc but in these contexts when you have

1271

00:43:56,470 --> 00:43:54,800

ambiguity again

1272

00:43:58,550 --> 00:43:56,480

lee mentioned a lot of topics in that

1273

00:44:01,190 --> 00:43:58,560

definition which is eminently correct in

1274

00:44:04,950 --> 00:44:01,200

so far as we all agree on things like

1275

00:44:06,710 --> 00:44:04,960

temperature um we agree on on basics

1276

00:44:08,069 --> 00:44:06,720

like

1277

00:44:10,790 --> 00:44:08,079

the microstate what constitutes

1278

00:44:13,670 --> 00:44:10,800

microstates distributions and

1279

00:44:16,470 --> 00:44:13,680

fundamentally if we agree on time and

1280

00:44:18,470 --> 00:44:16,480

lee has some very very again delightful

1281

00:44:20,550 --> 00:44:18,480

delicious uh you know possibly

1282

00:44:22,790 --> 00:44:20,560

delusional but but wonderful ideas about

1283

00:44:24,630 --> 00:44:22,800

time and and its fundamentality but

1284

00:44:26,550 --> 00:44:24,640

let's connect let's keep going back uh

1285

00:44:29,030 --> 00:44:26,560

to what lee said which i think is is

1286

00:44:31,349 --> 00:44:29,040

brilliant and controversial he said

1287

00:44:33,589 --> 00:44:31,359

physicists do not understand entropy

1288

00:44:35,430 --> 00:44:33,599

which implies concomitantly with that i

1289

00:44:37,829 --> 00:44:35,440

think lee you'll agree that we don't

1290

00:44:39,109 --> 00:44:37,839

understand time because time and

1291

00:44:40,470 --> 00:44:39,119

temperature i think you could say we

1292

00:44:41,829 --> 00:44:40,480

might understand but that's intimately

1293

00:44:43,829 --> 00:44:41,839

connected to molecules right you don't

1294

00:44:45,910 --> 00:44:43,839

have temperature of a single quark right

1295

00:44:48,390 --> 00:44:45,920

that's not substantive to talk about so

1296

00:44:50,069 --> 00:44:48,400

chemistry comes in and i think i would

1297

00:44:51,910 --> 00:44:50,079

disagree that you know chemists have a

1298

00:44:53,670 --> 00:44:51,920

superior understanding i think they have

1299

00:44:56,230 --> 00:44:53,680

insight that physicists do not

1300

00:44:58,150 --> 00:44:56,240

appreciate and lee is 100 correct we

1301

00:44:59,990 --> 00:44:58,160

don't appreciate this molecular story

1302

00:45:01,430 --> 00:45:00,000

and i'll just correct one thing that lee

1303

00:45:03,190 --> 00:45:01,440

said i don't think boltzmann you know

1304

00:45:04,630 --> 00:45:03,200

fundamentally you know prove the

1305

00:45:06,069 --> 00:45:04,640

existence of molecules i think that was

1306

00:45:08,630 --> 00:45:06,079

einstein later with brownie in motion

1307

00:45:10,630 --> 00:45:08,640

which was concomitant with boltzmann and

1308

00:45:12,069 --> 00:45:10,640

maxwell's earlier statistical mechanics

1309

00:45:14,390 --> 00:45:12,079

but let's just take this back to lee's

1310

00:45:16,550 --> 00:45:14,400

controversial statement which is that to

1311

00:45:18,390 --> 00:45:16,560

understand time and to understand

1312

00:45:19,990 --> 00:45:18,400

entropy we really need to understand

1313

00:45:21,270 --> 00:45:20,000

chemistry because they're all

1314

00:45:24,390 --> 00:45:21,280

fundamentally

1315

00:45:26,550 --> 00:45:24,400

pivoting on a very a very singular hinge

1316

00:45:28,790 --> 00:45:26,560

which is a chemical definition or a

1317

00:45:31,190 --> 00:45:28,800

practical working definition of entropy

1318

00:45:33,589 --> 00:45:31,200

which lee posits comes from chemistry

1319

00:45:36,230 --> 00:45:33,599

exclusively correctly

1320

00:45:37,910 --> 00:45:36,240

yeah and i think to i mean so the to

1321

00:45:40,790 --> 00:45:37,920

going back to boltzmann and the proof of

1322

00:45:41,829 --> 00:45:40,800

atoms boltzmann proved i mean you can

1323

00:45:44,630 --> 00:45:41,839

add it on

1324

00:45:47,510 --> 00:45:44,640

what einstein did that basically the

1325

00:45:49,510 --> 00:45:47,520

molecules are little microstates

1326

00:45:50,870 --> 00:45:49,520

basically and that microwave so that's a

1327

00:45:53,030 --> 00:45:50,880

good correction we must get these

1328

00:45:54,550 --> 00:45:53,040

corrections right um so going on with

1329

00:45:55,829 --> 00:45:54,560

entropy so what i was saying to you kurt

1330

00:45:58,309 --> 00:45:55,839

is that

1331

00:46:01,030 --> 00:45:58,319

when you you look at a process you say

1332

00:46:02,550 --> 00:46:01,040

oh this whole process has occurred

1333

00:46:04,150 --> 00:46:02,560

the entropy of the universe has

1334

00:46:07,430 --> 00:46:04,160

increased right it's like like some kind

1335

00:46:09,270 --> 00:46:07,440

of law and i keep saying to people

1336

00:46:10,790 --> 00:46:09,280

what is the basis for that law and this

1337

00:46:12,790 --> 00:46:10,800

is really tricky so we get to a circular

1338

00:46:14,470 --> 00:46:12,800

argument people say well of course if we

1339

00:46:16,950 --> 00:46:14,480

do the statistics

1340

00:46:18,630 --> 00:46:16,960

what we do is we count everything up

1341

00:46:20,069 --> 00:46:18,640

in their in their and put them in you

1342

00:46:21,750 --> 00:46:20,079

know how much energy you have how many

1343

00:46:23,109 --> 00:46:21,760

of you you know and then we then sum it

1344

00:46:25,109 --> 00:46:23,119

up and we look at the entropy we

1345

00:46:27,190 --> 00:46:25,119

calculate their number and then we look

1346

00:46:28,550 --> 00:46:27,200

at the change so we look at after with

1347

00:46:30,230 --> 00:46:28,560

before and after and we look at the

1348

00:46:32,470 --> 00:46:30,240

difference there now the problem is with

1349

00:46:34,950 --> 00:46:32,480

respect to what are we labeling

1350

00:46:37,750 --> 00:46:34,960

and so what i'm saying is that chemi

1351

00:46:41,109 --> 00:46:37,760

that entropy as a term

1352

00:46:43,430 --> 00:46:41,119

is useful if you're a god looking down

1353

00:46:45,349 --> 00:46:43,440

on your universe and you see the system

1354

00:46:46,870 --> 00:46:45,359

and you see the surroundings

1355

00:46:48,470 --> 00:46:46,880

if you're doing that you're good i'm not

1356

00:46:51,910 --> 00:46:48,480

saying that all everyone using entropy

1357

00:46:54,069 --> 00:46:51,920

is insane i'm saying entropy relies on

1358

00:47:00,710 --> 00:46:54,079

coarse graining

1359

00:47:02,309 --> 00:47:00,720

so this is the problem because entropy

1360

00:47:03,670 --> 00:47:02,319

basically says everyone says there's no

1361

00:47:05,430 --> 00:47:03,680

causation in the universe we don't need

1362

00:47:06,230 --> 00:47:05,440

it there's a second law and i'm saying

1363

00:47:14,069 --> 00:47:06,240

no

1364

00:47:15,030 --> 00:47:14,079

you allow causation to exist

1365

00:47:16,309 --> 00:47:15,040

and then

1366

00:47:19,510 --> 00:47:16,319

and it removes the number of

1367

00:47:21,190 --> 00:47:19,520

uncertainties and my universe requires

1368

00:47:23,349 --> 00:47:21,200

no second law

1369

00:47:26,309 --> 00:47:23,359

no order at the beginning

1370

00:47:28,150 --> 00:47:26,319

it only requires causation and the

1371

00:47:29,589 --> 00:47:28,160

physical laws we already know so i

1372

00:47:31,510 --> 00:47:29,599

remember that it's critical let me let

1373

00:47:33,750 --> 00:47:31,520

me just you know because lee is a

1374

00:47:35,670 --> 00:47:33,760

delightful ability i wonder if he is

1375

00:47:37,589 --> 00:47:35,680

part part a member of the of the tribal

1376

00:47:40,470 --> 00:47:37,599

families because uh he talks with his

1377

00:47:42,710 --> 00:47:40,480

hands and and and he's just so brilliant

1378

00:47:44,630 --> 00:47:42,720

in his uh in his single-mindedness of

1379

00:47:46,309 --> 00:47:44,640

discourse but i have to put a pause so

1380

00:47:47,990 --> 00:47:46,319

lee is also pushing back on something

1381

00:47:50,630 --> 00:47:48,000

that's very controversial and he has

1382

00:47:52,790 --> 00:47:50,640

tremendous courage again kurt i know you

1383

00:47:54,710 --> 00:47:52,800

wanted to have blood on the floor of the

1384

00:47:56,069 --> 00:47:54,720

mat by round five i think we're probably

1385

00:47:57,990 --> 00:47:56,079

around three it's gonna get there we're

1386

00:48:00,309 --> 00:47:58,000

gonna get bloody but one bloody good

1387

00:48:02,309 --> 00:48:00,319

thing that that leah said exclusively

1388

00:48:04,710 --> 00:48:02,319

courageously i think only on my podcast

1389

00:48:07,589 --> 00:48:04,720

interview with him was that uh chemistry

1390

00:48:09,430 --> 00:48:07,599

has quote an intelligent design problem

1391

00:48:10,790 --> 00:48:09,440

so what and and lee takes on these

1392

00:48:12,150 --> 00:48:10,800

intelligent designers which i've had on

1393

00:48:13,990 --> 00:48:12,160

my show and and i don't mind and at

1394

00:48:16,150 --> 00:48:14,000

least debated them and it's it's kosher

1395

00:48:19,030 --> 00:48:16,160

in my mind to talk to such people steven

1396

00:48:21,589 --> 00:48:19,040

c meyer james two or others um but

1397

00:48:23,589 --> 00:48:21,599

fundamentally he has courage lee has

1398

00:48:26,309 --> 00:48:23,599

courage in that he is admitting there is

1399

00:48:27,750 --> 00:48:26,319

a lack a lacuna in our understanding of

1400

00:48:29,510 --> 00:48:27,760

signs which we are comfortable with

1401

00:48:31,270 --> 00:48:29,520

because we are making progress towards

1402

00:48:33,430 --> 00:48:31,280

an understanding that hopefully would

1403

00:48:35,430 --> 00:48:33,440

not involve god but hopefully if it does

1404

00:48:37,430 --> 00:48:35,440

involve god chemist physicists around

1405

00:48:39,270 --> 00:48:37,440

the world could be open-minded enough to

1406

00:48:40,950 --> 00:48:39,280

accept and change their priors based on

1407

00:48:42,390 --> 00:48:40,960

that now what he said

1408

00:48:44,230 --> 00:48:42,400

is is fundamentally important two

1409

00:48:45,990 --> 00:48:44,240

minutes ago he said he doesn't require a

1410

00:48:47,990 --> 00:48:46,000

second law now why is the second law so

1411

00:48:50,309 --> 00:48:48,000

problematic for chemists who reject the

1412

00:48:52,710 --> 00:48:50,319

intelligent design hypothesis which

1413

00:48:55,109 --> 00:48:52,720

which which obviously lee does and and

1414

00:48:56,630 --> 00:48:55,119

that is that because without some low

1415

00:48:58,630 --> 00:48:56,640

ordered state which can get into my

1416

00:49:00,549 --> 00:48:58,640

field of cosmology how did inflation had

1417

00:49:02,630 --> 00:49:00,559

the big bang unfurl if there was no

1418

00:49:04,390 --> 00:49:02,640

pre-existing universe a pre-existing

1419

00:49:06,309 --> 00:49:04,400

collapsing state perhaps

1420

00:49:08,470 --> 00:49:06,319

how do you establish a low entropy state

1421

00:49:10,950 --> 00:49:08,480

of the universe for it to grow to

1422

00:49:13,910 --> 00:49:10,960

today's facility of information of

1423

00:49:16,790 --> 00:49:13,920

complexity of chaos of entropy by 10 to

1424

00:49:19,030 --> 00:49:16,800

the 100 orders of magnitude that penrose

1425

00:49:21,030 --> 00:49:19,040

has pointed out in the 80s already this

1426

00:49:22,710 --> 00:49:21,040

is a huge challenge to cosmology how do

1427

00:49:24,069 --> 00:49:22,720

you get to high entropy today if you

1428

00:49:25,910 --> 00:49:24,079

didn't start with low entropy in the

1429

00:49:27,109 --> 00:49:25,920

beginning people like david albert and

1430

00:49:28,950 --> 00:49:27,119

others have postulated something called

1431

00:49:31,829 --> 00:49:28,960

the past hypothesis which is basically

1432

00:49:33,589 --> 00:49:31,839

by fiat some entity instantiates a zero

1433

00:49:35,829 --> 00:49:33,599

entropy or low entropy state i don't i

1434

00:49:38,069 --> 00:49:35,839

think that's kind of touching on almost

1435

00:49:40,390 --> 00:49:38,079

intelligent design-like features but

1436

00:49:42,870 --> 00:49:40,400

lee's self-consistent if not correct i'm

1437

00:49:44,470 --> 00:49:42,880

saying he is self-consistent if he can

1438

00:49:47,190 --> 00:49:44,480

avoid the second law's validity

1439

00:49:49,430 --> 00:49:47,200

uniformly universally then he precludes

1440

00:49:51,829 --> 00:49:49,440

and excludes a need for some designer

1441

00:49:54,549 --> 00:49:51,839

and i just wonder lee is that driven by

1442

00:49:57,109 --> 00:49:54,559

some desire to eliminate a godhead or is

1443

00:49:58,549 --> 00:49:57,119

this fundamentally just an element of a

1444

00:50:00,230 --> 00:49:58,559

self-consistent theory of the early

1445

00:50:02,950 --> 00:50:00,240

universe that leads to the chemistry

1446

00:50:03,829 --> 00:50:02,960

time facility that we just described

1447

00:50:05,430 --> 00:50:03,839

um

1448

00:50:07,270 --> 00:50:05,440

i mean i'm i was thinking about this

1449

00:50:09,190 --> 00:50:07,280

today actually because i was listening

1450

00:50:11,510 --> 00:50:09,200

um to something you were saying

1451  
00:50:13,270 --> 00:50:11,520  
and um no i've always really had an

1452  
00:50:15,270 --> 00:50:13,280  
intuition for

1453  
00:50:17,030 --> 00:50:15,280  
time that was different to everyone

1454  
00:50:19,030 --> 00:50:17,040  
else's and i remember my physics teacher

1455  
00:50:20,710 --> 00:50:19,040  
when i was at high school who used to

1456  
00:50:22,549 --> 00:50:20,720  
work at cern

1457  
00:50:24,549 --> 00:50:22,559  
and i was just i was saying this thing

1458  
00:50:26,870 --> 00:50:24,559  
called time and she said you understand

1459  
00:50:29,589 --> 00:50:26,880  
time is nothing it's just the ability to

1460  
00:50:31,750 --> 00:50:29,599  
watch interactive things to happen it is

1461  
00:50:33,589 --> 00:50:31,760  
if you have to distribute energy

1462  
00:50:34,390 --> 00:50:33,599  
you have time and i was just like let's

1463  
00:50:40,470 --> 00:50:34,400

just

1464

00:50:41,349 --> 00:50:40,480

kind of ignored it

1465

00:50:45,910 --> 00:50:41,359

and

1466

00:50:47,510 --> 00:50:45,920

open-minded chemist in the um

1467

00:50:49,990 --> 00:50:47,520

for me chemistry is a way of interacting

1468

00:50:52,549 --> 00:50:50,000

the universe to ask questions and when i

1469

00:50:54,549 --> 00:50:52,559

look around and i can see that you have

1470

00:50:55,990 --> 00:50:54,559

sand on a beach that is inorganic made

1471

00:50:57,270 --> 00:50:56,000

of silicates there might be biological

1472

00:50:59,030 --> 00:50:57,280

stuff in there but you've got inorganic

1473

00:51:00,630 --> 00:50:59,040

stuff and then you can see a blade of

1474

00:51:02,309 --> 00:51:00,640

grass where there's a molecular machine

1475

00:51:05,109 --> 00:51:02,319

in there that's assembling

1476

00:51:06,549 --> 00:51:05,119

taking light taking co2 and respiring

1477

00:51:08,470 --> 00:51:06,559

you can't help thinking

1478

00:51:10,710 --> 00:51:08,480

there must be some incredible force of

1479

00:51:12,390 --> 00:51:10,720

nature that we're misunderstanding now i

1480

00:51:13,990 --> 00:51:12,400

don't mean like a force of gravity but i

1481

00:51:16,630 --> 00:51:14,000

will introduce and this is what assembly

1482

00:51:17,910 --> 00:51:16,640

theory quantifies the court that the

1483

00:51:19,750 --> 00:51:17,920

physicists should give us a bit of

1484

00:51:21,750 --> 00:51:19,760

causation the physicists have taken

1485

00:51:23,510 --> 00:51:21,760

causation out of everything in physics

1486

00:51:25,510 --> 00:51:23,520

so they have to magically invoke it

1487

00:51:26,790 --> 00:51:25,520

which is kind of why we have this free

1488

00:51:28,790 --> 00:51:26,800

will problem now because we've got

1489

00:51:29,829 --> 00:51:28,800

really smart people saying i don't have

1490

00:51:31,430 --> 00:51:29,839

free will because i live in a

1491

00:51:32,630 --> 00:51:31,440

deterministic universe and then you're

1492

00:51:34,390 --> 00:51:32,640

just like well what are we doing this

1493

00:51:35,910 --> 00:51:34,400

then i might as well just run round

1494

00:51:37,589 --> 00:51:35,920

naked on the youtube channel because

1495

00:51:38,870 --> 00:51:37,599

it's already nobody acts like they have

1496

00:51:40,950 --> 00:51:38,880

no free will i mean that's the thing

1497

00:51:42,309 --> 00:51:40,960

it's like if you meet somebody who truly

1498

00:51:44,150 --> 00:51:42,319

believes that they have no free will and

1499

00:51:46,150 --> 00:51:44,160

acts upon it that person's should be

1500

00:51:47,829 --> 00:51:46,160

referred to i think

1501  
00:51:49,910 --> 00:51:47,839  
doesn't sam harris claim but anyway i'm

1502  
00:51:52,230 --> 00:51:49,920  
digressing a bit so what i mean is that

1503  
00:51:54,870 --> 00:51:52,240  
um you have this thing that

1504  
00:51:57,270 --> 00:51:54,880  
that for me the missing force if you

1505  
00:52:00,230 --> 00:51:57,280  
like or the missing phenomena that we

1506  
00:52:01,510 --> 00:52:00,240  
are all missing by removing it by having

1507  
00:52:03,030 --> 00:52:01,520  
entropy

1508  
00:52:04,470 --> 00:52:03,040  
cheat number one

1509  
00:52:06,870 --> 00:52:04,480  
having order at the beginning of the

1510  
00:52:09,030 --> 00:52:06,880  
universe cheat number two and having

1511  
00:52:10,710 --> 00:52:09,040  
emergent time and emergent causation

1512  
00:52:13,109 --> 00:52:10,720  
cheats three and four

1513  
00:52:14,069 --> 00:52:13,119

is that we're me we're ignoring the fact

1514

00:52:16,150 --> 00:52:14,079

that

1515

00:52:19,910 --> 00:52:16,160

when you've got a universe just full of

1516

00:52:22,069 --> 00:52:19,920

objects let's call them just atoms right

1517

00:52:23,589 --> 00:52:22,079

and some energy and you start to break

1518

00:52:28,790 --> 00:52:23,599

symmetry

1519

00:52:30,549 --> 00:52:28,800

and there's this thing called selection

1520

00:52:32,309 --> 00:52:30,559

and you don't need biology for selection

1521

00:52:34,549 --> 00:52:32,319

you don't need i don't worry there's no

1522

00:52:36,549 --> 00:52:34,559

pan psychism here there is just

1523

00:52:38,549 --> 00:52:36,559

the environment can

1524

00:52:41,190 --> 00:52:38,559

start to be the shepherd

1525

00:52:42,950 --> 00:52:41,200

for the sheep if you like and then the

1526  
00:52:44,630 --> 00:52:42,960  
sheep can become the shepherd and they

1527  
00:52:47,750 --> 00:52:44,640  
switch between the two and you get

1528  
00:52:48,470 --> 00:52:47,760  
complex behavior frozen in now this is

1529  
00:52:51,510 --> 00:52:48,480  
the

1530  
00:52:52,549 --> 00:52:51,520  
point that random events are random but

1531  
00:52:55,030 --> 00:52:52,559  
they are

1532  
00:52:56,309 --> 00:52:55,040  
absolutely monumental in the trajectory

1533  
00:52:58,870 --> 00:52:56,319  
so what i mean is you go to a billiard

1534  
00:53:00,390 --> 00:52:58,880  
table and you just start moving the

1535  
00:53:03,030 --> 00:53:00,400  
balls around

1536  
00:53:05,510 --> 00:53:03,040  
the state that you'll have a number of

1537  
00:53:07,190 --> 00:53:05,520  
bounces later will become precisely

1538  
00:53:08,790 --> 00:53:07,200

controlled by your initial conditions

1539

00:53:09,990 --> 00:53:08,800

and some variations

1540

00:53:11,109 --> 00:53:10,000

start with different initial conditions

1541

00:53:13,670 --> 00:53:11,119

put different energy you'll get to a

1542

00:53:15,589 --> 00:53:13,680

different place now imagine that the

1543

00:53:17,510 --> 00:53:15,599

system is able to record that memory of

1544

00:53:19,990 --> 00:53:17,520

what happened before

1545

00:53:21,750 --> 00:53:20,000

that basically physics turns into

1546

00:53:24,230 --> 00:53:21,760

chemical chemistry through bond

1547

00:53:26,950 --> 00:53:24,240

formation and complex conventory

1548

00:53:29,430 --> 00:53:26,960

explosion and then that process is then

1549

00:53:31,510 --> 00:53:29,440

harnessed when biology is invented by

1550

00:53:33,349 --> 00:53:31,520

matter and you have you're able to

1551

00:53:36,150 --> 00:53:33,359

remember what happened to you at higher

1552

00:53:38,950 --> 00:53:36,160

higher dimensionality and that

1553

00:53:41,990 --> 00:53:38,960

is what that causation from

1554

00:53:43,990 --> 00:53:42,000

quarks to quacks

1555

00:53:46,309 --> 00:53:44,000

right we can have a quote on that we

1556

00:53:48,309 --> 00:53:46,319

call it from rocks to rachmaninoff yeah

1557

00:53:50,069 --> 00:53:48,319

yeah that's a much better you're much

1558

00:53:53,270 --> 00:53:50,079

better at this than i am brian but you

1559

00:53:55,910 --> 00:53:53,280

you go from this kind of non-causal

1560

00:53:57,910 --> 00:53:55,920

system to a causal system then act on

1561

00:53:59,589 --> 00:53:57,920

itself so there's two levels you get to

1562

00:54:01,349 --> 00:53:59,599

biology and you get causation trapped in

1563

00:54:03,109 --> 00:54:01,359

evolution but then when evolution

1564

00:54:05,430 --> 00:54:03,119

produces objects that can act on

1565

00:54:07,030 --> 00:54:05,440

themselves we can genetically engineer

1566

00:54:08,950 --> 00:54:07,040

ourselves we can play with the climate

1567

00:54:11,750 --> 00:54:08,960

we can play with the soil we can play

1568

00:54:14,309 --> 00:54:11,760

with technology you get this explosion

1569

00:54:16,230 --> 00:54:14,319

of further complexity and that's how it

1570

00:54:19,990 --> 00:54:16,240

works and i think that the universe is

1571

00:54:21,670 --> 00:54:20,000

literally teeming with um these engines

1572

00:54:23,430 --> 00:54:21,680

of causation

1573

00:54:25,109 --> 00:54:23,440

and it doesn't need to be we could come

1574

00:54:28,309 --> 00:54:25,119

to a drake occasion like god you like

1575

00:54:31,190 --> 00:54:28,319

earth you know the fact is there's life

1576

00:54:33,750 --> 00:54:31,200

everywhere the sad thing is we probably

1577

00:54:35,670 --> 00:54:33,760

won't be able to recognize it other than

1578

00:54:37,990 --> 00:54:35,680

if we use assembly theory but that's

1579

00:54:39,990 --> 00:54:38,000

obviously my bias right and the prop the

1580

00:54:41,270 --> 00:54:40,000

problem i have as a theorist here is i

1581

00:54:43,430 --> 00:54:41,280

invented a theory and several

1582

00:54:45,589 --> 00:54:43,440

experiments and what my challenge is to

1583

00:54:46,390 --> 00:54:45,599

disprove my own theory

1584

00:54:50,069 --> 00:54:46,400

with

1585

00:54:51,430 --> 00:54:50,079

i'm in is the chemist won't even engage

1586

00:54:53,510 --> 00:54:51,440

with it to start with and it's taken

1587

00:54:56,470 --> 00:54:53,520

them a very long time i have a different

1588

00:54:58,549 --> 00:54:56,480

i'm sorry kurt to interrupt go ahead

1589

00:54:59,990 --> 00:54:58,559

it's better if i don't say anything okay

1590

00:55:02,150 --> 00:55:00,000

it means it's going well

1591

00:55:02,950 --> 00:55:02,160

okay although i do have a quick question

1592

00:55:05,030 --> 00:55:02,960

yeah

1593

00:55:06,790 --> 00:55:05,040

as for lee and for you brian what's the

1594

00:55:09,670 --> 00:55:06,800

definition of order that doesn't involve

1595

00:55:11,910 --> 00:55:11,109

because if you're saying low entropy is

1596

00:55:13,589 --> 00:55:11,920

order

1597

00:55:15,589 --> 00:55:13,599

well then that sounds like a definition

1598

00:55:17,910 --> 00:55:15,599

of order yet the word order was used

1599

00:55:19,670 --> 00:55:17,920

prior to the word entropy being invented

1600

00:55:21,990 --> 00:55:19,680

so this is really tough so you've asked

1601

00:55:23,910 --> 00:55:22,000

a really smart so i'll take a stab at it

1602

00:55:26,790 --> 00:55:23,920

and brian will as well you can define

1603

00:55:28,309 --> 00:55:26,800

information in terms of your certainty

1604

00:55:30,870 --> 00:55:28,319

about what's going to happen next i take

1605

00:55:33,430 --> 00:55:30,880

a coin right and i say i'm going to flip

1606

00:55:35,670 --> 00:55:33,440

my coin and i have no idea i have no

1607

00:55:37,829 --> 00:55:35,680

prior i have no nothing to suggest that

1608

00:55:39,910 --> 00:55:37,839

it's a weighted coin i will assign a

1609

00:55:41,750 --> 00:55:39,920

prior that i'm going to give you know 50

1610

00:55:42,950 --> 00:55:41,760

head or sales and i'll collect data and

1611

00:55:45,030 --> 00:55:42,960

i'll update

1612

00:55:47,829 --> 00:55:45,040

when you're that so that update

1613

00:55:49,349 --> 00:55:47,839

constitutes some information when you're

1614

00:55:51,109 --> 00:55:49,359

and that is the same type of thing you

1615

00:55:53,030 --> 00:55:51,119

want to have a look at an order order is

1616

00:55:55,829 --> 00:55:53,040

a really odd thing because order is

1617

00:55:56,950 --> 00:55:55,839

about registry and so i would say that

1618

00:55:58,390 --> 00:55:56,960

order

1619

00:56:01,430 --> 00:55:58,400

happens

1620

00:56:03,430 --> 00:56:01,440

when you have no constraints let's say

1621

00:56:04,950 --> 00:56:03,440

oh and you allow things to cool down so

1622

00:56:07,030 --> 00:56:04,960

let's just take a phase transition you

1623

00:56:09,510 --> 00:56:07,040

take some water vapor and you know that

1624

00:56:10,630 --> 00:56:09,520

water vapor to kind of um precipitate

1625

00:56:12,309 --> 00:56:10,640

and grow a

1626  
00:56:13,829 --> 00:56:12,319  
an ice crystal

1627  
00:56:15,270 --> 00:56:13,839  
okay and if you allow that to happen

1628  
00:56:17,349 --> 00:56:15,280  
very slowly

1629  
00:56:19,430 --> 00:56:17,359  
the the order

1630  
00:56:21,510 --> 00:56:19,440  
will arise from the fact that molecules

1631  
00:56:24,069 --> 00:56:21,520  
in that ice crystal the water molecules

1632  
00:56:27,109 --> 00:56:24,079  
will take the correct low energy

1633  
00:56:29,349 --> 00:56:27,119  
configuration to make a nice tetrahedral

1634  
00:56:31,109 --> 00:56:29,359  
symmetry and then you'll get no defects

1635  
00:56:33,190 --> 00:56:31,119  
in there and you'll produce this perfect

1636  
00:56:36,470 --> 00:56:33,200  
object that just happens because the

1637  
00:56:38,710 --> 00:56:36,480  
laws of physics give you that so order

1638  
00:56:41,190 --> 00:56:38,720

arises when you have no or the

1639

00:56:44,069 --> 00:56:41,200

constraints are minimal

1640

00:56:45,430 --> 00:56:44,079

that's kind of a really nice definition

1641

00:56:47,670 --> 00:56:45,440

of order

1642

00:56:49,190 --> 00:56:47,680

um and it's hard because lots of people

1643

00:56:51,349 --> 00:56:49,200

argue and they bring in it's all

1644

00:56:53,349 --> 00:56:51,359

anthropologic you know

1645

00:56:56,150 --> 00:56:53,359

my kid's bedroom is not ordered he will

1646

00:56:57,750 --> 00:56:56,160

claim it is right but you know so that's

1647

00:56:59,430 --> 00:56:57,760

and then you then frame in these

1648

00:57:02,069 --> 00:56:59,440

entropic and information arguments but

1649

00:57:04,470 --> 00:57:02,079

you say hey what is information

1650

00:57:06,950 --> 00:57:04,480

information is about uncertainty what is

1651  
00:57:09,589 --> 00:57:06,960  
entropy entropy is about disorder so one

1652  
00:57:11,589 --> 00:57:09,599  
way of looking at is

1653  
00:57:13,910 --> 00:57:11,599  
causation or information for me is

1654  
00:57:15,270 --> 00:57:13,920  
almost the inverse of entropy so when i

1655  
00:57:17,750 --> 00:57:15,280  
burn something

1656  
00:57:19,750 --> 00:57:17,760  
i know how much entropy has changed so

1657  
00:57:21,990 --> 00:57:19,760  
if i burn a book

1658  
00:57:24,789 --> 00:57:22,000  
i in principle or i take a book to the

1659  
00:57:26,309 --> 00:57:24,799  
event hierarchy and black hole right

1660  
00:57:27,990 --> 00:57:26,319  
you're going to get all the information

1661  
00:57:29,829 --> 00:57:28,000  
back out talking radiation i won't be

1662  
00:57:31,910 --> 00:57:29,839  
able to count it but i should be able to

1663  
00:57:33,829 --> 00:57:31,920

work out what it's roughly going to be

1664

00:57:35,349 --> 00:57:33,839

so it tells you what i've lost it's

1665

00:57:37,510 --> 00:57:35,359

never told me what i have and that's why

1666

00:57:39,910 --> 00:57:37,520

i'm pushing so hard on this is entropy

1667

00:57:41,990 --> 00:57:39,920

is almost like the inverse it tells me

1668

00:57:44,309 --> 00:57:42,000

that i lost stuff it can never tell me

1669

00:57:45,109 --> 00:57:44,319

what i had

1670

00:57:46,390 --> 00:57:45,119

yeah i

1671

00:57:48,549 --> 00:57:46,400

very much agree with that i would only

1672

00:57:50,390 --> 00:57:48,559

add on just another example think of a

1673

00:57:52,069 --> 00:57:50,400

pendulum clock a grandfather clock with

1674

00:57:53,589 --> 00:57:52,079

a pendulum swinging back and forth in

1675

00:57:57,109 --> 00:57:53,599

vacuum

1676

00:57:58,710 --> 00:57:57,119

you can use that to tell time um and

1677

00:58:00,549 --> 00:57:58,720

actually i think it's the minimal clock

1678

00:58:02,789 --> 00:58:00,559

of lee works a lot on minimal systems

1679

00:58:05,510 --> 00:58:02,799

and and systems that exhibit uh you know

1680

00:58:07,349 --> 00:58:05,520

features of the very most simple basics

1681

00:58:09,190 --> 00:58:07,359

and essence of the phenomena not simple

1682

00:58:11,430 --> 00:58:09,200

in terms of like dumb but but simple in

1683

00:58:12,710 --> 00:58:11,440

terms of elementary and important um so

1684

00:58:14,549 --> 00:58:12,720

you can have this clock swing back and

1685

00:58:16,630 --> 00:58:14,559

forth and you can use it to tell time

1686

00:58:18,630 --> 00:58:16,640

i.e this you know describe order but if

1687

00:58:20,549 --> 00:58:18,640

and only if you you define the direction

1688

00:58:22,950 --> 00:58:20,559

of the arrow of time right because a

1689

00:58:24,309 --> 00:58:22,960

pendulum is timed translation symmetric

1690

00:58:26,150 --> 00:58:24,319

if i didn't tell you where it started i

1691

00:58:28,470 --> 00:58:26,160

swung the plum bomb out over here and

1692

00:58:31,030 --> 00:58:28,480

let it go you wouldn't know uh the

1693

00:58:33,109 --> 00:58:31,040

absolute origin of time but uh but you

1694

00:58:34,710 --> 00:58:33,119

could still count time in a parametric

1695

00:58:36,630 --> 00:58:34,720

relative way you could say so many

1696

00:58:38,549 --> 00:58:36,640

cycles of the pendulum later and you

1697

00:58:40,390 --> 00:58:38,559

could say that's in the forward but if

1698

00:58:42,390 --> 00:58:40,400

the universe were you know arranged

1699

00:58:44,390 --> 00:58:42,400

differently the laws of physics work for

1700

00:58:46,870 --> 00:58:44,400

newtonian physics in the absence of heat

1701  
00:58:48,950 --> 00:58:46,880  
and so forth work uh the other way so

1702  
00:58:51,030 --> 00:58:48,960  
yes so lee's right you imply some

1703  
00:58:53,030 --> 00:58:51,040  
constraint and then you can do stuff

1704  
00:58:55,270 --> 00:58:53,040  
without imposing uh this interplay

1705  
00:58:56,950 --> 00:58:55,280  
between entropy time and order but only

1706  
00:58:58,789 --> 00:58:56,960  
if you supply at least the minimum bit

1707  
00:59:01,670 --> 00:58:58,799  
of information i.e what was the initial

1708  
00:59:03,109 --> 00:59:01,680  
condition but to get back to lee's

1709  
00:59:04,630 --> 00:59:03,119  
point i think this will go back to our

1710  
00:59:06,470 --> 00:59:04,640  
rubric that we established in the ground

1711  
00:59:08,230 --> 00:59:06,480  
rules you know when lee and i were nose

1712  
00:59:10,230 --> 00:59:08,240  
to nose at the beginning and and kurt

1713  
00:59:11,270 --> 00:59:10,240

was like pushing us and we were like

1714

00:59:12,549 --> 00:59:11,280

you know at the very beginning of the

1715

00:59:14,390 --> 00:59:12,559

fight um

1716

00:59:16,950 --> 00:59:14,400

you know we we should have some

1717

00:59:19,190 --> 00:59:16,960

explanation of of what our priors are

1718

00:59:21,589 --> 00:59:19,200

and how we could change our our minds uh

1719

00:59:24,069 --> 00:59:21,599

so one thing that leah said just now and

1720

00:59:26,150 --> 00:59:24,079

said to me on my podcast and has said uh

1721

00:59:27,750 --> 00:59:26,160

in in many of his wonderful debates and

1722

00:59:29,430 --> 00:59:27,760

again i give him credit for his courage

1723

00:59:32,069 --> 00:59:29,440

this is so rare that you have a

1724

00:59:34,230 --> 00:59:32,079

publix-facing um scientists at the

1725

00:59:35,910 --> 00:59:34,240

highest level region professor at the

1726

00:59:37,910 --> 00:59:35,920

uk which is like appointed by the queen

1727

00:59:39,190 --> 00:59:37,920

so i think he has to like taste test all

1728

00:59:41,109 --> 00:59:39,200

her food to make sure she doesn't die

1729

00:59:43,750 --> 00:59:41,119

like martin reese he tells the queen her

1730

00:59:45,990 --> 00:59:43,760

horoscope as the royal astronomer lee is

1731

00:59:47,190 --> 00:59:46,000

like that level in in in in his

1732

00:59:48,950 --> 00:59:47,200

profession so

1733

00:59:51,670 --> 00:59:48,960

let me say that again prefacing with

1734

00:59:53,750 --> 00:59:51,680

respect um lee is basically claimed that

1735

00:59:55,589 --> 00:59:53,760

life is abundant

1736

00:59:57,430 --> 00:59:55,599

and so to me in the universe and and

1737

00:59:59,829 --> 00:59:57,440

he's gone so far as to make a life

1738

01:00:01,349 --> 00:59:59,839

detection machine which after his

1739

01:00:04,390 --> 01:00:01,359

twitter bot you know in the warm

1740

01:00:06,069 --> 01:00:04,400

darwinian pool registers you know um you

1741

01:00:07,910 --> 01:00:06,079

know i'm setting up my twitter like jack

1742

01:00:09,510 --> 01:00:07,920

did you know 20 years ago

1743

01:00:11,109 --> 01:00:09,520

after that he's going to also you know

1744

01:00:13,589 --> 01:00:11,119

provide the signal coming in from the

1745

01:00:15,750 --> 01:00:13,599

universe autonomously generated based on

1746

01:00:17,430 --> 01:00:15,760

fundamental mathematical principles

1747

01:00:18,950 --> 01:00:17,440

connected to computational devices

1748

01:00:21,829 --> 01:00:18,960

turing machines

1749

01:00:24,789 --> 01:00:21,839

but that is predicated on this bias i

1750

01:00:27,030 --> 01:00:24,799

call you out i use the b word lee

1751

01:00:28,870 --> 01:00:27,040

you are biased that there is a life is

1752

01:00:30,150 --> 01:00:28,880

plentiful throughout the universe and i

1753

01:00:31,910 --> 01:00:30,160

have to say

1754

01:00:33,430 --> 01:00:31,920

you know with the drake equation which

1755

01:00:35,910 --> 01:00:33,440

we can write down and i give it to my

1756

01:00:37,589 --> 01:00:35,920

undergraduate students and and lee knows

1757

01:00:39,270 --> 01:00:37,599

it backwards and forwards the most

1758

01:00:40,950 --> 01:00:39,280

important thing in any equation lee

1759

01:00:42,390 --> 01:00:40,960

correct me if i'm wrong is not that you

1760

01:00:43,990 --> 01:00:42,400

get the answer

1761

01:00:45,910 --> 01:00:44,000

it's how you account for your

1762

01:00:47,030 --> 01:00:45,920

uncertainties your statistical

1763

01:00:48,069 --> 01:00:47,040

uncertainties which are easy to

1764

01:00:49,990 --> 01:00:48,079

calculate

1765

01:00:51,430 --> 01:00:50,000

and your systematic uncertainties which

1766

01:00:53,670 --> 01:00:51,440

are very very difficult i use this

1767

01:00:55,270 --> 01:00:53,680

example in a talk i gave in the belly of

1768

01:00:57,510 --> 01:00:55,280

the beast guys i went to the seti

1769

01:00:59,270 --> 01:00:57,520

institute which we can talk about later

1770

01:01:01,349 --> 01:00:59,280

i gave a talk and said what if you apply

1771

01:01:02,470 --> 01:01:01,359

the drake equation to the san diego zoo

1772

01:01:03,589 --> 01:01:02,480

where i am

1773

01:01:05,510 --> 01:01:03,599

and he said how many people are in the

1774

01:01:07,109 --> 01:01:05,520

san diego zoo right now and i go through

1775

01:01:08,710 --> 01:01:07,119

the calculation i come out with a number

1776

01:01:10,710 --> 01:01:08,720

and it's like eight thousand

1777

01:01:12,710 --> 01:01:10,720

um and that's great except when i do the

1778

01:01:13,910 --> 01:01:12,720

error bars if i account for each one of

1779

01:01:16,150 --> 01:01:13,920

the terms that goes into the drake

1780

01:01:18,710 --> 01:01:16,160

equation for the san diego zoo and feel

1781

01:01:20,789 --> 01:01:18,720

free to estimate example of a fermi type

1782

01:01:23,109 --> 01:01:20,799

problem if you don't include the error

1783

01:01:25,109 --> 01:01:23,119

bars it's meaningless it's worthless so

1784

01:01:26,950 --> 01:01:25,119

i believe that league should say that

1785

01:01:28,789 --> 01:01:26,960

there's 100 you know that life is

1786

01:01:30,630 --> 01:01:28,799

abundant but i would i want to know his

1787

01:01:32,630 --> 01:01:30,640

error bars and i want to know how can he

1788

01:01:34,230 --> 01:01:32,640

go about reducing those error bars in

1789

01:01:35,910 --> 01:01:34,240

other words disproving himself rather

1790

01:01:37,910 --> 01:01:35,920

than confirming that life is abundant

1791

01:01:40,390 --> 01:01:37,920

necessarily what are the potential

1792

01:01:43,030 --> 01:01:40,400

pitfalls traps biases confirmation and

1793

01:01:44,789 --> 01:01:43,040

otherwise that this abundance detector

1794

01:01:47,670 --> 01:01:44,799

that you have that you have developed

1795

01:01:49,670 --> 01:01:47,680

and promoted um has any degree of

1796

01:01:51,430 --> 01:01:49,680

credulity right now that there's a

1797

01:01:53,510 --> 01:01:51,440

hundred percent as you said there's 100

1798

01:01:55,589 --> 01:01:53,520

chance i'm closer to zero percent chance

1799

01:01:56,870 --> 01:01:55,599

of life in the universe again no one

1800

01:01:58,710 --> 01:01:56,880

would like to believe it more than me

1801  
01:02:00,390 --> 01:01:58,720  
especially intelligent aliens that could

1802  
01:02:02,390 --> 01:02:00,400  
teach us the laws of physics at the 25th

1803  
01:02:04,309 --> 01:02:02,400  
century right now so i can win that

1804  
01:02:06,950 --> 01:02:04,319  
nobel prize finally but but i want to

1805  
01:02:08,309 --> 01:02:06,960  
know lee i'm with

1806  
01:02:09,750 --> 01:02:08,319  
let me unpack this let me qualify

1807  
01:02:12,950 --> 01:02:09,760  
because i think i mean we're violently

1808  
01:02:15,030 --> 01:02:12,960  
agreeing so um my intuition the way i

1809  
01:02:16,230 --> 01:02:15,040  
understand how chemistry works is i

1810  
01:02:17,990 --> 01:02:16,240  
think there's life everywhere i didn't

1811  
01:02:19,990 --> 01:02:18,000  
quite say a hundred percent brian is

1812  
01:02:21,670 --> 01:02:20,000  
kind of i have you on record saying a

1813  
01:02:23,190 --> 01:02:21,680

hundred percent i know that's fine it's

1814

01:02:24,549 --> 01:02:23,200

fine i'm happy to stand by i think it's

1815

01:02:26,309 --> 01:02:24,559

great it's like you're

1816

01:02:28,069 --> 01:02:26,319

you're really putting me there and you

1817

01:02:29,910 --> 01:02:28,079

know going me in the corner and just

1818

01:02:31,270 --> 01:02:29,920

throwing the punches and i would say

1819

01:02:34,870 --> 01:02:31,280

that um

1820

01:02:36,390 --> 01:02:34,880

it it is i i i i wouldn't say i'm biased

1821

01:02:38,150 --> 01:02:36,400

i'm optimistic

1822

01:02:39,510 --> 01:02:38,160

but if you were to say league how much

1823

01:02:42,390 --> 01:02:39,520

evidence do you have for life elsewhere

1824

01:02:43,990 --> 01:02:42,400

in the universe other nerf zero i have

1825

01:02:45,670 --> 01:02:44,000

zero evidence

1826

01:02:47,190 --> 01:02:45,680

but i would you know i could kind of say

1827

01:02:49,430 --> 01:02:47,200

it brian you know

1828

01:02:51,430 --> 01:02:49,440

hey brian let's let's set fire to

1829

01:02:53,750 --> 01:02:51,440

something right like i don't know some

1830

01:02:55,430 --> 01:02:53,760

carbon how much evidence do you have for

1831

01:02:57,190 --> 01:02:55,440

carbon being on fire in oxygen in the

1832

01:02:58,470 --> 01:02:57,200

universe you might

1833

01:03:01,349 --> 01:02:58,480

probably wouldn't

1834

01:03:03,030 --> 01:03:01,359

knows what happens on earth and knows

1835

01:03:04,230 --> 01:03:03,040

how simple it is and and you could

1836

01:03:05,829 --> 01:03:04,240

probably go yeah i could probably

1837

01:03:06,950 --> 01:03:05,839

imagine some carbon being on fire

1838

01:03:08,710 --> 01:03:06,960

somewhere

1839

01:03:10,630 --> 01:03:08,720

kelvin used to think the sun was powered

1840

01:03:12,630 --> 01:03:10,640

with coal right but when he did the math

1841

01:03:14,630 --> 01:03:12,640

he just worked out and have an energy so

1842

01:03:16,870 --> 01:03:14,640

totally i have no evidence there's life

1843

01:03:18,390 --> 01:03:16,880

elsewhere in the universe zero there's

1844

01:03:20,150 --> 01:03:18,400

some hints there might have been life on

1845

01:03:22,069 --> 01:03:20,160

mars there's some hints that there might

1846

01:03:23,829 --> 01:03:22,079

be some interesting stuff on venus we're

1847

01:03:25,910 --> 01:03:23,839

excited about going to europa and

1848

01:03:28,630 --> 01:03:25,920

enceladus right so i had just to be

1849

01:03:30,789 --> 01:03:28,640

clear for everyone listening zero i have

1850

01:03:33,910 --> 01:03:30,799

zero evidence does that mean that i'm

1851  
01:03:36,950 --> 01:03:33,920  
somehow life religious no no no no what

1852  
01:03:38,230 --> 01:03:36,960  
i'm saying is chemistry is so easy

1853  
01:03:40,870 --> 01:03:38,240  
so quick

1854  
01:03:42,950 --> 01:03:40,880  
and we there are so many missing gaps

1855  
01:03:45,190 --> 01:03:42,960  
what is the likelihood here is the

1856  
01:03:47,349 --> 01:03:45,200  
likelihood that life is just vanishing

1857  
01:03:50,710 --> 01:03:47,359  
at hard or is it that we don't actually

1858  
01:03:52,710 --> 01:03:50,720  
know what how how we store information

1859  
01:03:55,270 --> 01:03:52,720  
in chemical systems when an evolution

1860  
01:03:56,549 --> 01:03:55,280  
works because i i do agree

1861  
01:03:57,829 --> 01:03:56,559  
that um

1862  
01:03:59,589 --> 01:03:57,839  
there's probably life in the universe

1863  
01:04:02,230 --> 01:03:59,599

because life is we're using life is a

1864

01:04:05,270 --> 01:04:02,240

very i'm using life as a very broad

1865

01:04:07,670 --> 01:04:05,280

casual term for the following and i'm

1866

01:04:09,270 --> 01:04:07,680

saying that when there is selection

1867

01:04:11,430 --> 01:04:09,280

there will eventually be some kind of

1868

01:04:14,230 --> 01:04:11,440

evolution and that

1869

01:04:16,630 --> 01:04:14,240

will normally get give rise at some

1870

01:04:18,309 --> 01:04:16,640

point in time to a luca and that luca

1871

01:04:20,309 --> 01:04:18,319

will go on and brian is absolutely right

1872

01:04:21,990 --> 01:04:20,319

there's lots of fragile links in there

1873

01:04:23,829 --> 01:04:22,000

and we just don't know the point about

1874

01:04:25,990 --> 01:04:23,839

the drake equation however is this the

1875

01:04:27,910 --> 01:04:26,000

drake equation is not a law it's not

1876

01:04:30,069 --> 01:04:27,920

really a equation it's a kind of made-up

1877

01:04:31,670 --> 01:04:30,079

thing

1878

01:04:33,349 --> 01:04:31,680

but i do think that brian and i should

1879

01:04:36,309 --> 01:04:33,359

sit down say okay

1880

01:04:39,349 --> 01:04:36,319

how many stars how many planets

1881

01:04:42,230 --> 01:04:39,359

what fraction of the planets are even

1882

01:04:44,069 --> 01:04:42,240

you know my motto here is let's allow

1883

01:04:47,109 --> 01:04:44,079

any planet where bonds are allowed

1884

01:04:48,950 --> 01:04:47,119

covalent bonds because covalent bonds

1885

01:04:50,950 --> 01:04:48,960

that let's just let's allow life on or

1886

01:04:52,390 --> 01:04:50,960

let's allow all those to be lifeline so

1887

01:04:55,190 --> 01:04:52,400

then you know i say where there's bond

1888

01:04:57,190 --> 01:04:55,200

there's hope so that's important because

1889

01:04:58,789 --> 01:04:57,200

as kurt always points out you know you

1890

01:05:00,470 --> 01:04:58,799

want to have these no-go theorems right

1891

01:05:01,589 --> 01:05:00,480

cur this is something that's a fixture

1892

01:05:03,750 --> 01:05:01,599

on your channel you've been paying

1893

01:05:05,670 --> 01:05:03,760

attention brian yeah and i'm stipulating

1894

01:05:08,390 --> 01:05:05,680

to you lee i'm willing to change my mind

1895

01:05:09,750 --> 01:05:08,400

that there is no no-go theorem um you

1896

01:05:11,430 --> 01:05:09,760

know so in other words the probability

1897

01:05:13,190 --> 01:05:11,440

is greater than zero and i should never

1898

01:05:15,270 --> 01:05:13,200

say zero and i didn't say zero i said i

1899

01:05:17,430 --> 01:05:15,280

think it's closer to zero but uh but i

1900

01:05:19,670 --> 01:05:17,440

agree with you bonds the proclivity of

1901

01:05:21,990 --> 01:05:19,680

bonds and the vicinity of carbon to make

1902

01:05:23,430 --> 01:05:22,000

bonds and so forth um i i would say

1903

01:05:24,870 --> 01:05:23,440

there's lots of evidence of chemical

1904

01:05:27,270 --> 01:05:24,880

reaction i mean we have examples of

1905

01:05:28,870 --> 01:05:27,280

amino acids at high redshift you know

1906

01:05:30,150 --> 01:05:28,880

that we can detect uh and quasar

1907

01:05:32,150 --> 01:05:30,160

absorption features and we know

1908

01:05:34,470 --> 01:05:32,160

chemistry takes place in in distant

1909

01:05:36,470 --> 01:05:34,480

objects but but you know this main point

1910

01:05:38,950 --> 01:05:36,480

is well taken yeah and as i and i

1911

01:05:40,390 --> 01:05:38,960

continue to push back and say you know

1912

01:05:43,270 --> 01:05:40,400

i mean

1913

01:05:45,510 --> 01:05:43,280

my my my conviction is my out of my kind

1914

01:05:47,750 --> 01:05:45,520

of my humbleness really because

1915

01:05:49,750 --> 01:05:47,760

the earth isn't that special it's a rock

1916

01:05:51,990 --> 01:05:49,760

the solar system we've got some carbon

1917

01:05:53,670 --> 01:05:52,000

we've got some oxygen yeah people say oh

1918

01:05:55,750 --> 01:05:53,680

it's lucky that we had to clean up the

1919

01:05:57,670 --> 01:05:55,760

jupiter could clean up everything for us

1920

01:05:59,349 --> 01:05:57,680

and all this ah i don't know we don't

1921

01:06:01,190 --> 01:05:59,359

know what time life emerged on earth in

1922

01:06:03,430 --> 01:06:01,200

100 million years it might be lucky for

1923

01:06:05,750 --> 01:06:03,440

us that we have intelligent life and i'm

1924

01:06:07,910 --> 01:06:05,760

very happy to say it to you know i say

1925

01:06:10,069 --> 01:06:07,920

to ufo believers all the time

1926

01:06:12,309 --> 01:06:10,079

the chances that an intelligent life

1927

01:06:14,390 --> 01:06:12,319

form has sent ufo to earth is like i

1928

01:06:16,309 --> 01:06:14,400

mean it's not zero but there are other

1929

01:06:18,309 --> 01:06:16,319

explanations right i mean there's other

1930

01:06:19,910 --> 01:06:18,319

things we can do i mean i know eric

1931

01:06:22,309 --> 01:06:19,920

weinstein at the moment has gone a bit

1932

01:06:24,630 --> 01:06:22,319

kind of ufo you know let's think about

1933

01:06:26,950 --> 01:06:24,640

it but i think he's doing it for not not

1934

01:06:29,430 --> 01:06:26,960

to be disrupt well to be disruptive not

1935

01:06:31,029 --> 01:06:29,440

disingenuous and to get people to take

1936

01:06:34,069 --> 01:06:31,039

people's temperature but coming back to

1937

01:06:35,829 --> 01:06:34,079

this i would say i have seen no no-go

1938

01:06:37,430 --> 01:06:35,839

theorems for for know why life should

1939

01:06:38,789 --> 01:06:37,440

exist elsewhere and given them an

1940

01:06:40,470 --> 01:06:38,799

internal optimist will say well look

1941

01:06:43,270 --> 01:06:40,480

there should be it should be everywhere

1942

01:06:45,670 --> 01:06:43,280

but what i'm super excited about is i

1943

01:06:48,870 --> 01:06:45,680

have a i'm willing to make a wager brian

1944

01:06:50,710 --> 01:06:48,880

is still young i'm even younger um not

1945

01:06:52,549 --> 01:06:50,720

that much but uh

1946

01:06:55,109 --> 01:06:52,559

but in the next decade or two we'll get

1947

01:06:57,510 --> 01:06:55,119

a go to enceladus in europa

1948

01:07:00,069 --> 01:06:57,520

and and titan and i'm willing to bet

1949

01:07:01,750 --> 01:07:00,079

that if there if we do find any evidence

1950

01:07:04,150 --> 01:07:01,760

of life on these

1951

01:07:05,430 --> 01:07:04,160

um objects they will be totally

1952

01:07:06,710 --> 01:07:05,440

different to life on earth because

1953

01:07:09,190 --> 01:07:06,720

they've had a completely different

1954

01:07:11,430 --> 01:07:09,200

history there is no relationship whereas

1955

01:07:13,670 --> 01:07:11,440

we might find life on mars if we haven't

1956

01:07:15,589 --> 01:07:13,680

put life on mars by mistake we might

1957

01:07:17,109 --> 01:07:15,599

find evidence of primitive life on mars

1958

01:07:18,630 --> 01:07:17,119

like going to earth and seeded earth

1959

01:07:20,230 --> 01:07:18,640

right yeah i i agree with that i mean

1960

01:07:22,069 --> 01:07:20,240

but that pushes things back that's just

1961

01:07:23,910 --> 01:07:22,079

changing the day but let me yeah yeah

1962

01:07:25,670 --> 01:07:23,920

exactly i mean life on earth and life on

1963

01:07:27,430 --> 01:07:25,680

mars luckily to be coupled that's not

1964

01:07:29,589 --> 01:07:27,440

that's nothing if we go to mars and we

1965

01:07:31,589 --> 01:07:29,599

find earth like life

1966

01:07:33,510 --> 01:07:31,599

i'll be happy for a day

1967

01:07:34,630 --> 01:07:33,520

and i'll watch the nobel prizes be given

1968

01:07:36,710 --> 01:07:34,640

but i'm like that hasn't told me

1969

01:07:38,710 --> 01:07:36,720

anything new as a scientist i want to

1970

01:07:41,190 --> 01:07:38,720

discover something new if i went to

1971

01:07:44,150 --> 01:07:41,200

enceladus i found life form based on

1972

01:07:45,990 --> 01:07:44,160

something that isn't rna

1973

01:07:48,069 --> 01:07:46,000

that would be it for me that would just

1974

01:07:50,309 --> 01:07:48,079

be like the most amazing event in the

1975

01:07:52,470 --> 01:07:50,319

universe why well if i could find

1976

01:07:55,109 --> 01:07:52,480

different life enceladus i could start

1977

01:07:57,109 --> 01:07:55,119

to frame the likelihood of alien life in

1978

01:07:59,670 --> 01:07:57,119

our local group okay

1979

01:08:01,190 --> 01:07:59,680

um i could think about how we could look

1980

01:08:03,510 --> 01:08:01,200

at making new technologies based on

1981

01:08:05,430 --> 01:08:03,520

living systems on earth and really even

1982

01:08:07,510 --> 01:08:05,440

more important in fact i almost have the

1983

01:08:10,710 --> 01:08:07,520

same passion that brian has for

1984

01:08:12,870 --> 01:08:10,720

understand the origin of universe um for

1985

01:08:14,630 --> 01:08:12,880

this is that if we can make life on

1986

01:08:16,709 --> 01:08:14,640

earth and understand the origin of life

1987

01:08:18,390 --> 01:08:16,719

we might be able to start to accept that

1988

01:08:19,829 --> 01:08:18,400

life on earth that we have right now in

1989

01:08:22,229 --> 01:08:19,839

our ecosystem

1990

01:08:24,550 --> 01:08:22,239

is very precious and

1991

01:08:25,749 --> 01:08:24,560

is a thing and we need to think about

1992

01:08:26,709 --> 01:08:25,759

framing

1993

01:08:31,910 --> 01:08:26,719

this

1994

01:08:33,829 --> 01:08:31,920

you know jewel that we need to keep to

1995

01:08:35,910 --> 01:08:33,839

be as persistent for as long as possible

1996

01:08:38,390 --> 01:08:35,920

and to create maximum flourishing for

1997

01:08:40,550 --> 01:08:38,400

our little moral kind of

1998

01:08:42,709 --> 01:08:40,560

work part in the universe so i think

1999

01:08:44,550 --> 01:08:42,719

almost way if you know there are two

2000

01:08:46,149 --> 01:08:44,560

films i watched i know i'm talking a lot

2001

01:08:48,149 --> 01:08:46,159

but there's two films that came out the

2002

01:08:49,990 --> 01:08:48,159

same year one called ad astra which was

2003

01:08:51,669 --> 01:08:50,000

the most depressing the brian keating

2004

01:08:53,349 --> 01:08:51,679

movie you know

2005

01:08:54,309 --> 01:08:53,359

you're just as good looking as brad pitt

2006

01:08:58,229 --> 01:08:54,319

you know

2007

01:09:01,110 --> 01:08:58,239

another film called cosmos which was a

2008

01:09:02,309 --> 01:09:01,120

low-budget uk movie which i like and you

2009

01:09:03,749 --> 01:09:02,319

should watch them because one basically

2010

01:09:06,309 --> 01:09:03,759

they're both about shall we find life

2011

01:09:07,669 --> 01:09:06,319

and one finds life very optimistic comes

2012

01:09:09,829 --> 01:09:07,679

to earth and says we're here and the

2013

01:09:12,149 --> 01:09:09,839

other one is like miserable there's no

2014

01:09:14,070 --> 01:09:12,159

life anywhere and for me

2015

01:09:15,829 --> 01:09:14,080

i think the difference between us is i'm

2016

01:09:18,390 --> 01:09:15,839

an optimist because i understand my

2017

01:09:19,990 --> 01:09:18,400

chemistry and i'm a chemist you're an

2018

01:09:21,749 --> 01:09:20,000

optimist in your field you understand

2019

01:09:23,189 --> 01:09:21,759

that and i'm trying to i'm trying to

2020

01:09:24,550 --> 01:09:23,199

borrow a bit of your

2021

01:09:25,829 --> 01:09:24,560

intuition and i'm trying to lend you a

2022

01:09:27,110 --> 01:09:25,839

bit of mind and see if we can change

2023

01:09:29,269 --> 01:09:27,120

each other's mind from that point of

2024

01:09:32,149 --> 01:09:29,279

view but you're absolutely right

2025

01:09:34,149 --> 01:09:32,159

i have no evidence but i have no reason

2026

01:09:36,470 --> 01:09:34,159

why it can't happen there is nothing

2027

01:09:38,390 --> 01:09:36,480

magic about life on earth

2028

01:09:40,390 --> 01:09:38,400

yeah well i wonder if we could have a

2029

01:09:41,910 --> 01:09:40,400

no-go theorem if you uh if you would

2030

01:09:44,309 --> 01:09:41,920

agree and then you know perhaps that

2031

01:09:47,349 --> 01:09:44,319

would make our our generous host

2032

01:09:48,870 --> 01:09:47,359

generous good looking and uh and uh just

2033

01:09:50,950 --> 01:09:48,880

with a delightful aroma although i've

2034

01:09:52,149 --> 01:09:50,960

never met him in person kurt's one of my

2035

01:09:53,990 --> 01:09:52,159

best friends that i've never met in

2036

01:09:56,950 --> 01:09:54,000

person i hope to rectify that in the

2037

01:09:58,709 --> 01:09:56,960

very near future you too lee um but you

2038

01:10:01,669 --> 01:09:58,719

you brought up eric you brought up and

2039

01:10:04,550 --> 01:10:01,679

so i find that there is sort of a uh a

2040

01:10:06,630 --> 01:10:04,560

wish fulfillment aspect in in in many of

2041

01:10:09,910 --> 01:10:06,640

these things including in this huge and

2042

01:10:12,149 --> 01:10:09,920

deservedly so excitement over jwst i

2043

01:10:14,630 --> 01:10:12,159

mean i basically heard people portraying

2044

01:10:16,470 --> 01:10:14,640

one of the science cases for jwst

2045

01:10:18,870 --> 01:10:16,480

tantamount to well we're going to see

2046

01:10:20,390 --> 01:10:18,880

like cities on exoplanet you know like

2047

01:10:22,550 --> 01:10:20,400

no you're not you're going to see like

2048

01:10:25,350 --> 01:10:22,560

spectral lines and and often eric has

2049

01:10:26,950 --> 01:10:25,360

talked about data and collecting data um

2050

01:10:28,950 --> 01:10:26,960

and and it's our data the hubble space

2051

01:10:31,510 --> 01:10:28,960

telescope is our day like

2052

01:10:33,030 --> 01:10:31,520

well it's data but like take the hubble

2053

01:10:35,430 --> 01:10:33,040

deep field i love mentioning this topic

2054

01:10:37,350 --> 01:10:35,440

so the hubble deep field is data but

2055

01:10:39,990 --> 01:10:37,360

actually we don't use it uh the data the

2056

01:10:41,910 --> 01:10:40,000

image for anything it's a screen saver i

2057

01:10:43,830 --> 01:10:41,920

call it the cosmic screen saver cosmic

2058

01:10:45,910 --> 01:10:43,840

wallpaper and that's all the image

2059

01:10:47,510 --> 01:10:45,920

itself is the data is within it so if

2060

01:10:49,830 --> 01:10:47,520

there's a ufo floating around in there

2061

01:10:51,830 --> 01:10:49,840

that is not the same as what astronomers

2062

01:10:54,070 --> 01:10:51,840

call the type of evidence that we

2063

01:10:56,390 --> 01:10:54,080

associate with data stuff that we can be

2064

01:10:59,430 --> 01:10:56,400

quantitative and analyze spectral time

2065

01:11:00,790 --> 01:10:59,440

domain uh multi-waterfall display you

2066

01:11:02,870 --> 01:11:00,800

know we can do a ton of stuff with

2067

01:11:04,550 --> 01:11:02,880

actual with the photon information not

2068

01:11:05,990 --> 01:11:04,560

just the image information the picture

2069

01:11:08,550 --> 01:11:06,000

information

2070

01:11:10,630 --> 01:11:08,560

now mentioning this there

2071

01:11:12,709 --> 01:11:10,640

there are you know concerns about what

2072

01:11:15,110 --> 01:11:12,719

the implication would be and so i'm

2073

01:11:17,590 --> 01:11:15,120

curious to to know why if life is so

2074

01:11:20,149 --> 01:11:17,600

abundant and then you sprinkle in some

2075

01:11:22,070 --> 01:11:20,159

darwinian evolution why isn't you know a

2076

01:11:24,310 --> 01:11:22,080

technological life abundant and why

2077

01:11:25,669 --> 01:11:24,320

isn't it more plausible than not it

2078

01:11:29,350 --> 01:11:25,679

seems like you're saying you're you're

2079

01:11:31,669 --> 01:11:29,360

kind of a a a life maximalist but a ufo

2080

01:11:33,189 --> 01:11:31,679

minimalist so so tell me what how can

2081

01:11:35,110 --> 01:11:33,199

you rectify those two things because it

2082

01:11:37,110 --> 01:11:35,120

would seem to me unless there's a no-go

2083

01:11:38,870 --> 01:11:37,120

theorem against it that maybe there is

2084

01:11:40,630 --> 01:11:38,880

more hope i get around that by saying i

2085

01:11:42,229 --> 01:11:40,640

don't think life exists elsewhere

2086

01:11:44,229 --> 01:11:42,239

besides the earth and if it does it's

2087

01:11:46,149 --> 01:11:44,239

from the earth via panspermic processes

2088

01:11:49,270 --> 01:11:46,159

but but tell me what what could

2089

01:11:50,790 --> 01:11:49,280

potentially uh forbid life from evolving

2090

01:11:52,470 --> 01:11:50,800

technologically

2091

01:11:53,910 --> 01:11:52,480

yeah yeah so i'm gonna say a couple of

2092

01:11:55,110 --> 01:11:53,920

things so i think kurt if you want to go

2093

01:11:56,310 --> 01:11:55,120

to assembly through we'll do that in a

2094

01:11:58,470 --> 01:11:56,320

minute i think it's quite important the

2095

01:12:00,390 --> 01:11:58,480

story but let me answer brian's question

2096

01:12:02,070 --> 01:12:00,400

i asked so i think you know there's a

2097

01:12:04,470 --> 01:12:02,080

scooby-doo you know the ways the the

2098

01:12:06,149 --> 01:12:04,480

villain says you pissed pesky kids i'm

2099

01:12:07,750 --> 01:12:06,159

gonna say the reason why we can't see

2100

01:12:09,990 --> 01:12:07,760

technological life as you pesky

2101

01:12:12,149 --> 01:12:10,000

physicists because the universe is

2102

01:12:15,510 --> 01:12:12,159

really big and things are accelerating

2103

01:12:17,910 --> 01:12:15,520

away and it's you know and sadly

2104

01:12:20,149 --> 01:12:17,920

um you know i'd love to break the i'd

2105

01:12:21,990 --> 01:12:20,159

love to understand more about the the

2106

01:12:24,390 --> 01:12:22,000

way the universe is and the speed of

2107

01:12:25,830 --> 01:12:24,400

light and get around but the fact is

2108

01:12:27,750 --> 01:12:25,840

there seems to be little indication that

2109

01:12:29,189 --> 01:12:27,760

we can have wormholes and and break the

2110

01:12:30,790 --> 01:12:29,199

speed of light and

2111

01:12:32,470 --> 01:12:30,800

you know designing

2112

01:12:34,229 --> 01:12:32,480

as a quick clarification i'm sorry to

2113

01:12:36,070 --> 01:12:34,239

interject lee then when you say that

2114

01:12:38,950 --> 01:12:36,080

life is abundant in the universe are you

2115

01:12:40,630 --> 01:12:38,960

not referring to the observable universe

2116

01:12:42,070 --> 01:12:40,640

sure i think it's abundant in the

2117

01:12:43,669 --> 01:12:42,080

observable universe and we'll learn how

2118

01:12:45,669 --> 01:12:43,679

to find it and i think actually

2119

01:12:48,070 --> 01:12:45,679

frustratingly we probably will find

2120

01:12:50,229 --> 01:12:48,080

techno signatures uh

2121

01:12:51,910 --> 01:12:50,239

you know hints of them and not just

2122

01:12:53,430 --> 01:12:51,920

hints hints that brian and i will look

2123

01:12:56,229 --> 01:12:53,440

at the data we'll look at the

2124

01:12:57,750 --> 01:12:56,239

uncertainty the error bars your point is

2125

01:12:59,750 --> 01:12:57,760

taken i haven't forgotten it's a very

2126

01:13:02,470 --> 01:12:59,760

good point brian and we will then go

2127

01:13:05,030 --> 01:13:02,480

well the balance is fact here is like we

2128

01:13:06,390 --> 01:13:05,040

will be it is possible remotely to get

2129

01:13:08,310 --> 01:13:06,400

data

2130

01:13:10,390 --> 01:13:08,320

uh um squeeze down those areas and know

2131

01:13:12,070 --> 01:13:10,400

for sure there's alien technological

2132

01:13:14,709 --> 01:13:12,080

life elsewhere in the universe we could

2133

01:13:16,470 --> 01:13:14,719

do it okay and don't let nasa and other

2134

01:13:18,709 --> 01:13:16,480

people say it's not we can do it we can

2135

01:13:20,709 --> 01:13:18,719

detect the higgs boson if we can look at

2136

01:13:23,590 --> 01:13:20,719

the cosmic microwave background we will

2137

01:13:25,990 --> 01:13:23,600

be our fine technological um signatures

2138

01:13:27,590 --> 01:13:26,000

but we but we need a better theory which

2139

01:13:29,590 --> 01:13:27,600

i'm trying to introduce it might not be

2140

01:13:31,590 --> 01:13:29,600

the right one but i've got a feeling

2141

01:13:33,669 --> 01:13:31,600

it's going that direction but to answer

2142

01:13:35,510 --> 01:13:33,679

the question where all the technology is

2143

01:13:37,750 --> 01:13:35,520

there's a number of answers to that but

2144

01:13:39,750 --> 01:13:37,760

i want to say something quite profound

2145

01:13:41,510 --> 01:13:39,760

if time really is a thing and let's say

2146

01:13:43,750 --> 01:13:41,520

time is a commodity

2147

01:13:45,510 --> 01:13:43,760

and at the beginning of our local

2148

01:13:47,430 --> 01:13:45,520

universe where the laws are now i'm

2149

01:13:48,870 --> 01:13:47,440

going to define time and this is going

2150

01:13:50,550 --> 01:13:48,880

to be like

2151  
01:13:52,390 --> 01:13:50,560  
i mean i'm not a very good singer but

2152  
01:13:53,990 --> 01:13:52,400  
this is going to be like brian hearing a

2153  
01:13:56,470 --> 01:13:54,000  
really bad singer

2154  
01:13:57,750 --> 01:13:56,480  
and he's like breaking physics but here

2155  
01:13:59,110 --> 01:13:57,760  
i'll try

2156  
01:14:01,270 --> 01:13:59,120  
at the origin of the universe it was

2157  
01:14:03,669 --> 01:14:01,280  
some kind of singularity which basically

2158  
01:14:06,149 --> 01:14:03,679  
we seem to be we were kind of one

2159  
01:14:08,390 --> 01:14:06,159  
quantumly connected one particle let's

2160  
01:14:09,669 --> 01:14:08,400  
say and through that causal

2161  
01:14:10,550 --> 01:14:09,679  
aperture

2162  
01:14:28,790 --> 01:14:10,560  
the

2163  
01:14:29,830 --> 01:14:28,800

just contingencies right and so so we

2164

01:14:32,070 --> 01:14:29,840

have that

2165

01:14:34,229 --> 01:14:32,080

and then from that that process that

2166

01:14:35,430 --> 01:14:34,239

point in time where the universe

2167

01:14:36,550 --> 01:14:35,440

expanded

2168

01:14:38,149 --> 01:14:36,560

and i think

2169

01:14:40,709 --> 01:14:38,159

again brian has the history of the

2170

01:14:42,550 --> 01:14:40,719

universe down like i think if i remember

2171

01:14:44,310 --> 01:14:42,560

i'm studying you that all the hydrogen

2172

01:14:46,310 --> 01:14:44,320

in the universe was made in the first 20

2173

01:14:48,950 --> 01:14:46,320

minutes or something which is just a

2174

01:14:52,070 --> 01:14:48,960

mind-blowing uh uh kind of fact and it's

2175

01:14:54,550 --> 01:14:52,080

true than the big bang theory tv show

2176  
01:14:56,550 --> 01:14:54,560  
exactly that's a great so now you've got

2177  
01:14:58,149 --> 01:14:56,560  
this stuff right

2178  
01:14:59,750 --> 01:14:58,159  
in time

2179  
01:15:01,510 --> 01:14:59,760  
now the reason is the clock is ticking

2180  
01:15:03,430 --> 01:15:01,520  
now at that time you don't have enough

2181  
01:15:06,229 --> 01:15:03,440  
states in the universe

2182  
01:15:07,430 --> 01:15:06,239  
to actually produce life it's kind of

2183  
01:15:09,750 --> 01:15:07,440  
cool

2184  
01:15:11,750 --> 01:15:09,760  
basically you actually they're the fermi

2185  
01:15:13,350 --> 01:15:11,760  
paradox and i'm saying i have to qualify

2186  
01:15:15,669 --> 01:15:13,360  
this because i'm stealing this idea i

2187  
01:15:17,110 --> 01:15:15,679  
agree with it from sarah walker so i you

2188  
01:15:18,950 --> 01:15:17,120

know i'm not very good well i should be

2189

01:15:21,110 --> 01:15:18,960

clear i should steal more ideas but but

2190

01:15:22,070 --> 01:15:21,120

she's convinced me and i and i also

2191

01:15:24,550 --> 01:15:22,080

think it's true it's a natural

2192

01:15:27,270 --> 01:15:24,560

consequence of assembly theory the fermi

2193

01:15:29,350 --> 01:15:27,280

paradox is not about the fact that we

2194

01:15:31,830 --> 01:15:29,360

that we don't see the aliens just

2195

01:15:33,189 --> 01:15:31,840

the we're looking back in time and at

2196

01:15:35,350 --> 01:15:33,199

that time the universe didn't have the

2197

01:15:37,270 --> 01:15:35,360

ability to produce technology so it's

2198

01:15:39,510 --> 01:15:37,280

like a fermi filter now think for a

2199

01:15:41,270 --> 01:15:39,520

second it's like oh

2200

01:15:42,709 --> 01:15:41,280

we looking back in time the universe

2201

01:15:45,189 --> 01:15:42,719

didn't have the ability to produce

2202

01:15:46,709 --> 01:15:45,199

technology at that time

2203

01:15:49,030 --> 01:15:46,719

we have to look in a different way

2204

01:15:50,550 --> 01:15:49,040

actually i'll push back again uh just

2205

01:15:52,470 --> 01:15:50,560

to say that there was an epoch in the

2206

01:15:55,030 --> 01:15:52,480

universe where you didn't need a hard

2207

01:15:57,110 --> 01:15:55,040

rocky planet to sustain uh room

2208

01:15:59,030 --> 01:15:57,120

temperature liquid water and that was a

2209

01:16:01,110 --> 01:15:59,040

time about you know eight billion years

2210

01:16:03,510 --> 01:16:01,120

ago when the universe was at the

2211

01:16:05,990 --> 01:16:03,520

temperature above zero degrees celsius

2212

01:16:08,229 --> 01:16:06,000

which is uh you know about 50 degrees

2213

01:16:09,590 --> 01:16:08,239

warmer than it is in toronto or glasgow

2214

01:16:10,950 --> 01:16:09,600

i'm just trying to make you guys jealous

2215

01:16:13,270 --> 01:16:10,960

you'll visit me here in san diego in

2216

01:16:15,669 --> 01:16:13,280

january sometime um so the universe

2217

01:16:17,350 --> 01:16:15,679

could have liquid water for millions

2218

01:16:19,270 --> 01:16:17,360

billions of years until it become frozen

2219

01:16:20,950 --> 01:16:19,280

water um and so actually no there

2220

01:16:23,350 --> 01:16:20,960

there's a reverse filter there there's

2221

01:16:25,189 --> 01:16:23,360

sort of a system no no no no that's that

2222

01:16:26,470 --> 01:16:25,199

i have to push back that's quite nice

2223

01:16:28,070 --> 01:16:26,480

but i'm saying

2224

01:16:30,390 --> 01:16:28,080

something very

2225

01:16:32,149 --> 01:16:30,400

profound in terms of the the number of

2226

01:16:33,990 --> 01:16:32,159

states available i don't care how much

2227

01:16:35,590 --> 01:16:34,000

water's available who cares what i care

2228

01:16:37,110 --> 01:16:35,600

about is a combinatorial state space

2229

01:16:38,790 --> 01:16:37,120

remember i'm not a chemist here i'm a

2230

01:16:40,550 --> 01:16:38,800

mathematician within the states so

2231

01:16:41,830 --> 01:16:40,560

you're right with kurt but kurt the

2232

01:16:43,590 --> 01:16:41,840

amount i'm going to have sarah on my

2233

01:16:45,669 --> 01:16:43,600

show next week but but uh and i'll ask

2234

01:16:48,149 --> 01:16:45,679

her about this but the the i mean is it

2235

01:16:50,149 --> 01:16:48,159

galaxy is one galaxy sufficient uh space

2236

01:16:51,750 --> 01:16:50,159

state space to create technological life

2237

01:16:53,669 --> 01:16:51,760

obviously this is what we're this is

2238

01:16:56,070 --> 01:16:53,679

what i think i think the answer is no

2239

01:16:57,669 --> 01:16:56,080

right and i what we just let's just keep

2240

01:17:00,310 --> 01:16:57,679

going with this argument there's let's

2241

01:17:01,910 --> 01:17:00,320

just make a conjecture i don't know

2242

01:17:03,350 --> 01:17:01,920

right but isn't it interesting you've

2243

01:17:04,709 --> 01:17:03,360

got a smaller volume in the universe

2244

01:17:07,270 --> 01:17:04,719

time is a thing so you're not going back

2245

01:17:09,510 --> 01:17:07,280

and forth so you have to

2246

01:17:12,149 --> 01:17:09,520

um there's this causal chain of events i

2247

01:17:14,310 --> 01:17:12,159

don't know how delicate it plays into

2248

01:17:16,630 --> 01:17:14,320

your argument really nicely what

2249

01:17:19,270 --> 01:17:16,640

sequence of events have to happen in the

2250

01:17:21,350 --> 01:17:19,280

first 20 minutes the next 200 million

2251

01:17:23,750 --> 01:17:21,360

years the next two billion years to

2252

01:17:27,189 --> 01:17:23,760

prepare the universe to be able to

2253

01:17:29,189 --> 01:17:27,199

metabolize elements fusion right

2254

01:17:31,830 --> 01:17:29,199

produce objects that can then have

2255

01:17:33,669 --> 01:17:31,840

enough structure enough surface area for

2256

01:17:35,590 --> 01:17:33,679

selection to occur

2257

01:17:37,030 --> 01:17:35,600

over a period of time so you might not

2258

01:17:38,950 --> 01:17:37,040

you might need stability of a few

2259

01:17:40,390 --> 01:17:38,960

hundred million years with a certain

2260

01:17:42,310 --> 01:17:40,400

gravitational force but let's not add

2261

01:17:44,950 --> 01:17:42,320

that on i'm just saying hey wouldn't it

2262

01:17:47,750 --> 01:17:44,960

be cool if the fermi paradox is actually

2263

01:17:50,630 --> 01:17:47,760

just evidence the universe had not yet

2264

01:17:51,669 --> 01:17:50,640

had enough causal history to produce

2265

01:17:54,070 --> 01:17:51,679

life

2266

01:17:56,790 --> 01:17:54,080

we popped up as soon as it could so we

2267

01:17:58,950 --> 01:17:56,800

should go ah okay let's now i'll say

2268

01:18:01,750 --> 01:17:58,960

let's just make this very simple for

2269

01:18:03,990 --> 01:18:01,760

ourselves and say life in the universe

2270

01:18:05,669 --> 01:18:04,000

kind of started to emerge when life

2271

01:18:06,550 --> 01:18:05,679

let's say there's nothing special about

2272

01:18:07,910 --> 01:18:06,560

earth

2273

01:18:09,510 --> 01:18:07,920

happened quickly

2274

01:18:11,590 --> 01:18:09,520

so life was possible in the universe

2275

01:18:13,590 --> 01:18:11,600

about 4 billion years ago and so what we

2276

01:18:14,870 --> 01:18:13,600

now do is we reframe our observations

2277

01:18:16,790 --> 01:18:14,880

and we look around i'm just making this

2278

01:18:18,470 --> 01:18:16,800

up so no idea i had today thanks to

2279

01:18:19,270 --> 01:18:18,480

sarah's idea and brian's question and

2280

01:18:20,709 --> 01:18:19,280

yours did you come up with the

2281

01:18:21,910 --> 01:18:20,719

metabolized elements because that's a

2282

01:18:23,030 --> 01:18:21,920

cool line i'm going to steal that yeah

2283

01:18:24,390 --> 01:18:23,040

yeah i just made it up i wouldn't steal

2284

01:18:26,070 --> 01:18:24,400

it from sarah i would steal it from you

2285

01:18:28,310 --> 01:18:26,080

no no no i you could steal that from me

2286

01:18:29,750 --> 01:18:28,320

i just made it up just now um and so

2287

01:18:30,870 --> 01:18:29,760

you've kind of got this idea that

2288

01:18:33,350 --> 01:18:30,880

basically

2289

01:18:34,870 --> 01:18:33,360

um you're creating this infrastructure

2290

01:18:37,510 --> 01:18:34,880

for causation

2291

01:18:39,669 --> 01:18:37,520

that that allows you to go a bit further

2292

01:18:42,630 --> 01:18:39,679

and and so what happens i don't know i

2293

01:18:44,950 --> 01:18:42,640

mean if only we had an astronomer who

2294

01:18:46,310 --> 01:18:44,960

understood how to look back here like if

2295

01:18:48,149 --> 01:18:46,320

you read through the lines right we're

2296

01:18:49,590 --> 01:18:48,159

going to now restrict ourselves looking

2297

01:18:52,070 --> 01:18:49,600

for a 4 billion

2298

01:18:53,750 --> 01:18:52,080

year old light cone and we look at the

2299

01:18:55,030 --> 01:18:53,760

exoplanets other objects how does that

2300

01:18:58,229 --> 01:18:55,040

reframe

2301

01:18:59,669 --> 01:18:58,239

the search for life or intelligence so i

2302

01:19:01,110 --> 01:18:59,679

mean there's lots of ideas there so the

2303

01:19:02,950 --> 01:19:01,120

conjecture is

2304

01:19:04,709 --> 01:19:02,960

there is a filter that is just the

2305

01:19:07,350 --> 01:19:04,719

universe wasn't capable of producing

2306

01:19:08,950 --> 01:19:07,360

life until a particular time now it is

2307

01:19:10,870 --> 01:19:08,960

then technology and then how does that

2308

01:19:13,510 --> 01:19:10,880

go on and that plays into redoing our

2309

01:19:16,870 --> 01:19:13,520

error bars in the in the in the in the

2310

01:19:20,950 --> 01:19:16,880

fermi paradox and in the drake equation

2311

01:19:23,669 --> 01:19:20,960

and also i hide my only shield brian is

2312

01:19:25,830 --> 01:19:23,679

i don't see anything magic on earth

2313

01:19:27,669 --> 01:19:25,840

so it's probably possible elsewhere

2314

01:19:29,669 --> 01:19:27,679

because okay so that's a great point let

2315

01:19:31,189 --> 01:19:29,679

me interject because you're

2316

01:19:33,350 --> 01:19:31,199

it's difficult to interject without

2317

01:19:36,390 --> 01:19:33,360

interrupting i'm sorry lee no no it's

2318

01:19:39,270 --> 01:19:36,400

all good your podcast uh you you beat us

2319

01:19:41,030 --> 01:19:39,280

in come on yeah okay great you use many

2320

01:19:42,790 --> 01:19:41,040

ants and so i'm not sure if the sentence

2321

01:19:45,270 --> 01:19:42,800

is complete or if it's run on and i

2322

01:19:46,790 --> 01:19:45,280

don't want to seem rude okay so brian

2323

01:19:48,870 --> 01:19:46,800

you just made a great point what is an

2324

01:19:50,310 --> 01:19:48,880

example of some other phenomenon that

2325

01:19:52,310 --> 01:19:50,320

happens on earth that doesn't occur

2326  
01:19:53,990 --> 01:19:52,320  
elsewhere in the universe so water waves

2327  
01:19:57,510 --> 01:19:54,000  
may be one well there's maybe water

2328  
01:19:59,270 --> 01:19:57,520  
waves in mountains atmosphere okay so

2329  
01:20:01,350 --> 01:19:59,280  
given that it sounds like there's

2330  
01:20:03,750 --> 01:20:01,360  
nothing special about earth's life so

2331  
01:20:06,149 --> 01:20:03,760  
why are you isolating earth's life

2332  
01:20:07,990 --> 01:20:06,159  
as saying well that's unique

2333  
01:20:09,350 --> 01:20:08,000  
on example these if these plot you know

2334  
01:20:11,110 --> 01:20:09,360  
it's like they want to have their you

2335  
01:20:12,310 --> 01:20:11,120  
know primordial soup and eat it too you

2336  
01:20:15,350 --> 01:20:12,320  
know they want to say it's ubiquitous

2337  
01:20:16,790 --> 01:20:15,360  
these processes are generic uh and yet

2338  
01:20:18,470 --> 01:20:16,800

not seeing it you know it's more than

2339

01:20:20,709 --> 01:20:18,480

just a fermi paradox and i will push

2340

01:20:23,030 --> 01:20:20,719

back on sarah gently with respect uh

2341

01:20:25,189 --> 01:20:23,040

because i love her work uh uh but but

2342

01:20:27,590 --> 01:20:25,199

the fact is you know though those are

2343

01:20:29,030 --> 01:20:27,600

almost borderline you know kind of ideas

2344

01:20:30,790 --> 01:20:29,040

that i hear from intelligent designers

2345

01:20:32,630 --> 01:20:30,800

too you know which is that the laws of

2346

01:20:34,310 --> 01:20:32,640

physics the state space of the laws of

2347

01:20:36,709 --> 01:20:34,320

physics the constants of nature the mass

2348

01:20:38,149 --> 01:20:36,719

of the electron the uh fine structure

2349

01:20:41,510 --> 01:20:38,159

constant all the things you talked about

2350

01:20:43,830 --> 01:20:41,520

are implied um those you know are can be

2351

01:20:45,669 --> 01:20:43,840

con conflated with you know some kind of

2352

01:20:47,510 --> 01:20:45,679

low entropy state instantiated by a

2353

01:20:49,590 --> 01:20:47,520

designer i don't want to talk about that

2354

01:20:52,070 --> 01:20:49,600

except to say that i don't think that

2355

01:20:53,830 --> 01:20:52,080

that pushes the pro that filter is very

2356

01:20:56,229 --> 01:20:53,840

fine cor fine grain and i will talk to

2357

01:20:58,229 --> 01:20:56,239

her about it but i do want to say that

2358

01:21:00,870 --> 01:20:58,239

again generically speaking these

2359

01:21:02,630 --> 01:21:00,880

processes are ubiquitous so therefore

2360

01:21:04,470 --> 01:21:02,640

the non-observation like that should go

2361

01:21:06,070 --> 01:21:04,480

into the fermi paradox not that the

2362

01:21:08,790 --> 01:21:06,080

universe is large

2363

01:21:10,870 --> 01:21:08,800

uh that these processes are uh you know

2364

01:21:13,430 --> 01:21:10,880

we we just detected uh you know we've

2365

01:21:15,430 --> 01:21:13,440

detected uh helioseismological effects

2366

01:21:17,270 --> 01:21:15,440

on other stars we've detected uh the

2367

01:21:19,189 --> 01:21:17,280

existence of you know what we think are

2368

01:21:21,510 --> 01:21:19,199

continental you know patterns so

2369

01:21:23,669 --> 01:21:21,520

tectonic you know potential potentiality

2370

01:21:25,750 --> 01:21:23,679

for tectonic activity which we do

2371

01:21:27,750 --> 01:21:25,760

believe some believe are but all this

2372

01:21:29,750 --> 01:21:27,760

kind of pushes things back like one of

2373

01:21:31,590 --> 01:21:29,760

my big um gripes against the seti

2374

01:21:33,830 --> 01:21:31,600

institute which i know and love and i've

2375

01:21:36,390 --> 01:21:33,840

had jill tarter and seth sostak and i've

2376

01:21:38,709 --> 01:21:36,400

donated to them um and and i've spoken

2377

01:21:40,229 --> 01:21:38,719

there but you know i started to get a

2378

01:21:41,910 --> 01:21:40,239

little bit suspicious when a couple

2379

01:21:43,910 --> 01:21:41,920

years ago they started shifting away

2380

01:21:46,390 --> 01:21:43,920

from the existence of live techno

2381

01:21:48,470 --> 01:21:46,400

signatures to extremophiles here on

2382

01:21:50,070 --> 01:21:48,480

earth i don't think that necessarily

2383

01:21:51,189 --> 01:21:50,080

answers or gets to the heart of the

2384

01:21:53,110 --> 01:21:51,199

question certainly not of

2385

01:21:56,390 --> 01:21:53,120

extraterrestrial intelligence to know

2386

01:21:58,870 --> 01:21:56,400

some smokey uh deep smoker has uh you

2387

01:22:01,750 --> 01:21:58,880

know has bacteria or cyanogenic bacteria

2388

01:22:03,750 --> 01:22:01,760

or or prokaryotic type whatever that's

2389

01:22:07,189 --> 01:22:03,760

interesting but it's not aligned with

2390

01:22:08,709 --> 01:22:07,199

eti that's what i care about i mean

2391

01:22:10,790 --> 01:22:08,719

yeah let's cut the bs what we really

2392

01:22:12,950 --> 01:22:10,800

care about is making contact as eric

2393

01:22:15,590 --> 01:22:12,960

says you know if you could short circuit

2394

01:22:17,430 --> 01:22:15,600

and get to the laws of the 25th century

2395

01:22:19,510 --> 01:22:17,440

and get to the other side maybe we would

2396

01:22:21,750 --> 01:22:19,520

pass the great filter you know as it's

2397

01:22:23,590 --> 01:22:21,760

been called and protect ourselves and i

2398

01:22:24,550 --> 01:22:23,600

i happen to think that might be wishful

2399

01:22:26,229 --> 01:22:24,560

thinking

2400

01:22:28,310 --> 01:22:26,239

but i commend eric for working on y'all

2401

01:22:30,310 --> 01:22:28,320

theory to perhaps unlock some of these

2402

01:22:33,189 --> 01:22:30,320

uh some of these portals as he calls it

2403

01:22:35,110 --> 01:22:33,199

um but but nevertheless i i think again

2404

01:22:37,910 --> 01:22:35,120

is there you know is there a rubric that

2405

01:22:39,350 --> 01:22:37,920

you and i could agree on or disagree on

2406

01:22:40,229 --> 01:22:39,360

and i think the audience would like to

2407

01:22:42,950 --> 01:22:40,239

know

2408

01:22:44,790 --> 01:22:42,960

are there um in other words if you hear

2409

01:22:47,350 --> 01:22:44,800

you know there's been an a credible

2410

01:22:49,910 --> 01:22:47,360

account louis elizondo past guests on

2411

01:22:53,030 --> 01:22:49,920

kurt show um you know has claimed you

2412

01:22:54,709 --> 01:22:53,040

know really very very high credence

2413

01:22:56,709 --> 01:22:54,719

levels in the existence of

2414

01:22:58,470 --> 01:22:56,719

extraterrestrials capable of

2415

01:23:00,709 --> 01:22:58,480

technologically navigating across our

2416

01:23:02,550 --> 01:23:00,719

galaxy correct me if i'm misstating or

2417

01:23:05,590 --> 01:23:02,560

overstating the basic point as a

2418

01:23:07,590 --> 01:23:05,600

physicist cares about um and that is um

2419

01:23:09,350 --> 01:23:07,600

you know non god bless you lee non god

2420

01:23:11,270 --> 01:23:09,360

bless you or whatever

2421

01:23:13,750 --> 01:23:11,280

darwin bless you darwin bless you when

2422

01:23:16,070 --> 01:23:13,760

you sneeze i have to say that uh but but

2423

01:23:18,470 --> 01:23:16,080

he's making this so can we by laws of

2424

01:23:20,310 --> 01:23:18,480

chemistry physics assembly whatever can

2425

01:23:22,950 --> 01:23:20,320

we say no we actually shouldn't have the

2426

01:23:25,430 --> 01:23:22,960

cr you know credulity that lee that uh

2427

01:23:27,750 --> 01:23:25,440

that luis has uh and instead we should

2428

01:23:30,149 --> 01:23:27,760

he should update his priors based on

2429

01:23:31,990 --> 01:23:30,159

these following chemical physical

2430

01:23:33,910 --> 01:23:32,000

mathematical laws is there a way that we

2431

01:23:35,270 --> 01:23:33,920

can do that for them i think so i think

2432

01:23:36,229 --> 01:23:35,280

there's a way to do this let me just

2433

01:23:38,470 --> 01:23:36,239

answer a little bit and then i'll

2434

01:23:40,550 --> 01:23:38,480

explain assembly theory so yeah i think

2435

01:23:41,430 --> 01:23:40,560

what i think is likely to happen

2436

01:23:42,870 --> 01:23:41,440

if

2437

01:23:43,669 --> 01:23:42,880

i mean i don't know i mean like i have

2438

01:23:46,229 --> 01:23:43,679

no

2439

01:23:48,470 --> 01:23:46,239

i'm a curious i would i think it's

2440

01:23:49,830 --> 01:23:48,480

likely that we if life exists in the

2441

01:23:51,910 --> 01:23:49,840

solar system

2442

01:23:54,310 --> 01:23:51,920

some chemical lice life

2443

01:23:56,550 --> 01:23:54,320

um i'm i'm optimistic that we'll go and

2444

01:23:59,030 --> 01:23:56,560

find some evidence with some

2445

01:24:00,310 --> 01:23:59,040

you know sending dragonfly to titan the

2446

01:24:02,550 --> 01:24:00,320

mass spectrometer on it we're going to

2447

01:24:04,390 --> 01:24:02,560

hopefully go to europa and so on

2448

01:24:06,790 --> 01:24:04,400

we're going to hopefully do origin of

2449

01:24:08,709 --> 01:24:06,800

life on earth and when i succeed but

2450

01:24:10,310 --> 01:24:08,719

don't get the nobel prize i can write my

2451

01:24:11,750 --> 01:24:10,320

other book you know i can get brian to

2452

01:24:13,510 --> 01:24:11,760

do it forward in it and all that because

2453

01:24:15,590 --> 01:24:13,520

we chemists hate it and what we're

2454

01:24:17,990 --> 01:24:15,600

likely to do i think is we should be

2455

01:24:19,510 --> 01:24:18,000

looking for technology technological

2456

01:24:20,950 --> 01:24:19,520

techno signatures

2457

01:24:22,310 --> 01:24:20,960

you know i mean i think that the

2458

01:24:24,149 --> 01:24:22,320

exoplanet we're going to detect an

2459

01:24:25,510 --> 01:24:24,159

exoplanet of oxygen on them so we found

2460

01:24:27,910 --> 01:24:25,520

life and that's just going to be baloney

2461

01:24:29,270 --> 01:24:27,920

so that's that i agree with brian so let

2462

01:24:30,870 --> 01:24:29,280

me just tell you briefly what assembly

2463

01:24:33,110 --> 01:24:30,880

theory is because assembly theory is

2464

01:24:34,229 --> 01:24:33,120

actually a kind of a cool way of

2465

01:24:36,870 --> 01:24:34,239

actually

2466

01:24:37,910 --> 01:24:36,880

doing entropy without labeling and it's

2467

01:24:40,709 --> 01:24:37,920

just about

2468

01:24:42,550 --> 01:24:40,719

as a chemist i realized years ago

2469

01:24:44,950 --> 01:24:42,560

that there are molecules on earth that

2470

01:24:46,950 --> 01:24:44,960

are just weird right weird molecules

2471

01:24:48,790 --> 01:24:46,960

like really complex and so let's just

2472

01:24:51,430 --> 01:24:48,800

take a molecule that i that is used a

2473

01:24:53,590 --> 01:24:51,440

lot called taxol taxol

2474

01:24:55,430 --> 01:24:53,600

is made by the pacific yew tree it's a

2475

01:24:56,870 --> 01:24:55,440

metabolism it's a it's a it's a

2476

01:24:59,110 --> 01:24:56,880

secondary metabolite which means it's

2477

01:25:00,790 --> 01:24:59,120

made by protein interaction proteins in

2478

01:25:03,990 --> 01:25:00,800

the cell and that molecule is really

2479

01:25:06,709 --> 01:25:04,000

special because it's very good at um

2480

01:25:09,350 --> 01:25:06,719

killing vascular polarization of cancer

2481

01:25:11,510 --> 01:25:09,360

tumors so people get that and they they

2482

01:25:15,030 --> 01:25:11,520

use it as an anti-cancer drug now to

2483

01:25:17,510 --> 01:25:15,040

make this molecule it's like got 62

2484

01:25:20,709 --> 01:25:17,520

carbon atoms you know load of oxygen

2485

01:25:23,030 --> 01:25:20,719

atoms nitrogen and so on in this pattern

2486

01:25:24,550 --> 01:25:23,040

and this molecule has a molecular weight

2487

01:25:27,350 --> 01:25:24,560

of about

2488

01:25:28,709 --> 01:25:27,360

852

2489

01:25:30,550 --> 01:25:28,719

something like this so i'm going to go

2490

01:25:32,229 --> 01:25:30,560

and check it now

2491

01:25:33,510 --> 01:25:32,239

it's like okay like i'll google it

2492

01:25:36,070 --> 01:25:33,520

whilst i'm saying but it's a big

2493

01:25:37,750 --> 01:25:36,080

molecular weight and it's a fingerprint

2494

01:25:39,350 --> 01:25:37,760

and the way that molecule works is the

2495

01:25:40,629 --> 01:25:39,360

way the commentary chemistry words that

2496

01:25:41,669 --> 01:25:40,639

molecule

2497

01:25:43,430 --> 01:25:41,679

is

2498

01:25:45,270 --> 01:25:43,440

beautiful it's like a rembrandt right

2499

01:25:47,669 --> 01:25:45,280

it's in its features

2500

01:25:49,350 --> 01:25:47,679

but chemists can make loads of it so you

2501

01:25:52,270 --> 01:25:49,360

can make literally

2502

01:25:55,830 --> 01:25:52,280

um 10 to the 23

2503

01:25:58,470 --> 01:25:55,840

6.022 times 10 to the 23 and that's one

2504

01:26:01,430 --> 01:25:58,480

mole so you have one mole of taxol so

2505

01:26:03,110 --> 01:26:01,440

that's 10 to the 23 identical copies and

2506

01:26:06,070 --> 01:26:03,120

that's made in biology on earth human

2507

01:26:07,669 --> 01:26:06,080

beings can make it in the lab but

2508

01:26:08,870 --> 01:26:07,679

if brian and i did the math together and

2509

01:26:10,790 --> 01:26:08,880

we said right we'll look at that

2510

01:26:13,750 --> 01:26:10,800

molecule we'll work out what is the

2511

01:26:16,390 --> 01:26:13,760

probability that that molecule

2512

01:26:17,910 --> 01:26:16,400

could form randomly in a plasma in the

2513

01:26:21,669 --> 01:26:17,920

universe

2514

01:26:25,030 --> 01:26:21,679

it's basically one in a like

2515

01:26:27,510 --> 01:26:25,040

countless in 10 100 right maybe more

2516

01:26:30,550 --> 01:26:27,520

that's just for one molecule so if you

2517

01:26:32,229 --> 01:26:30,560

find a detectable amount you're like oh

2518

01:26:34,390 --> 01:26:32,239

oh my god this is like the biggest

2519

01:26:37,030 --> 01:26:34,400

coincidence ever so that's where

2520

01:26:38,390 --> 01:26:37,040

assembly theory was born and i realized

2521

01:26:40,709 --> 01:26:38,400

that there's lots of molecules on earth

2522

01:26:43,110 --> 01:26:40,719

that pass the great filter they are made

2523

01:26:45,669 --> 01:26:43,120

by biology and i realize they can make a

2524

01:26:47,110 --> 01:26:45,679

detection system that detects molecules

2525

01:26:49,189 --> 01:26:47,120

that are above that threshold of

2526

01:26:51,669 --> 01:26:49,199

complexity and that when you do random

2527

01:26:53,189 --> 01:26:51,679

miliuri and random stuff

2528

01:26:55,189 --> 01:26:53,199

get meteorites and look at the organic

2529

01:26:57,189 --> 01:26:55,199

chemistry they are way below that filter

2530

01:26:59,189 --> 01:26:57,199

they have an assembly number and what

2531

01:27:01,910 --> 01:26:59,199

assembly theory does it says like take

2532

01:27:03,510 --> 01:27:01,920

your molecule put it on a graph

2533

01:27:05,350 --> 01:27:03,520

what is the shortest route you can get

2534

01:27:08,149 --> 01:27:05,360

from your atoms to that target the

2535

01:27:09,669 --> 01:27:08,159

shortest possible route how many steps

2536

01:27:11,830 --> 01:27:09,679

right so it's a bit like you take the

2537

01:27:13,350 --> 01:27:11,840

word abracadabra if you were to make if

2538

01:27:16,870 --> 01:27:13,360

you've got a b

2539

01:27:17,990 --> 01:27:16,880

uh um you know c r a how many steps

2540

01:27:20,790 --> 01:27:18,000

would you need to make the word

2541

01:27:22,629 --> 01:27:20,800

abracadabra well you can do it in in a

2542

01:27:24,550 --> 01:27:22,639

much number the number of letters in the

2543

01:27:27,110 --> 01:27:24,560

in the word because you can reuse some

2544

01:27:28,790 --> 01:27:27,120

parts and so my conjecture is assembly

2545

01:27:31,430 --> 01:27:28,800

theory says he finds where there's

2546

01:27:34,629 --> 01:27:31,440

memory of contingency in a chain so it

2547

01:27:36,149 --> 01:27:34,639

looks for lossless compressibility

2548

01:27:38,709 --> 01:27:36,159

that's kind of cool right it's a bit

2549

01:27:39,669 --> 01:27:38,719

like a information theory compression

2550

01:27:40,870 --> 01:27:39,679

shannon

2551

01:27:43,189 --> 01:27:40,880

but it's just like that what is your

2552

01:27:44,790 --> 01:27:43,199

shortest route to get there because

2553

01:27:46,870 --> 01:27:44,800

like brian

2554

01:27:48,870 --> 01:27:46,880

i'm as an experimentalist the data is

2555

01:27:51,510 --> 01:27:48,880

more important than my feelings that's

2556

01:27:53,350 --> 01:27:51,520

right and so you know it's like yeah so

2557

01:27:56,229 --> 01:27:53,360

i'm like ben shapiro you just sounded

2558

01:27:58,870 --> 01:27:56,239

like ben shapiro for a second

2559

01:28:00,149 --> 01:27:58,880

yeah i love ben shapiro

2560

01:28:02,149 --> 01:28:00,159

and so

2561

01:28:03,430 --> 01:28:02,159

it's really important that we understand

2562

01:28:05,030 --> 01:28:03,440

that because

2563

01:28:06,870 --> 01:28:05,040

it work it's pervasive right where

2564

01:28:08,390 --> 01:28:06,880

people just think that and chemists

2565

01:28:09,750 --> 01:28:08,400

think that complex molecules this is

2566

01:28:10,950 --> 01:28:09,760

where the chemists

2567

01:28:12,390 --> 01:28:10,960

they're getting they're beginning to

2568

01:28:14,229 --> 01:28:12,400

change their view

2569

01:28:16,390 --> 01:28:14,239

and what i'm trying to say is that the

2570

01:28:18,550 --> 01:28:16,400

the chemists don't because they take it

2571

01:28:20,390 --> 01:28:18,560

for granted that there's complex

2572

01:28:22,950 --> 01:28:20,400

chemistry everyone saying hey guys it's

2573

01:28:24,709 --> 01:28:22,960

not just rna that's important atp is

2574

01:28:27,189 --> 01:28:24,719

important you know that's my that's my

2575

01:28:28,629 --> 01:28:27,199

joke lee i say you know in in economics

2576

01:28:30,870 --> 01:28:28,639

you know past performance is no

2577

01:28:32,390 --> 01:28:30,880

guarantee of future results it's like we

2578

01:28:33,510 --> 01:28:32,400

have past performance evidence here on

2579

01:28:36,070 --> 01:28:33,520

earth but

2580

01:28:37,910 --> 01:28:36,080

that's no guarantee so assembly theory

2581

01:28:39,750 --> 01:28:37,920

what it does it allows you given a

2582

01:28:42,550 --> 01:28:39,760

complex molecule you can work out the

2583

01:28:44,470 --> 01:28:42,560

likelihood it formed by chance and and

2584

01:28:46,629 --> 01:28:44,480

that i think is fairly irrefutable

2585

01:28:48,950 --> 01:28:46,639

although publishing that paper last year

2586

01:28:51,030 --> 01:28:48,960

took me six goes right i sent it to them

2587

01:28:52,870 --> 01:28:51,040

why do you think that is

2588

01:28:54,629 --> 01:28:52,880

well because well it took me i sense a

2589

01:28:56,870 --> 01:28:54,639

nature i almost got in right senate

2590

01:29:01,030 --> 01:28:56,880

nature i got three reports back

2591

01:29:04,310 --> 01:29:02,550

can't be right

2592

01:29:06,470 --> 01:29:04,320

so i wrote back and so they're nature

2593

01:29:07,990 --> 01:29:06,480

what do we do and i said well

2594

01:29:09,990 --> 01:29:08,000

we can ask the referee why it can't be

2595

01:29:11,510 --> 01:29:10,000

right so he said i'll do that there and

2596

01:29:12,790 --> 01:29:11,520

the referee could say the referee why

2597

01:29:14,070 --> 01:29:12,800

can't it be right and the referee said

2598

01:29:15,830 --> 01:29:14,080

in the second round

2599

01:29:17,590 --> 01:29:15,840

because it's impossible

2600

01:29:19,110 --> 01:29:17,600

we're like okay this is like i kid you

2601  
01:29:20,790 --> 01:29:19,120  
not right this is a conversation we had

2602  
01:29:22,550 --> 01:29:20,800  
with the editor i said but here's the

2603  
01:29:25,030 --> 01:29:22,560  
data are you saying we fabricated the

2604  
01:29:26,629 --> 01:29:25,040  
data and the referee just said it's

2605  
01:29:28,629 --> 01:29:26,639  
impossible

2606  
01:29:31,270 --> 01:29:28,639  
and we we went in this loop and what

2607  
01:29:32,790 --> 01:29:31,280  
actually happened is one of the referees

2608  
01:29:34,390 --> 01:29:32,800  
fabricated

2609  
01:29:37,430 --> 01:29:34,400  
a data

2610  
01:29:39,189 --> 01:29:37,440  
from a paper to assert that we couldn't

2611  
01:29:41,030 --> 01:29:39,199  
be right that's how desperate they were

2612  
01:29:42,790 --> 01:29:41,040  
i got the evidence right come back

2613  
01:29:44,390 --> 01:29:42,800

they said in this paper it says that

2614

01:29:45,990 --> 01:29:44,400

complexity is important is already

2615

01:29:47,189 --> 01:29:46,000

present in outer space blah blah blah

2616

01:29:48,070 --> 01:29:47,199

blah

2617

01:29:56,149 --> 01:29:48,080

and

2618

01:29:58,550 --> 01:29:56,159

that the referee took the word complex

2619

01:30:00,390 --> 01:29:58,560

mixtures have been found in space and

2620

01:30:02,390 --> 01:30:00,400

changed it to complex molecules because

2621

01:30:05,030 --> 01:30:02,400

they were so believing the complex

2622

01:30:07,590 --> 01:30:05,040

molecules are a free lunch

2623

01:30:09,590 --> 01:30:07,600

um i then went to the fifth round to

2624

01:30:11,270 --> 01:30:09,600

review and the editor by this point was

2625

01:30:13,350 --> 01:30:11,280

like just like

2626  
01:30:14,950 --> 01:30:13,360  
go away we're not publishing i said no

2627  
01:30:17,110 --> 01:30:14,960  
we're gonna i believe in the rule of

2628  
01:30:18,070 --> 01:30:17,120  
peer review i'm answering all your

2629  
01:30:20,070 --> 01:30:18,080  
points

2630  
01:30:22,149 --> 01:30:20,080  
this is important it's important we

2631  
01:30:23,910 --> 01:30:22,159  
change people's views of complexity

2632  
01:30:26,229 --> 01:30:23,920  
because brian is on a really good side

2633  
01:30:28,149 --> 01:30:26,239  
we're saying hey i want the data i know

2634  
01:30:29,590 --> 01:30:28,159  
that nothing is for free and the chemist

2635  
01:30:31,350 --> 01:30:29,600  
in the middle saying everything is for

2636  
01:30:32,950 --> 01:30:31,360  
free complexity happens and i'm in the

2637  
01:30:34,790 --> 01:30:32,960  
middle saying no i can count it and

2638  
01:30:36,470 --> 01:30:34,800

quantify and here it is what actually

2639

01:30:38,550 --> 01:30:36,480

happened it was rejected

2640

01:30:40,870 --> 01:30:38,560

right because of for i won't go into i

2641

01:30:43,350 --> 01:30:40,880

don't want to complain i'm a very lucky

2642

01:30:44,709 --> 01:30:43,360

um scientist i love doing the science i

2643

01:30:46,149 --> 01:30:44,719

just feel bad for the research group but

2644

01:30:48,149 --> 01:30:46,159

i got it published i published in nature

2645

01:30:52,870 --> 01:30:48,159

communications and that paper was

2646

01:30:54,790 --> 01:30:52,880

downloaded 27 000 times in five months

2647

01:30:56,310 --> 01:30:54,800

um because we presented the theory the

2648

01:30:57,910 --> 01:30:56,320

mass spec and all the evidence we had a

2649

01:30:59,910 --> 01:30:57,920

little meteorites we even got scottish

2650

01:31:01,350 --> 01:30:59,920

whiskey we proved that scottish whiskey

2651  
01:31:03,750 --> 01:31:01,360  
is evidence of life because there's

2652  
01:31:05,750 --> 01:31:03,760  
complexity in the peak right we show it

2653  
01:31:09,189 --> 01:31:05,760  
works so we know we can fingerprint life

2654  
01:31:10,790 --> 01:31:09,199  
on earth and molecules um and so it's

2655  
01:31:12,070 --> 01:31:10,800  
but we realized something more that

2656  
01:31:14,070 --> 01:31:12,080  
assembly theory is about just something

2657  
01:31:16,070 --> 01:31:14,080  
about molecules it's about

2658  
01:31:17,590 --> 01:31:16,080  
every time you have a step on your path

2659  
01:31:18,950 --> 01:31:17,600  
and you make a decision let's say you go

2660  
01:31:21,110 --> 01:31:18,960  
down the street you say i'm gonna go

2661  
01:31:23,030 --> 01:31:21,120  
left today you go left and say right i'm

2662  
01:31:24,870 --> 01:31:23,040  
gonna go left again then i'm gonna go

2663  
01:31:27,270 --> 01:31:24,880

right and go left and right and you find

2664

01:31:29,270 --> 01:31:27,280

yourself in a very particular spot that

2665

01:31:30,550 --> 01:31:29,280

contingency is pretty on your history

2666

01:31:31,350 --> 01:31:30,560

right there's a lot of mathematics on

2667

01:31:37,669 --> 01:31:31,360

that

2668

01:31:38,870 --> 01:31:37,679

i haven't spoken to brian about it

2669

01:31:41,030 --> 01:31:38,880

because sarah and i are just finishing

2670

01:31:43,350 --> 01:31:41,040

the paper and oh my god it works and

2671

01:31:45,669 --> 01:31:43,360

what i mean by that i mean i can take a

2672

01:31:48,470 --> 01:31:45,679

kilogram of sand and calculate the

2673

01:31:50,870 --> 01:31:48,480

assembly of that kilogram of sand and i

2674

01:31:53,110 --> 01:31:50,880

can calculate take a kilogram of e coli

2675

01:31:55,350 --> 01:31:53,120

and calculate the assembly assembly is a

2676

01:31:57,350 --> 01:31:55,360

number like entropy

2677

01:31:59,270 --> 01:31:57,360

an entropy tells you the causal power of

2678

01:32:01,990 --> 01:31:59,280

the object and of course the causal

2679

01:32:04,149 --> 01:32:02,000

power of a kilogram of aquila of e coli

2680

01:32:06,870 --> 01:32:04,159

is vastly higher than the kilogram of

2681

01:32:09,510 --> 01:32:06,880

sand because the sound can do nothing so

2682

01:32:12,229 --> 01:32:09,520

what about the uh assembly of rule 38

2683

01:32:13,830 --> 01:32:12,239

wolfram's you know rule well and

2684

01:32:16,470 --> 01:32:13,840

you'll hear about this in a few weeks

2685

01:32:18,550 --> 01:32:16,480

maybe but the problem with that is that

2686

01:32:21,270 --> 01:32:18,560

is again a labeled system so rule 38

2687

01:32:24,070 --> 01:32:21,280

doesn't exist outside of a von neumann

2688

01:32:26,390 --> 01:32:24,080

machine and graph paper an observer

2689

01:32:28,390 --> 01:32:26,400

putting the rules in so yeah so there's

2690

01:32:31,189 --> 01:32:28,400

so the problem is and physicists get

2691

01:32:33,030 --> 01:32:31,199

stuck with things that give complexity

2692

01:32:35,030 --> 01:32:33,040

that aren't really complexity it's just

2693

01:32:36,870 --> 01:32:35,040

games with numbers

2694

01:32:38,629 --> 01:32:36,880

and and i think that i've got a little

2695

01:32:41,510 --> 01:32:38,639

bit of work to do with that and i think

2696

01:32:43,030 --> 01:32:41,520

the wolfram's ideas here are pretty cool

2697

01:32:45,590 --> 01:32:43,040

i think they're not they're not the

2698

01:32:47,590 --> 01:32:45,600

problem is with wolfram he traps himself

2699

01:32:49,669 --> 01:32:47,600

in a line of thought and doesn't talk to

2700

01:32:51,270 --> 01:32:49,679

anyone and think he's the lost genius

2701

01:32:52,790 --> 01:32:51,280

bit like eric actually and no one will

2702

01:32:54,629 --> 01:32:52,800

talk to him we'll talk to him in fact

2703

01:32:56,709 --> 01:32:54,639

he's got a lot of good ideas that might

2704

01:32:58,550 --> 01:32:56,719

actually be right but it's up

2705

01:32:59,910 --> 01:32:58,560

i've had not only have i talked to him

2706

01:33:01,590 --> 01:32:59,920

and i've talked to eric i've talked to

2707

01:33:03,030 --> 01:33:01,600

him and eric at the same time i'm like

2708

01:33:04,470 --> 01:33:03,040

oh cool i'd love to take part in that

2709

01:33:06,470 --> 01:33:04,480

conversation if i maybe could bang their

2710

01:33:07,990 --> 01:33:06,480

heads together

2711

01:33:10,470 --> 01:33:08,000

assembly theory tells you about

2712

01:33:11,750 --> 01:33:10,480

causation it's now measurable and that's

2713

01:33:13,350 --> 01:33:11,760

why i'm excited because we're going to

2714

01:33:15,750 --> 01:33:13,360

start to roll this out

2715

01:33:18,870 --> 01:33:15,760

in in inanimate objects and it will help

2716

01:33:20,070 --> 01:33:18,880

physics i think newton screwed physics

2717

01:33:21,830 --> 01:33:20,080

because screw

2718

01:33:23,669 --> 01:33:21,840

n newton and there's a hell of a thing

2719

01:33:25,590 --> 01:33:23,679

to say i'm british right i love newton

2720

01:33:27,910 --> 01:33:25,600

you know there's a lot of coins and on

2721

01:33:30,550 --> 01:33:27,920

our notes and everything but leibniz

2722

01:33:32,229 --> 01:33:30,560

understood assembly theory and i've been

2723

01:33:34,390 --> 01:33:32,239

reading philosophy for the last few

2724

01:33:37,430 --> 01:33:34,400

weeks if you read the monodology from

2725

01:33:39,270 --> 01:33:37,440

leibniz you'll see that he understood

2726  
01:33:40,550 --> 01:33:39,280  
assembly theory and that objects have

2727  
01:33:42,950 --> 01:33:40,560  
souls

2728  
01:33:44,709 --> 01:33:42,960  
this cup has a soul and you're like you

2729  
01:33:47,590 --> 01:33:44,719  
can use legal on or pants i can say no

2730  
01:33:49,430 --> 01:33:47,600  
no the soul is not in the cup but it's

2731  
01:33:51,669 --> 01:33:49,440  
in the causal structure of the person

2732  
01:33:54,229 --> 01:33:51,679  
that made it who made it who made it who

2733  
01:33:56,390 --> 01:33:54,239  
made it this cup is a fantastically

2734  
01:33:58,550 --> 01:33:56,400  
improbable object that cannot have

2735  
01:34:00,390 --> 01:33:58,560  
existed at a long line

2736  
01:34:02,390 --> 01:34:00,400  
of cup makers

2737  
01:34:04,390 --> 01:34:02,400  
that's where the soul of the cup is okay

2738  
01:34:05,189 --> 01:34:04,400

let's let brian respond to what you've

2739

01:34:06,629 --> 01:34:05,199

said

2740

01:34:08,229 --> 01:34:06,639

well you know i think i mean it's

2741

01:34:11,030 --> 01:34:08,239

unassailable to say that you know

2742

01:34:13,189 --> 01:34:11,040

complexity begets complexity and again

2743

01:34:15,350 --> 01:34:13,199

that lee will take on intelligent

2744

01:34:17,510 --> 01:34:15,360

designers with one fist but he'll also

2745

01:34:20,390 --> 01:34:17,520

you know take on chemists uh with the

2746

01:34:22,229 --> 01:34:20,400

other and say look we we have to address

2747

01:34:24,470 --> 01:34:22,239

you know as as uh

2748

01:34:26,550 --> 01:34:24,480

as uh you know roger penrose calls the

2749

01:34:29,189 --> 01:34:26,560

mastodon in the room which is you know

2750

01:34:30,790 --> 01:34:29,199

this surprising you know uh feature

2751

01:34:33,350 --> 01:34:30,800

about the universe that we can

2752

01:34:34,950 --> 01:34:33,360

comprehend it we tend to impose you know

2753

01:34:37,430 --> 01:34:34,960

consciousness upon it and our

2754

01:34:40,149 --> 01:34:37,440

definitions our contingent upon our

2755

01:34:42,149 --> 01:34:40,159

causal history and how we were assembled

2756

01:34:44,149 --> 01:34:42,159

you know and i think the ultimate theory

2757

01:34:45,990 --> 01:34:44,159

of everything when it comes to uh what

2758

01:34:48,709 --> 01:34:46,000

lee's working on will have to involve

2759

01:34:50,229 --> 01:34:48,719

the observer which will undoubtedly then

2760

01:34:52,149 --> 01:34:50,239

finally force him to get into

2761

01:34:53,189 --> 01:34:52,159

fundamentals of of quantum mechanics

2762

01:34:54,950 --> 01:34:53,199

which i don't think he can call

2763

01:34:56,310 --> 01:34:54,960

chemistry i'm okay with you calling you

2764

01:34:58,149 --> 01:34:56,320

know entropy and thermodynamics

2765

01:34:59,430 --> 01:34:58,159

chemistry but i think you know the

2766

01:35:01,270 --> 01:34:59,440

elementary foundations of quantum

2767

01:35:03,189 --> 01:35:01,280

mechanics that's a stretch i've always

2768

01:35:05,270 --> 01:35:03,199

wanted to be a physicist that's okay

2769

01:35:07,350 --> 01:35:05,280

okay yeah well me too but you know i i

2770

01:35:09,270 --> 01:35:07,360

lapsed and became an astrophysicist

2771

01:35:11,830 --> 01:35:09,280

but i think um

2772

01:35:14,629 --> 01:35:11,840

you know when we talk about how uh you

2773

01:35:15,590 --> 01:35:14,639

know this this can be used to to kind of

2774

01:35:17,830 --> 01:35:15,600

um

2775

01:35:19,430 --> 01:35:17,840

as i say be quantitative how we can get

2776

01:35:21,990 --> 01:35:19,440

something out of it deliver some value

2777

01:35:23,910 --> 01:35:22,000

to the audience uh certainly these are

2778

01:35:25,590 --> 01:35:23,920

and the last the more flexible we are i

2779

01:35:28,310 --> 01:35:25,600

think the more can be understood but

2780

01:35:30,070 --> 01:35:28,320

maybe maybe to even narrow down and come

2781

01:35:32,390 --> 01:35:30,080

back to the original definition of

2782

01:35:33,990 --> 01:35:32,400

things i think to have a taxonomy you

2783

01:35:35,990 --> 01:35:34,000

know what what is it that the the name

2784

01:35:38,790 --> 01:35:36,000

is not the thing uh there's there's some

2785

01:35:40,950 --> 01:35:38,800

principle like that right um and so so

2786

01:35:44,070 --> 01:35:40,960

yes describing things that are complex

2787

01:35:45,590 --> 01:35:44,080

and are have originators in a mind that

2788

01:35:48,550 --> 01:35:45,600

on the one hand is beautiful it's

2789

01:35:50,470 --> 01:35:48,560

elegant it's it's simple and again in a

2790

01:35:52,709 --> 01:35:50,480

in a praiseworthy fashion not in a

2791

01:35:54,870 --> 01:35:52,719

childless fashion on the other hand i do

2792

01:35:56,870 --> 01:35:54,880

think we have to then confront the

2793

01:35:58,790 --> 01:35:56,880

ultimate you know question of you know

2794

01:36:01,910 --> 01:35:58,800

is there does there have to be some mind

2795

01:36:05,750 --> 01:36:01,920

at work behind the cup behind the 747

2796

01:36:08,070 --> 01:36:05,760

behind the uh the the dna code and i i

2797

01:36:10,390 --> 01:36:08,080

think we know we've agreed not to really

2798

01:36:12,870 --> 01:36:10,400

get into this this notion but i think it

2799

01:36:14,870 --> 01:36:12,880

at some level we just get to this a a

2800

01:36:17,510 --> 01:36:14,880

eventual chicken or egg and this motte

2801  
01:36:18,310 --> 01:36:17,520  
bailey you know retreat and i guess you

2802  
01:36:24,070 --> 01:36:18,320  
know

2803  
01:36:26,950 --> 01:36:24,080  
the ultimate benefit of this approach is

2804  
01:36:29,030 --> 01:36:26,960  
is that it it gives a plausible scenario

2805  
01:36:31,430 --> 01:36:29,040  
for life to arise from inanimate objects

2806  
01:36:33,270 --> 01:36:31,440  
that's that's an ultimate it's a way to

2807  
01:36:34,950 --> 01:36:33,280  
quantify when something is animate let's

2808  
01:36:36,790 --> 01:36:34,960  
just say or was created by something

2809  
01:36:39,189 --> 01:36:36,800  
adamant um

2810  
01:36:41,270 --> 01:36:39,199  
and i think you know to look at how

2811  
01:36:44,149 --> 01:36:41,280  
we can do better and and maybe go

2812  
01:36:46,390 --> 01:36:44,159  
further into which i think is really

2813  
01:36:48,550 --> 01:36:46,400

important uh you know is life abundant

2814

01:36:50,390 --> 01:36:48,560

and technological i think kurt's

2815

01:36:51,669 --> 01:36:50,400

audience appreciates that and i think

2816

01:36:54,310 --> 01:36:51,679

you know we haven't spoken so much about

2817

01:36:57,350 --> 01:36:54,320

that maybe we can talk about that um you

2818

01:36:59,830 --> 01:36:57,360

know how and what could we glean from

2819

01:37:01,350 --> 01:36:59,840

the search as a search you know and

2820

01:37:02,870 --> 01:37:01,360

where are we going qual vadas you know

2821

01:37:05,109 --> 01:37:02,880

where are we going with with the search

2822

01:37:07,430 --> 01:37:05,119

is it important is a good use of of

2823

01:37:10,229 --> 01:37:07,440

chemist's time of physicist time uh et

2824

01:37:12,709 --> 01:37:10,239

cetera to look at these uh reported

2825

01:37:13,910 --> 01:37:12,719

unexplained phenomena um can that tell

2826

01:37:16,310 --> 01:37:13,920

us something is this something that

2827

01:37:18,229 --> 01:37:16,320

interests you and and me and and maybe

2828

01:37:20,950 --> 01:37:18,239

you know kurt can can lead us in that

2829

01:37:22,550 --> 01:37:20,960

path and and kind of yeah really i mean

2830

01:37:24,550 --> 01:37:22,560

we're at a very interesting you know

2831

01:37:26,229 --> 01:37:24,560

point in time and a lot of it has to do

2832

01:37:27,669 --> 01:37:26,239

with people that kurt's had on the show

2833

01:37:30,390 --> 01:37:27,679

and that i've tried to have on my

2834

01:37:32,470 --> 01:37:30,400

podcast as well um and i think that you

2835

01:37:34,629 --> 01:37:32,480

know kind of the abiogenesis

2836

01:37:37,109 --> 01:37:34,639

argument is is you know you've

2837

01:37:38,790 --> 01:37:37,119

eloquently described it um i think you

2838

01:37:40,950 --> 01:37:38,800

know if we look maybe as curt as an

2839

01:37:42,310 --> 01:37:40,960

impartial observer maybe we could say

2840

01:37:43,430 --> 01:37:42,320

like where are you kurt in this

2841

01:37:46,149 --> 01:37:43,440

discussion because i think you're a

2842

01:37:48,390 --> 01:37:46,159

proxy for your everyday audience how do

2843

01:37:50,390 --> 01:37:48,400

we how are you feeling about the

2844

01:37:52,149 --> 01:37:50,400

prospects of the ultimate question

2845

01:37:54,070 --> 01:37:52,159

life from non-life and then we could

2846

01:37:55,510 --> 01:37:54,080

talk about universe from non-universe we

2847

01:37:57,109 --> 01:37:55,520

can talk about consciousness from

2848

01:37:58,390 --> 01:37:57,119

inanimate matter and then we can talk

2849

01:38:00,709 --> 01:37:58,400

about technological matter from

2850

01:38:03,510 --> 01:38:00,719

conscious matter but um where are you

2851  
01:38:04,629 --> 01:38:03,520  
sitting right now kurt

2852  
01:38:07,270 --> 01:38:04,639  
if we use

2853  
01:38:09,510 --> 01:38:07,280  
lee's definition of life which is

2854  
01:38:11,669 --> 01:38:09,520  
what begets some high assembly number

2855  
01:38:12,870 --> 01:38:11,679  
then it sounds like

2856  
01:38:14,950 --> 01:38:12,880  
it's almost like pan psychos and

2857  
01:38:16,629 --> 01:38:14,960  
pan-lifeism because it's a circular

2858  
01:38:17,910 --> 01:38:16,639  
definition of life where okay well what

2859  
01:38:20,149 --> 01:38:17,920  
would produce that well then we'd get

2860  
01:38:21,350 --> 01:38:20,159  
down to the atoms which produce and so

2861  
01:38:23,109 --> 01:38:21,360  
on and so on so it sounds like life is

2862  
01:38:26,070 --> 01:38:23,119  
abundant if we use the definition that

2863  
01:38:27,910 --> 01:38:26,080

life is what produces life

2864

01:38:29,750 --> 01:38:27,920

let me qualify one second no so what i'm

2865

01:38:31,350 --> 01:38:29,760

saying is you have

2866

01:38:33,910 --> 01:38:31,360

random events

2867

01:38:36,550 --> 01:38:33,920

that basically um

2868

01:38:38,950 --> 01:38:36,560

increasing causal power and there's a

2869

01:38:40,470 --> 01:38:38,960

phase transition to life right life

2870

01:38:42,310 --> 01:38:40,480

doesn't just appear magically right

2871

01:38:43,669 --> 01:38:42,320

we've already there is but there's

2872

01:38:45,830 --> 01:38:43,679

causation in the universe right the

2873

01:38:47,669 --> 01:38:45,840

universe does do some stuff before life

2874

01:38:49,510 --> 01:38:47,679

there's a phase transition because then

2875

01:38:51,510 --> 01:38:49,520

evolution can do stuff

2876

01:38:53,510 --> 01:38:51,520

like that which is just you can and what

2877

01:38:55,590 --> 01:38:53,520

it what can and we there is a meaning to

2878

01:38:58,629 --> 01:38:55,600

this which we can come to it's not pan

2879

01:39:00,470 --> 01:38:58,639

psychism i totally refute well no let's

2880

01:39:02,149 --> 01:39:00,480

be friendly to the pan psychist because

2881

01:39:04,310 --> 01:39:02,159

there are interesting things there but i

2882

01:39:06,709 --> 01:39:04,320

think there's a mischaracterization

2883

01:39:09,189 --> 01:39:06,719

the pan psychists want something there

2884

01:39:11,109 --> 01:39:09,199

but i would argue they want causation

2885

01:39:12,950 --> 01:39:11,119

and they want and they're missing out on

2886

01:39:14,149 --> 01:39:12,960

causation so there's causations there

2887

01:39:16,550 --> 01:39:14,159

and then there's biology and then

2888

01:39:18,470 --> 01:39:16,560

there's technology so i'm i'm i don't

2889

01:39:19,990 --> 01:39:18,480

think it's circular but i think you're

2890

01:39:21,910 --> 01:39:20,000

really right to push on it because i

2891

01:39:23,830 --> 01:39:21,920

think your your listeners your viewers

2892

01:39:26,629 --> 01:39:23,840

will be like well come on it what do i

2893

01:39:28,229 --> 01:39:26,639

mean i mean rocks can

2894

01:39:30,149 --> 01:39:28,239

through their random interactions can

2895

01:39:31,669 --> 01:39:30,159

have memories and those memories just

2896

01:39:33,669 --> 01:39:31,679

randomly will be

2897

01:39:35,830 --> 01:39:33,679

um trapped in the causal chain which

2898

01:39:39,270 --> 01:39:35,840

will allow certain other processes to

2899

01:39:40,709 --> 01:39:39,280

occur it's not magic it's contingent

2900

01:39:43,430 --> 01:39:40,719

tell me if i'm understanding it

2901

01:39:46,229 --> 01:39:43,440

correctly it sounds like in your model

2902

01:39:48,629 --> 01:39:46,239

life is not binary it's not alive or

2903

01:39:50,310 --> 01:39:48,639

dead it's actually a continuous spectrum

2904

01:39:53,430 --> 01:39:50,320

and if that's the case then what i'm

2905

01:39:56,070 --> 01:39:53,440

saying that there is no zero to life

2906

01:39:58,390 --> 01:39:56,080

there's no zero i think life is a kind

2907

01:40:00,229 --> 01:39:58,400

of island right this is why we have so

2908

01:40:03,350 --> 01:40:00,239

difficult pinning it down the physics

2909

01:40:06,790 --> 01:40:03,360

it's like is this is my cup alive no was

2910

01:40:09,830 --> 01:40:06,800

my cup produced by life yes am i alive

2911

01:40:12,149 --> 01:40:09,840

yes i think so um you know

2912

01:40:14,790 --> 01:40:12,159

so this kind of this is a movable feast

2913

01:40:17,430 --> 01:40:14,800

in a way in the same way consciousness

2914

01:40:19,510 --> 01:40:17,440

is kind of we have more so agency we

2915

01:40:22,629 --> 01:40:19,520

have maximum agency in our bodies right

2916

01:40:24,149 --> 01:40:22,639

now but newton is still exerting agency

2917

01:40:25,830 --> 01:40:24,159

over all of us

2918

01:40:28,070 --> 01:40:25,840

because of what he did

2919

01:40:29,830 --> 01:40:28,080

that life form and it's kind of cool so

2920

01:40:31,510 --> 01:40:29,840

yes you're absolutely right i think life

2921

01:40:33,590 --> 01:40:31,520

is kind of a continuum and there's a

2922

01:40:35,750 --> 01:40:33,600

phase transition to you have there is

2923

01:40:37,350 --> 01:40:35,760

really a lot of causal power and you get

2924

01:40:38,950 --> 01:40:37,360

something special with that that faith

2925

01:40:40,870 --> 01:40:38,960

transition is an intuition at this point

2926

01:40:42,149 --> 01:40:40,880

is it formalized

2927

01:40:44,070 --> 01:40:42,159

we're formalizing it yeah and doing

2928

01:40:45,590 --> 01:40:44,080

experiments and i think that exactly

2929

01:40:46,790 --> 01:40:45,600

there's a nobel prize there the nobel

2930

01:40:48,790 --> 01:40:46,800

prize there's another pro i mean they're

2931

01:40:50,629 --> 01:40:48,800

like everywhere i mean let me talk about

2932

01:40:52,310 --> 01:40:50,639

your ufos if that's all right let me

2933

01:40:54,870 --> 01:40:52,320

just ask one more question sure just on

2934

01:40:56,550 --> 01:40:54,880

this if you have an assembly theory and

2935

01:40:59,750 --> 01:40:56,560

computation and all these wonderful

2936

01:41:01,910 --> 01:40:59,760

things um could you have a bs detector i

2937

01:41:03,669 --> 01:41:01,920

mean could you say you know now now you

2938

01:41:05,990 --> 01:41:03,679

feed in some um

2939

01:41:08,550 --> 01:41:06,000

some left-handed dna i think that's the

2940

01:41:10,709 --> 01:41:08,560

uh non-uh stereoisomer that occur

2941

01:41:11,430 --> 01:41:10,719

doesn't occur in life that we know about

2942

01:41:13,189 --> 01:41:11,440

so

2943

01:41:14,470 --> 01:41:13,199

look what i found you know would this

2944

01:41:16,470 --> 01:41:14,480

then tell you

2945

01:41:18,470 --> 01:41:16,480

that there there's this there's some

2946

01:41:19,750 --> 01:41:18,480

trickery and some jiggery pokery as you

2947

01:41:21,590 --> 01:41:19,760

say i mean

2948

01:41:24,070 --> 01:41:21,600

could it tell that this is not and is

2949

01:41:26,790 --> 01:41:24,080

that instantiated by you lee did you put

2950

01:41:28,709 --> 01:41:26,800

in if you see a left-handed dna helix

2951

01:41:31,109 --> 01:41:28,719

you know the guy is a fraud you know

2952

01:41:31,830 --> 01:41:31,119

tell me how does that how would

2953

01:41:34,050 --> 01:41:31,840

it's a that be

2954

01:41:35,750 --> 01:41:34,060

of asking about the lab league theory

2955

01:41:37,109 --> 01:41:35,760

[Laughter]

2956

01:41:38,870 --> 01:41:37,119

well

2957

01:41:41,109 --> 01:41:38,880

actually um it's not cheeky it's

2958

01:41:42,870 --> 01:41:41,119

actually entirely appropriate so i'll

2959

01:41:46,790 --> 01:41:42,880

but maybe we don't need to go down there

2960

01:41:50,870 --> 01:41:49,030

okay good um

2961

01:41:52,550 --> 01:41:50,880

i use assembly theory a very crude

2962

01:41:55,270 --> 01:41:52,560

version to show

2963

01:41:58,550 --> 01:41:55,280

some plagiarism so because because

2964

01:41:59,669 --> 01:41:58,560

plagiarism is the ultimate um

2965

01:42:03,109 --> 01:41:59,679

kind of you know

2966

01:42:04,629 --> 01:42:03,119

commendation right and when melina trump

2967

01:42:06,709 --> 01:42:04,639

gave her

2968

01:42:07,990 --> 01:42:06,719

presentation to the cup republican

2969

01:42:10,629 --> 01:42:08,000

convention

2970

01:42:12,870 --> 01:42:10,639

she used a speech which was the same as

2971

01:42:14,070 --> 01:42:12,880

Michelle Obama's speech

2972

01:42:15,750 --> 01:42:14,080

and everyone's like they look the same

2973

01:42:17,750 --> 01:42:15,760

and i was like oh well let's take all

2974

01:42:19,910 --> 01:42:17,760

the subjects of the sentences and i

2975

01:42:22,790 --> 01:42:19,920

broke them down and with assembly theory

2976

01:42:25,270 --> 01:42:22,800

be like you know um on number one i

2977

01:42:27,109 --> 01:42:25,280

talked about my you know my my mom my my

2978

01:42:28,790 --> 01:42:27,119

country and number two i talked about my

2979

01:42:30,229 --> 01:42:28,800

childhood number three i talked about my

2980

01:42:31,669 --> 01:42:30,239

dog number three you know you went

2981

01:42:34,629 --> 01:42:31,679

through and went wow when i by the time

2982

01:42:37,109 --> 01:42:34,639

i got to 14 and a match i knew that that

2983

01:42:39,030 --> 01:42:37,119

was plagiarism right because the the

2984

01:42:41,590 --> 01:42:39,040

chances of that

2985

01:42:43,189 --> 01:42:41,600

not being was like you know 14 factorial

2986

01:42:45,430 --> 01:42:43,199

or something right so it was kind of

2987

01:42:47,270 --> 01:42:45,440

cool it's like yeah so so you can use it

2988

01:42:49,430 --> 01:42:47,280

as a bs detector

2989

01:42:51,750 --> 01:42:49,440

and and yes you can use it to look for

2990

01:42:53,030 --> 01:42:51,760

genetic material and look for motifs

2991

01:42:54,950 --> 01:42:53,040

that are repeating

2992

01:42:56,950 --> 01:42:54,960

and and then you can see what

2993

01:42:58,709 --> 01:42:56,960

engineering has been done and what

2994

01:43:01,430 --> 01:42:58,719

evolution has done and it should be

2995

01:43:03,430 --> 01:43:01,440

possible to get get that because entropy

2996

01:43:06,229 --> 01:43:03,440

course grains it all out assembly

2997

01:43:07,590 --> 01:43:06,239

reassembles it okay so now the next

2998

01:43:09,109 --> 01:43:07,600

question will dovetail into what kurt

2999

01:43:11,590 --> 01:43:09,119

was just about to ask which is could

3000

01:43:13,990 --> 01:43:11,600

there be an analog of assembly theory to

3001  
01:43:16,149 --> 01:43:14,000  
apply to unidentified aerial phenomena

3002  
01:43:18,310 --> 01:43:16,159  
kurt is that is that okay to ask

3003  
01:43:20,149 --> 01:43:18,320  
sure i'd also like to explain re-explain

3004  
01:43:21,430 --> 01:43:20,159  
if you don't mind myself to the audience

3005  
01:43:23,189 --> 01:43:21,440  
and then you can correct my explanation

3006  
01:43:24,390 --> 01:43:23,199  
of assembly theory because it's

3007  
01:43:25,189 --> 01:43:24,400  
extremely important

3008  
01:43:27,750 --> 01:43:25,199  
so

3009  
01:43:29,830 --> 01:43:27,760  
lee cronin has a number it's almost like

3010  
01:43:30,629 --> 01:43:29,840  
kolmogorov complexity so those of you

3011  
01:43:32,390 --> 01:43:30,639  
who know what that is there are

3012  
01:43:34,629 --> 01:43:32,400  
different forms of

3013  
01:43:37,430 --> 01:43:34,639

of putting a number to a piece of

3014

01:43:39,109 --> 01:43:37,440

information to see how complex it is

3015

01:43:40,470 --> 01:43:39,119

and what you have in lee's theory is you

3016

01:43:42,310 --> 01:43:40,480

have elements that you consider to be

3017

01:43:44,229 --> 01:43:42,320

atomic so you can consider those to be

3018

01:43:45,590 --> 01:43:44,239

axioms and then you have certain rules

3019

01:43:47,669 --> 01:43:45,600

of inference now those rules of

3020

01:43:48,709 --> 01:43:47,679

inference are like the laws of physics

3021

01:43:50,229 --> 01:43:48,719

though this can also be applied to

3022

01:43:51,430 --> 01:43:50,239

mathematics and that's why i think it's

3023

01:43:53,430 --> 01:43:51,440

extremely interesting because you can

3024

01:43:55,750 --> 01:43:53,440

quantify how difficult a formula is to

3025

01:43:56,950 --> 01:43:55,760

prove anyway so you have you have atoms

3026  
01:43:58,070 --> 01:43:56,960  
and then you have rules of inference and

3027  
01:43:59,590 --> 01:43:58,080  
then you wonder what is the minimum

3028  
01:44:01,830 --> 01:43:59,600  
amount of steps to get from the axioms

3029  
01:44:04,149 --> 01:44:01,840  
to the stated formula so for example the

3030  
01:44:05,750 --> 01:44:04,159  
word candy if we consider the letters of

3031  
01:44:07,430 --> 01:44:05,760  
the alphabet to be atomic then the word

3032  
01:44:08,870 --> 01:44:07,440  
candies complexity is five so you think

3033  
01:44:10,709 --> 01:44:08,880  
well that makes sense it's five letters

3034  
01:44:12,629 --> 01:44:10,719  
yeah because step one you pull c out

3035  
01:44:15,590 --> 01:44:12,639  
step two you pull an a out but the word

3036  
01:44:18,310 --> 01:44:15,600  
pom-poms which is seven letters is

3037  
01:44:20,550 --> 01:44:18,320  
complexity of five because you p okay

3038  
01:44:22,629 --> 01:44:20,560

you pull a p out that's step one pull an

3039

01:44:24,709 --> 01:44:22,639

o out pull an m out then you need to put

3040

01:44:26,950 --> 01:44:24,719

another p but great we have the word

3041

01:44:28,950 --> 01:44:26,960

palm already created so that's that step

3042

01:44:30,629 --> 01:44:28,960

is taken care of by simply duplicating

3043

01:44:32,629 --> 01:44:30,639

the palm so then we have another step

3044

01:44:34,709 --> 01:44:32,639

for the s so then that's five in total

3045

01:44:36,629 --> 01:44:34,719

now is that a correct summation okay

3046

01:44:38,790 --> 01:44:36,639

yeah yeah you'll hive

3047

01:44:41,430 --> 01:44:38,800

great you're great okay and and the

3048

01:44:43,590 --> 01:44:41,440

reason this is extremely fascinating is

3049

01:44:46,550 --> 01:44:43,600

because you can use certain instruments

3050

01:44:49,669 --> 01:44:46,560

like mass spectrometry potentially to

3051

01:44:51,910 --> 01:44:49,679

assess the complexity of far away

3052

01:44:54,070 --> 01:44:51,920

molecules and then you can see well look

3053

01:44:55,270 --> 01:44:54,080

h<sub>2</sub>o maybe has a complexity of four i

3054

01:44:57,350 --> 01:44:55,280

don't know maybe five whatever it

3055

01:45:00,550 --> 01:44:57,360

doesn't matter two hydrogen one oxygen

3056

01:45:02,629 --> 01:45:00,560

but a simple protein may have 400 steps

3057

01:45:04,550 --> 01:45:02,639

a simple protein and thus if you can

3058

01:45:06,070 --> 01:45:04,560

quantify by looking through a telescope

3059

01:45:07,590 --> 01:45:06,080

the complexity of something far away

3060

01:45:09,990 --> 01:45:07,600

then perhaps you can say well it was

3061

01:45:11,189 --> 01:45:10,000

produced by life is that correct

3062

01:45:12,310 --> 01:45:11,199

yeah yeah i can tell you something quick

3063

01:45:14,550 --> 01:45:12,320

and blow your mind don't have to use a

3064

01:45:16,910 --> 01:45:14,560

mass spec and use infrared so i came up

3065

01:45:19,510 --> 01:45:16,920

with a the brianal like this a

3066

01:45:21,669 --> 01:45:19,520

non-gravitationally lensing complexity

3067

01:45:23,990 --> 01:45:21,679

cloak what the is that well sorry

3068

01:45:25,990 --> 01:45:24,000

for swearing um so you know black holes

3069

01:45:28,629 --> 01:45:26,000

are black holes but if you could make an

3070

01:45:30,790 --> 01:45:28,639

object that would basically so

3071

01:45:33,189 --> 01:45:30,800

in the infrared um

3072

01:45:35,430 --> 01:45:33,199

infrared uh radiation gets absorbed at

3073

01:45:37,669 --> 01:45:35,440

specific lines well all radiation gets

3074

01:45:39,590 --> 01:45:37,679

specific lines um but i came up with a

3075

01:45:41,189 --> 01:45:39,600

way of making molecules to store binary

3076

01:45:43,270 --> 01:45:41,199

coding because i want to leave a message

3077

01:45:44,470 --> 01:45:43,280

for some aliens when the humanity is

3078

01:45:46,470 --> 01:45:44,480

about to end and put it in the

3079

01:45:48,149 --> 01:45:46,480

atmosphere and what you could do is you

3080

01:45:49,430 --> 01:45:48,159

have these like if you're able to say

3081

01:45:50,870 --> 01:45:49,440

right i've got all this spectrum and i

3082

01:45:53,030 --> 01:45:50,880

want to cover all of it i'm going to

3083

01:45:54,790 --> 01:45:53,040

design a molecule absorbs here here here

3084

01:45:56,470 --> 01:45:54,800

here here here here

3085

01:45:58,070 --> 01:45:56,480

and i'll make it super light

3086

01:45:59,910 --> 01:45:58,080

there might be objects in the universe

3087

01:46:02,390 --> 01:45:59,920

that are non-gravitational lens in

3088

01:46:04,149 --> 01:46:02,400

complexity cloaks because they're light

3089

01:46:05,910 --> 01:46:04,159

and they can absorb all that energy

3090

01:46:08,149 --> 01:46:05,920

across and just re-radiate it to some

3091

01:46:10,629 --> 01:46:08,159

other way or be used so it's like a it's

3092

01:46:12,950 --> 01:46:10,639

kind of like a dyson sphere but it's

3093

01:46:15,590 --> 01:46:12,960

cooler because it's it's basically

3094

01:46:17,910 --> 01:46:15,600

really dark over everything

3095

01:46:19,590 --> 01:46:17,920

and and what am i saying the reason i

3096

01:46:21,430 --> 01:46:19,600

was saying this to you kurt not only was

3097

01:46:23,990 --> 01:46:21,440

your explanation spot on you're talking

3098

01:46:24,830 --> 01:46:24,000

about mass spec but you could also

3099

01:46:26,790 --> 01:46:24,840

use

3100

01:46:29,350 --> 01:46:26,800

infrared um

3101

01:46:32,870 --> 01:46:29,360

spectroscopy and a telescope to go and

3102

01:46:35,510 --> 01:46:32,880

look for not just life but technology

3103

01:46:37,510 --> 01:46:35,520

that basically is showing itself in the

3104

01:46:39,990 --> 01:46:37,520

in the infrared and uv and maybe x-ray

3105

01:46:42,870 --> 01:46:40,000

whatever

3106

01:46:44,390 --> 01:46:42,880

okay great now on to the ufo question

3107

01:46:46,310 --> 01:46:44,400

brian when you say that scientists have

3108

01:46:48,229 --> 01:46:46,320

an incentive to find life in the

3109

01:46:50,790 --> 01:46:48,239

universe in the sentence via nobel prize

3110

01:46:52,229 --> 01:46:50,800

in money etc i don't buy that per se i

3111

01:46:53,910 --> 01:46:52,239

think they have an incentive to find a

3112

01:46:55,910 --> 01:46:53,920

certain form of life in the universe but

3113

01:46:58,390 --> 01:46:55,920

not life in general and the reason is

3114

01:47:00,550 --> 01:46:58,400

that life in general borders on what is

3115

01:47:03,189 --> 01:47:00,560

considered to be woo or paranormal for

3116

01:47:04,950 --> 01:47:03,199

example if you were to study ufos and

3117

01:47:07,910 --> 01:47:04,960

say is there credibility to these

3118

01:47:09,669 --> 01:47:07,920

reports that's almost not done besides a

3119

01:47:10,950 --> 01:47:09,679

few individuals like kevin knuth for

3120

01:47:12,470 --> 01:47:10,960

example

3121

01:47:15,430 --> 01:47:12,480

because i

3122

01:47:16,870 --> 01:47:15,440

i think almost none of us i don't think

3123

01:47:18,629 --> 01:47:16,880

any of us are actually pursuing the

3124

01:47:20,310 --> 01:47:18,639

truth including myself which is why i

3125

01:47:22,390 --> 01:47:20,320

don't like when people say this channel

3126  
01:47:23,990 --> 01:47:22,400  
is for truth seekers almost none of us

3127  
01:47:25,669 --> 01:47:24,000  
care about the truth per se because the

3128  
01:47:27,350 --> 01:47:25,679  
truth can be extremely hard so we care

3129  
01:47:29,270 --> 01:47:27,360  
about it in a certain bounded fashion so

3130  
01:47:31,510 --> 01:47:29,280  
we also care about our reputations we

3131  
01:47:33,350 --> 01:47:31,520  
care about not sounding like these d in

3132  
01:47:35,030 --> 01:47:33,360  
sensitive to celebrate rednecks which is

3133  
01:47:37,430 --> 01:47:35,040  
what the people in the academy generally

3134  
01:47:39,669 --> 01:47:37,440  
think of those who who consider the ufo

3135  
01:47:41,270 --> 01:47:39,679  
reports to be real they they generally

3136  
01:47:43,430 --> 01:47:41,280  
consider them to and let's be honest

3137  
01:47:45,350 --> 01:47:43,440  
they consider them to be kooks and i

3138  
01:47:47,430 --> 01:47:45,360

think that academics generally care much

3139

01:47:50,149 --> 01:47:47,440

more about either sounding intelligence

3140

01:47:51,669 --> 01:47:50,159

or not appearing to be inane

3141

01:47:52,470 --> 01:47:51,679

more than they care about the truth per

3142

01:47:54,229 --> 01:47:52,480

se

3143

01:47:55,350 --> 01:47:54,239

and so it's it's extremely bounded by

3144

01:47:59,830 --> 01:47:55,360

their

3145

01:48:02,790 --> 01:47:59,840

want to be ostracized it's anathema to

3146

01:48:05,109 --> 01:48:02,800

analyze ufo reports so that's why i say

3147

01:48:06,870 --> 01:48:05,119

i don't buy when

3148

01:48:08,390 --> 01:48:06,880

you say that well we have an extreme

3149

01:48:11,430 --> 01:48:08,400

incentive to find life in the universe a

3150

01:48:14,229 --> 01:48:11,440

certain type of life i agree

3151

01:48:16,229 --> 01:48:14,239

yeah well i think uh i think largely

3152

01:48:18,070 --> 01:48:16,239

that is accurate although i will say in

3153

01:48:19,910 --> 01:48:18,080

my defense you know i did join the

3154

01:48:21,430 --> 01:48:19,920

galileo project with our mutual friend

3155

01:48:22,950 --> 01:48:21,440

navi loeb

3156

01:48:25,109 --> 01:48:22,960

specifically for this reason not as a

3157

01:48:27,189 --> 01:48:25,119

researcher but as a member of the

3158

01:48:28,390 --> 01:48:27,199

external oversight board because i

3159

01:48:30,310 --> 01:48:28,400

actually don't think they need my help

3160

01:48:32,629 --> 01:48:30,320

as an observational astronomer i'm

3161

01:48:34,790 --> 01:48:32,639

pretty good but you know harvard is not

3162

01:48:36,310 --> 01:48:34,800

exactly hurting for for money and

3163

01:48:37,990 --> 01:48:36,320

you know they can certainly raise

3164

01:48:39,669 --> 01:48:38,000

funding especially when you have the you

3165

01:48:41,189 --> 01:48:39,679

know former uh chairman the

3166

01:48:42,950 --> 01:48:41,199

longest-serving chairman in harvard's

3167

01:48:44,790 --> 01:48:42,960

history in the astronomy department at

3168

01:48:46,709 --> 01:48:44,800

the helm who's you know joe rogan's

3169

01:48:48,790 --> 01:48:46,719

appearance blew up the internet and uh

3170

01:48:51,430 --> 01:48:48,800

has has uh you know number five

3171

01:48:52,709 --> 01:48:51,440

bestseller um you know last year in the

3172

01:48:54,149 --> 01:48:52,719

new york times list so i don't think

3173

01:48:55,910 --> 01:48:54,159

they need my help you know kind of

3174

01:48:57,750 --> 01:48:55,920

necessarily doing the research but i do

3175

01:48:59,669 --> 01:48:57,760

think they can always use help

3176

01:49:01,830 --> 01:48:59,679

uh holding them to account

3177

01:49:03,030 --> 01:49:01,840

and you know if i i told this to avi you

3178

01:49:04,790 --> 01:49:03,040

know i wouldn't have called it the

3179

01:49:08,229 --> 01:49:04,800

galileo project i think it's dangerous

3180

01:49:09,750 --> 01:49:08,239

when you know uh astronomers begin uh by

3181

01:49:12,070 --> 01:49:09,760

you know kind of bringing up the names

3182

01:49:13,590 --> 01:49:12,080

like bruno and and galileo and and

3183

01:49:14,950 --> 01:49:13,600

persecuted

3184

01:49:17,350 --> 01:49:14,960

figures in history i think that's a

3185

01:49:19,910 --> 01:49:17,360

fraught perilous endeavor and i think i

3186

01:49:22,229 --> 01:49:19,920

would be even that is sort of a be lying

3187

01:49:23,990 --> 01:49:22,239

a bias in other words his his claim is

3188

01:49:26,070 --> 01:49:24,000

that just like galileo

3189

01:49:28,149 --> 01:49:26,080

suffered from and the inability of the

3190

01:49:29,990 --> 01:49:28,159

powers that be the funding agencies of

3191

01:49:32,950 --> 01:49:30,000

this time the the

3192

01:49:34,870 --> 01:49:32,960

venetian dogens and senate and and other

3193

01:49:36,790 --> 01:49:34,880

agencies to at first look through in the

3194

01:49:39,270 --> 01:49:36,800

catholic church later on to look through

3195

01:49:40,629 --> 01:49:39,280

his telescope and and see for themselves

3196

01:49:42,310 --> 01:49:40,639

as if that would have proven anything i

3197

01:49:44,550 --> 01:49:42,320

mean just looking through a telescope

3198

01:49:46,390 --> 01:49:44,560

proves nothing it's the connection of

3199

01:49:49,350 --> 01:49:46,400

the human mind and the formulation of a

3200

01:49:51,030 --> 01:49:49,360

hypothesis and evidentiary data that

3201

01:49:53,669 --> 01:49:51,040

could disconfirm his hypothesis you know

3202

01:49:55,430 --> 01:49:53,679

galileo had many blunders kurt

3203

01:49:58,870 --> 01:49:55,440

i'm pleased and privileged to be working

3204

01:50:01,990 --> 01:49:58,880

with uh with uh jim gates carlo revelli

3205

01:50:04,070 --> 01:50:02,000

frank wilczyk fabiola giannatti and my

3206

01:50:06,310 --> 01:50:04,080

good friend from uh from uh graduate

3207

01:50:08,229 --> 01:50:06,320

school lucio picarillo on the first ever

3208

01:50:09,990 --> 01:50:08,239

audiobook version of any of galileo's

3209

01:50:11,109 --> 01:50:10,000

book and it's oh that's interesting and

3210

01:50:12,950 --> 01:50:11,119

i also didn't know that that was the

3211

01:50:14,149 --> 01:50:12,960

genesis of the word galileo in the

3212

01:50:15,590 --> 01:50:14,159

project i thought it just meant i'm

3213

01:50:16,550 --> 01:50:15,600

going to be looking out like galileo

3214

01:50:19,030 --> 01:50:16,560

looked down

3215

01:50:20,950 --> 01:50:19,040

no no i mean i i think the project's

3216

01:50:22,870 --> 01:50:20,960

really dangerous i'd like to kind of

3217

01:50:24,709 --> 01:50:22,880

push back on you i mean not push back

3218

01:50:26,629 --> 01:50:24,719

i'd like to reassure you i mean i can't

3219

01:50:28,550 --> 01:50:26,639

speak for brian just a second just a

3220

01:50:30,229 --> 01:50:28,560

second lee i'm so sorry i'm so sorry i

3221

01:50:32,070 --> 01:50:30,239

just want brian to finish because i i

3222

01:50:33,830 --> 01:50:32,080

interrupted him and then so please

3223

01:50:36,709 --> 01:50:33,840

finish brian and then and then leave

3224

01:50:38,550 --> 01:50:36,719

kurt's used to me and throw up punch him

3225

01:50:40,070 --> 01:50:38,560

but uh so we're translating galileo's

3226

01:50:42,550 --> 01:50:40,080

book we have the rights to the first

3227

01:50:44,790 --> 01:50:42,560

ever audiobook for galileo uh with a

3228

01:50:46,310 --> 01:50:44,800

forward by einstein and uh that's read

3229

01:50:49,830 --> 01:50:46,320

by frank wilcheck winner of the nobel

3230

01:50:52,550 --> 01:50:49,840

prize in 2004 and jim gates so what does

3231

01:50:53,910 --> 01:50:52,560

it say it says galileo was wrote the the

3232

01:50:55,430 --> 01:50:53,920

the definitive treatise on the

3233

01:50:57,590 --> 01:50:55,440

scientific method on what you're

3234

01:50:59,189 --> 01:50:57,600

supposed to do with evidence etc etc and

3235

01:51:01,270 --> 01:50:59,199

yet in that very book he makes a

3236

01:51:03,910 --> 01:51:01,280

catastrophic confirmation blunder at the

3237

01:51:05,430 --> 01:51:03,920

very end on day four it's a trialog

3238

01:51:07,030 --> 01:51:05,440

between these three characters i'm one

3239

01:51:08,870 --> 01:51:07,040

of them carlo revelli's another one and

3240

01:51:11,430 --> 01:51:08,880

my friend lucio's the other and we go

3241

01:51:13,510 --> 01:51:11,440

about and we're trying to disprove uh uh

3242

01:51:16,310 --> 01:51:13,520

galileo's character salviati is trying

3243

01:51:18,070 --> 01:51:16,320

to disprove uh the uh the the

3244

01:51:20,950 --> 01:51:18,080

earth-centered notion of the universe

3245

01:51:23,189 --> 01:51:20,960

that's held by simplicio the simpleton

3246

01:51:24,790 --> 01:51:23,199

who is espousing the words of the pope

3247

01:51:26,550 --> 01:51:24,800

uh that the earth is the center of the

3248

01:51:28,870 --> 01:51:26,560

universe and then i'm playing segreto

3249

01:51:30,709 --> 01:51:28,880

the kind of knowledgeable lay person who

3250

01:51:32,870 --> 01:51:30,719

is interpreting between them and galilee

3251

01:51:34,390 --> 01:51:32,880

is a phenomenal writer but he goes

3252

01:51:36,070 --> 01:51:34,400

through and describes these things in

3253

01:51:38,149 --> 01:51:36,080

such loving detail that even i become

3254

01:51:40,790 --> 01:51:38,159

convinced when he goes about and says

3255

01:51:43,430 --> 01:51:40,800

that the tides on the earth are proof

3256

01:51:45,510 --> 01:51:43,440

that the earth is going around uh the

3257

01:51:46,790 --> 01:51:45,520

sun that's complete balderdash we know

3258

01:51:48,629 --> 01:51:46,800

that's not correct and it would take

3259

01:51:50,550 --> 01:51:48,639

newton to do it and his argument is very

3260

01:51:52,070 --> 01:51:50,560

simple and persuasive it uses data it

3261

01:51:54,470 --> 01:51:52,080

would have gotten accepted by nature

3262

01:51:56,790 --> 01:51:54,480

probably if nature had existed not like

3263

01:51:57,830 --> 01:51:56,800

you know lees travails um but his

3264

01:51:59,350 --> 01:51:57,840

argument is that you've got this you

3265

01:52:01,350 --> 01:51:59,360

know you've got this object that's going

3266

01:52:03,350 --> 01:52:01,360

around the sun here's the sun over here

3267

01:52:05,750 --> 01:52:03,360

and here we've got tides on the earth

3268

01:52:07,589 --> 01:52:05,760

and uh as it goes around the sun it

3269

01:52:09,990 --> 01:52:07,599

orbits and the tide sloshes around and

3270

01:52:11,510 --> 01:52:10,000

that's why we have ti it's totally wrong

3271

01:52:13,430 --> 01:52:11,520

the tides are caused by the lunar

3272

01:52:15,189 --> 01:52:13,440

gravitational force the tidal force

3273

01:52:16,950 --> 01:52:15,199

quadripolar moment of the lunar

3274

01:52:18,709 --> 01:52:16,960

gravitational force field nothing to do

3275

01:52:21,270 --> 01:52:18,719

with our motion around the sun really

3276

01:52:23,430 --> 01:52:21,280

and yet it's incredibly persuasive and

3277

01:52:25,350 --> 01:52:23,440

so if you took the lessons of absolute

3278

01:52:26,790 --> 01:52:25,360

objective history and you say like

3279

01:52:28,550 --> 01:52:26,800

should we have listened to galileo no

3280

01:52:29,990 --> 01:52:28,560

you'd throw out that book you throw it

3281

01:52:31,589 --> 01:52:30,000

out you say it's nonsense even though

3282

01:52:33,589 --> 01:52:31,599

that he brings up relativity for the

3283

01:52:35,109 --> 01:52:33,599

first time in human history the notion

3284

01:52:36,870 --> 01:52:35,119

of relative motion does not affect the

3285

01:52:38,709 --> 01:52:36,880

laws of nature which we now call lorentz

3286

01:52:40,470 --> 01:52:38,719

and variance these are foundational

3287

01:52:42,229 --> 01:52:40,480

things and yet the summary of the book

3288

01:52:43,910 --> 01:52:42,239

is totally wrong the conclusion of the

3289

01:52:45,910 --> 01:52:43,920

book is totally misproven and he didn't

3290

01:52:47,109 --> 01:52:45,920

use the best evidence in hand so look

3291

01:52:49,589 --> 01:52:47,119

for that coming soon hopefully on

3292

01:52:51,510 --> 01:52:49,599

galileo's birthday in february but

3293

01:52:53,589 --> 01:52:51,520

this is all to say when it comes to when

3294

01:52:54,950 --> 01:52:53,599

it comes to avi's project avi loeb's

3295

01:52:56,790 --> 01:52:54,960

project

3296

01:52:58,870 --> 01:52:56,800

i think they need oversight more than

3297

01:53:00,950 --> 01:52:58,880

they need my insight which is to say

3298

01:53:03,750 --> 01:53:00,960

that i think the the first reaction that

3299

01:53:05,430 --> 01:53:03,760

we have to have is skepticism because we

3300

01:53:07,350 --> 01:53:05,440

do want to believe i think if we all go

3301

01:53:08,950 --> 01:53:07,360

back to our 12 year old boys when we

3302

01:53:11,189 --> 01:53:08,960

were 12 year old boys forget about

3303

01:53:13,510 --> 01:53:11,199

funding and and i'm going to lose my my

3304

01:53:15,750 --> 01:53:13,520

my status as a chair professor or lee's

3305

01:53:17,350 --> 01:53:15,760

gonna lose no we're just little boys and

3306

01:53:19,510 --> 01:53:17,360

we're playing with that little pebble on

3307

01:53:21,510 --> 01:53:19,520

the beach like ninten said and we're

3308

01:53:23,669 --> 01:53:21,520

looking for a shinier pebble if we were

3309

01:53:25,589 --> 01:53:23,679

to discover that i mean it raises the

3310

01:53:28,149 --> 01:53:25,599

hair in the back of my neck that there

3311

01:53:29,910 --> 01:53:28,159

was extraterrestrial intelligence first

3312

01:53:31,109 --> 01:53:29,920

life you know i i have my misgivings

3313

01:53:32,229 --> 01:53:31,119

i've talked to lee about that we'll talk

3314

01:53:34,390 --> 01:53:32,239

about that some other but just about

3315

01:53:36,070 --> 01:53:34,400

slime mold on the planet enceladus or

3316

01:53:37,990 --> 01:53:36,080

the moon enceladus i don't think that

3317

01:53:39,910 --> 01:53:38,000

will make as big an impact as lee does

3318

01:53:41,910 --> 01:53:39,920

but let's leave that aside let's just

3319

01:53:44,070 --> 01:53:41,920

talk about ufos i

3320

01:53:46,229 --> 01:53:44,080

don't want to believe i want to have

3321

01:53:47,270 --> 01:53:46,239

evidence and i think if you if you bury

3322

01:53:49,189 --> 01:53:47,280

your head in the sand you won't get

3323

01:53:51,510 --> 01:53:49,199

evidence so i have to say

3324

01:53:53,990 --> 01:53:51,520

and i hope this is true of avi too uh

3325

01:53:55,589 --> 01:53:54,000

that we are kind of the boy the 12 year

3326

01:53:56,790 --> 01:53:55,599

old boys sitting on the on the bed not

3327

01:53:58,550 --> 01:53:56,800

being able to fall asleep at night

3328

01:54:00,310 --> 01:53:58,560

looking up at the stars we do want to

3329

01:54:02,470 --> 01:54:00,320

know the truth uh but we want to have

3330

01:54:05,030 --> 01:54:02,480

evidence for it as mature men as

3331

01:54:06,070 --> 01:54:05,040

scientists at this very moment so anyway

3332

01:54:07,669 --> 01:54:06,080

lee you were going to say you've got

3333

01:54:09,030 --> 01:54:07,679

some problems with with uh with the

3334

01:54:10,550 --> 01:54:09,040

project and i'm happy again i don't

3335

01:54:11,910 --> 01:54:10,560

speak for them i'm on their external

3336

01:54:14,149 --> 01:54:11,920

advisory committee i think it's

3337

01:54:15,750 --> 01:54:14,159

important to do but i am predisposed

3338

01:54:17,510 --> 01:54:15,760

it's like the bets that stephen hawking

3339

01:54:20,149 --> 01:54:17,520

used to make with kip thorne he would

3340

01:54:22,550 --> 01:54:20,159

bet against hawking radiation ever being

3341

01:54:24,550 --> 01:54:22,560

you know validated and uh so that if he

3342

01:54:26,229 --> 01:54:24,560

lost a bet you know he'd have the thrill

3343

01:54:27,430 --> 01:54:26,239

of intellectual superiority being

3344

01:54:29,830 --> 01:54:27,440

correct

3345

01:54:31,510 --> 01:54:29,840

uh so what say you lee

3346

01:54:33,270 --> 01:54:31,520

yeah i mean it's no big it's no big deal

3347

01:54:38,310 --> 01:54:33,280

i'm i think i'm i've got a lot of

3348

01:54:40,550 --> 01:54:38,320

sympathy for kurt's position or kind of

3349

01:54:43,510 --> 01:54:40,560

worry about where we are as scientists

3350

01:54:45,430 --> 01:54:43,520

look for ufos but i think that i know

3351

01:54:47,750 --> 01:54:45,440

avi very well he's great but he's

3352

01:54:49,830 --> 01:54:47,760

playing a very strange game here i would

3353

01:54:51,510 --> 01:54:49,840

like to say he's kind of saying oh the

3354

01:54:53,589 --> 01:54:51,520

scientific establishment's not ready for

3355

01:54:55,990 --> 01:54:53,599

this i'm a genuine conterian and i'm

3356

01:54:57,270 --> 01:54:56,000

just gonna i'm just gonna basically come

3357

01:54:59,589 --> 01:54:57,280

up with these things i'm being ignored

3358

01:55:01,669 --> 01:54:59,599

no he's just making stuff up all right

3359

01:55:04,149 --> 01:55:01,679

making stuff up what is he making up a

3360

01:55:06,550 --> 01:55:04,159

theo location with leah cronin and avilo

3361

01:55:08,229 --> 01:55:06,560

is about to be booked we got a plan

3362

01:55:09,910 --> 01:55:08,239

yeah so what i mean by he's making stuff

3363

01:55:12,629 --> 01:55:09,920

up he's making up a

3364

01:55:14,629 --> 01:55:12,639

false argument about um

3365

01:55:16,070 --> 01:55:14,639

that people are kind of you know when it

3366

01:55:18,149 --> 01:55:16,080

comes to this interstellar object that

3367

01:55:20,070 --> 01:55:18,159

came through and he was just he was

3368

01:55:22,709 --> 01:55:20,080

saying why it could be alien space junk

3369

01:55:25,990 --> 01:55:22,719

sure it could be all sorts of things but

3370

01:55:27,669 --> 01:55:26,000

it but we were trying to understand

3371

01:55:29,510 --> 01:55:27,679

what the characteristics of trajectory

3372

01:55:31,350 --> 01:55:29,520

were telling us so he's kind of making

3373

01:55:32,709 --> 01:55:31,360

up stories which are fine i don't mean

3374

01:55:34,229 --> 01:55:32,719

he's fabricating stuff i mean he's

3375

01:55:36,709 --> 01:55:34,239

saying a narrative

3376

01:55:38,870 --> 01:55:36,719

and i'm wondering why is he making that

3377

01:55:40,870 --> 01:55:38,880

narrative what does he have to gain

3378

01:55:43,189 --> 01:55:40,880

other than some kind of you know fame

3379

01:55:45,189 --> 01:55:43,199

and notoriety and i'm going to be

3380

01:55:46,950 --> 01:55:45,199

downtrodden by the establishment because

3381

01:55:48,950 --> 01:55:46,960

if i suddenly said to brian hey brian

3382

01:55:50,790 --> 01:55:48,960

we've just found wormholes i saw it over

3383

01:55:52,229 --> 01:55:50,800

there look wormhole over there wormhole

3384

01:55:53,830 --> 01:55:52,239

over there wormhole over there and and

3385

01:55:55,270 --> 01:55:53,840

then brian says lee you haven't got any

3386

01:55:56,390 --> 01:55:55,280

wormholes you just may you know you

3387

01:55:58,709 --> 01:55:56,400

haven't got any date and i'll be like

3388

01:56:00,310 --> 01:55:58,719

you're just beating me up big professor

3389

01:56:01,990 --> 01:56:00,320

you know and i think it's a bit like

3390

01:56:03,910 --> 01:56:02,000

this so well i i'm really glad that

3391

01:56:05,589 --> 01:56:03,920

brian that is kind of borderline ad

3392

01:56:08,790 --> 01:56:05,599

hominem lee i have to point that out i

3393

01:56:10,709 --> 01:56:08,800

mean i love avi i fight with avi but but

3394

01:56:12,470 --> 01:56:10,719

that seems like imputing his impugning

3395

01:56:14,149 --> 01:56:12,480

his character almost you can

3396

01:56:16,629 --> 01:56:14,159

disassociate yourself from it what i'm

3397

01:56:20,070 --> 01:56:16,639

trying to say to so it's not clipped out

3398

01:56:21,350 --> 01:56:20,080

of context is that i like the idea of

3399

01:56:23,030 --> 01:56:21,360

searching

3400

01:56:24,550 --> 01:56:23,040

but i there is this so what i'm trying

3401  
01:56:26,629 --> 01:56:24,560  
to say there's this cultural vibe going

3402  
01:56:28,070 --> 01:56:26,639  
on right now our culture is changing

3403  
01:56:29,350 --> 01:56:28,080  
people are asking questions what are

3404  
01:56:31,750 --> 01:56:29,360  
these things that the pentagon has

3405  
01:56:32,950 --> 01:56:31,760  
released what is the probability of us

3406  
01:56:35,510 --> 01:56:32,960  
this happening

3407  
01:56:37,510 --> 01:56:35,520  
and and i'm saying that we don't

3408  
01:56:40,229 --> 01:56:37,520  
we could play together i would love to

3409  
01:56:41,589 --> 01:56:40,239  
help avi be successful i it doesn't i

3410  
01:56:43,589 --> 01:56:41,599  
don't think it's a

3411  
01:56:45,189 --> 01:56:43,599  
we i don't think the establishment is

3412  
01:56:47,669 --> 01:56:45,199  
against him i don't think even i'm in

3413  
01:56:50,550 --> 01:56:47,679

the establishment we genuinely want to

3414

01:56:51,750 --> 01:56:50,560

know and i do agree with you that there

3415

01:56:53,669 --> 01:56:51,760

is some

3416

01:56:55,510 --> 01:56:53,679

we are putting we could put our careers

3417

01:56:57,270 --> 01:56:55,520

on the line if we get it wrong but

3418

01:56:59,350 --> 01:56:57,280

actually in science you have become

3419

01:57:00,709 --> 01:56:59,360

better scientists the more you're wrong

3420

01:57:03,350 --> 01:57:00,719

and what i'm saying here is abby's

3421

01:57:05,109 --> 01:57:03,360

adopting an extreme viewpoint where he

3422

01:57:06,310 --> 01:57:05,119

may not allow himself to be wrong and

3423

01:57:07,910 --> 01:57:06,320

it's not an ad hominem not saying he's

3424

01:57:09,189 --> 01:57:07,920

anything bad i'm not saying he's doing

3425

01:57:11,109 --> 01:57:09,199

anything dishonest i'm saying he's

3426  
01:57:12,709 --> 01:57:11,119  
making a narrative well let's be precise

3427  
01:57:14,550 --> 01:57:12,719  
so i had him on my show

3428  
01:57:16,550 --> 01:57:14,560  
and it was a wonderful episode and this

3429  
01:57:18,629 --> 01:57:16,560  
is long before i decided to join

3430  
01:57:21,109 --> 01:57:18,639  
and i said avi i don't believe that you

3431  
01:57:23,669 --> 01:57:21,119  
believe this is real that this

3432  
01:57:26,550 --> 01:57:23,679  
is an extraterrestrial and he says

3433  
01:57:29,430 --> 01:57:26,560  
and i said because if you did you happen

3434  
01:57:32,229 --> 01:57:29,440  
to have access to a resource that's

3435  
01:57:33,990 --> 01:57:32,239  
highly complex has a lot of uh

3436  
01:57:37,189 --> 01:57:34,000  
has a lot of assembly behind it called

3437  
01:57:39,589 --> 01:57:37,199  
yuri milner who is a russian billionaire

3438  
01:57:41,589 --> 01:57:39,599

and he's showered upon uh you the

3439

01:57:43,350 --> 01:57:41,599

potential as a leader of the

3440

01:57:45,030 --> 01:57:43,360

breakthrough starshot uh prize one of

3441

01:57:46,790 --> 01:57:45,040

the leaders uh there's tremendous

3442

01:57:48,870 --> 01:57:46,800

resource so instead of sending you know

3443

01:57:50,950 --> 01:57:48,880

ten to the fourth uh cell phone cameras

3444

01:57:53,189 --> 01:57:50,960

to proxima century b

3445

01:57:54,790 --> 01:57:53,199

why don't you send one of them at you

3446

01:57:56,070 --> 01:57:54,800

know not even half the speed of life not

3447

01:57:58,470 --> 01:57:56,080

even ten percent of the speed i'll just

3448

01:58:00,470 --> 01:57:58,480

you know three four percent and catch up

3449

01:58:01,910 --> 01:58:00,480

to omumu and you know what he said he

3450

01:58:03,510 --> 01:58:01,920

said no no we don't need to do that

3451  
01:58:06,390 --> 01:58:03,520  
because when ruben telescope which is

3452  
01:58:08,229 --> 01:58:06,400  
the vera rubin uh uh observatory in

3453  
01:58:09,910 --> 01:58:08,239  
chile which is going to be a phenomenal

3454  
01:58:11,430 --> 01:58:09,920  
instrument it's designed it was the

3455  
01:58:12,629 --> 01:58:11,440  
original name was the large-scale

3456  
01:58:14,709 --> 01:58:12,639  
synoptic

3457  
01:58:16,709 --> 01:58:14,719  
survey telescope to survey the whole sky

3458  
01:58:18,629 --> 01:58:16,719  
with a huge cadence very quickly looking

3459  
01:58:20,229 --> 01:58:18,639  
for objects that are anomalous that

3460  
01:58:21,750 --> 01:58:20,239  
could do and he says that's one of the

3461  
01:58:23,589 --> 01:58:21,760  
dream machines for discovering we

3462  
01:58:25,589 --> 01:58:23,599  
already discovered one of them using pan

3463  
01:58:27,350 --> 01:58:25,599

stars on hawaii um so we're gonna

3464

01:58:29,030 --> 01:58:27,360

discover millions of these things i said

3465

01:58:31,430 --> 01:58:29,040

well avi you know i don't know if you

3466

01:58:33,030 --> 01:58:31,440

know about this but you know like uh you

3467

01:58:34,550 --> 01:58:33,040

know sometimes you know

3468

01:58:36,390 --> 01:58:34,560

things happen only once you know there's

3469

01:58:37,830 --> 01:58:36,400

an n of one problem that we talk about

3470

01:58:39,910 --> 01:58:37,840

and what if this yeah what if they are

3471

01:58:41,669 --> 01:58:39,920

abundant and what if there are forces

3472

01:58:43,030 --> 01:58:41,679

that conspire against in our solar

3473

01:58:45,350 --> 01:58:43,040

system just particularly not to the

3474

01:58:48,149 --> 01:58:45,360

cosmos to our solar system maybe the

3475

01:58:50,229 --> 01:58:48,159

lunar you know so tidal solar whatever

3476

01:58:52,070 --> 01:58:50,239

whatever it is um and it makes these

3477

01:58:53,830 --> 01:58:52,080

objects very very unlikely to ever be

3478

01:58:55,109 --> 01:58:53,840

seen again even though they're abundant

3479

01:58:57,270 --> 01:58:55,119

wouldn't you want to catch up to the

3480

01:58:59,350 --> 01:58:57,280

only one with all the resources you have

3481

01:59:00,870 --> 01:58:59,360

and he was sort of agnostic about it

3482

01:59:02,310 --> 01:59:00,880

that gave me some pause and that's one

3483

01:59:05,430 --> 01:59:02,320

of the things i'm going to push back on

3484

01:59:07,109 --> 01:59:05,440

as an external advisor but i i would you

3485

01:59:08,629 --> 01:59:07,119

know and i love you lee but but i don't

3486

01:59:11,510 --> 01:59:08,639

think he's doing it for fam i mean he

3487

01:59:13,830 --> 01:59:11,520

has an ego that's well known um he's he

3488

01:59:16,709 --> 01:59:13,840

has trouble controlling um you know

3489

01:59:17,910 --> 01:59:16,719

sometimes his passions for what he does

3490

01:59:19,350 --> 01:59:17,920

i think he's doing an incredible

3491

01:59:20,709 --> 01:59:19,360

valuable service but i just want to talk

3492

01:59:22,629 --> 01:59:20,719

about from the perspective as an

3493

01:59:25,030 --> 01:59:22,639

observational astronomer can

3494

01:59:26,709 --> 01:59:25,040

observational astronomers provide

3495

01:59:27,750 --> 01:59:26,719

information in the way that you've been

3496

01:59:30,070 --> 01:59:27,760

using it

3497

01:59:32,149 --> 01:59:30,080

about this phenomenon uh in other words

3498

01:59:34,470 --> 01:59:32,159

we survey the sky in all wavelength

3499

01:59:36,229 --> 01:59:34,480

bands 24 7 around the earth from

3500

01:59:38,870 --> 01:59:36,239

antarctica where i've been twice for two

3501

01:59:42,790 --> 01:59:38,880

months of my life uh and uh to the north

3502

01:59:45,109 --> 01:59:42,800

pole to space now we've got jwst um what

3503

01:59:45,910 --> 01:59:45,119

would it convince a believer

3504

01:59:48,470 --> 01:59:45,920

to

3505

01:59:50,470 --> 01:59:48,480

give up the uh the expectations in other

3506

01:59:52,470 --> 01:59:50,480

words carl sagan said lack of evidence

3507

01:59:54,470 --> 01:59:52,480

is not evidence of absence or absence of

3508

01:59:56,229 --> 01:59:54,480

evidence so we can't but we can't we

3509

01:59:58,070 --> 01:59:56,239

also have to admit we have conserved

3510

01:59:59,589 --> 01:59:58,080

resources and finite time which is the

3511

02:00:00,950 --> 01:59:59,599

most prominent of all reasons

3512

02:00:02,390 --> 02:00:00,960

let me just come in quickly so i

3513

02:00:04,629 --> 02:00:02,400

completely agree we're all characters

3514

02:00:06,870 --> 02:00:04,639

right and i know avid is great

3515

02:00:08,470 --> 02:00:06,880

all i'm trying to say is um we i want

3516

02:00:10,550 --> 02:00:08,480

him to help i want him to succeed so

3517

02:00:12,070 --> 02:00:10,560

exactly i think my the only thing i

3518

02:00:13,750 --> 02:00:12,080

would comment here say how can we help

3519

02:00:15,109 --> 02:00:13,760

you let's help let's help you do this

3520

02:00:17,589 --> 02:00:15,119

right whatever you think the narratives

3521

02:00:19,430 --> 02:00:17,599

are it's capturing the day i do think we

3522

02:00:21,510 --> 02:00:19,440

have a responsibility though and it's

3523

02:00:24,310 --> 02:00:21,520

not an ad holmen it is kind of a bit way

3524

02:00:27,270 --> 02:00:24,320

in this polarization in the time of

3525

02:00:29,830 --> 02:00:27,280

covet elections we do have a

3526

02:00:31,510 --> 02:00:29,840

responsibility for correctly framing the

3527

02:00:32,950 --> 02:00:31,520

arguments we're not leading people down

3528

02:00:34,470 --> 02:00:32,960

the guard up the garden path that's the

3529

02:00:36,310 --> 02:00:34,480

only point i'm getting at i mean being

3530

02:00:38,629 --> 02:00:36,320

too optimistic or being too high

3531

02:00:40,229 --> 02:00:38,639

salesman yeah exactly exactly that's all

3532

02:00:42,709 --> 02:00:40,239

i mean nothing else everything else is

3533

02:00:44,149 --> 02:00:42,719

good so what i would say to avi is like

3534

02:00:45,270 --> 02:00:44,159

how can we help you what i would say to

3535

02:00:46,470 --> 02:00:45,280

kurt it's like

3536

02:00:48,709 --> 02:00:46,480

what do you think

3537

02:00:50,310 --> 02:00:48,719

science science mainstream science is

3538

02:00:53,589 --> 02:00:50,320

doing enough of you're finding

3539

02:00:56,070 --> 02:00:53,599

frustrating because you know i'm i'm a

3540

02:00:57,430 --> 02:00:56,080

i'm a cheap scientist in the regard

3541

02:00:59,030 --> 02:00:57,440

i want to know why i'm in the universe i

3542

02:00:59,910 --> 02:00:59,040

want to know why i'm here i want to have

3543

02:01:01,589 --> 02:00:59,920

meaning

3544

02:01:03,270 --> 02:01:01,599

if there are aliens out there i want to

3545

02:01:05,270 --> 02:01:03,280

know it's not just the right type of

3546

02:01:09,350 --> 02:01:05,280

alien any will do me

3547

02:01:12,870 --> 02:01:11,189

getting meaning from science and meaning

3548

02:01:14,870 --> 02:01:12,880

from life in the universe that might

3549

02:01:16,870 --> 02:01:14,880

have to be a part two uh kirk but but

3550

02:01:18,470 --> 02:01:16,880

anyway yeah i know we both

3551

02:01:20,950 --> 02:01:18,480

want we want evidence right we don't

3552

02:01:22,550 --> 02:01:20,960

want to just you know just marginally

3553

02:01:24,550 --> 02:01:22,560

and we only have finite amount of time

3554

02:01:25,510 --> 02:01:24,560

and intellectual time but don't forget

3555

02:01:28,550 --> 02:01:25,520

you know

3556

02:01:29,830 --> 02:01:28,560

i can tell you from experience in a few

3557

02:01:31,270 --> 02:01:29,840

years you're going to have trouble

3558

02:01:34,550 --> 02:01:31,280

remembering your kids names and you know

3559

02:01:36,070 --> 02:01:34,560

hopefully you know uh that'll stop but

3560

02:01:39,189 --> 02:01:36,080

uh but but we only have so much time for

3561

02:01:41,990 --> 02:01:39,199

attention to pay attention to things of

3562

02:01:43,910 --> 02:01:42,000

of of great import to us so i i you know

3563

02:01:45,669 --> 02:01:43,920

i guess the the subject is what what

3564

02:01:47,589 --> 02:01:45,679

else should we be doing we being

3565

02:01:50,390 --> 02:01:47,599

astronomers avi's not going to build you

3566

02:01:52,149 --> 02:01:50,400

know a large hadron collider squared you

3567

02:01:53,830 --> 02:01:52,159

know look for uh inter-dimensional

3568

02:01:54,870 --> 02:01:53,840

aliens you know manipulating wormholes

3569

02:01:56,229 --> 02:01:54,880

to get here right he's he's an

3570

02:01:58,550 --> 02:01:56,239

astronomer he's a theorist by the way

3571

02:02:00,870 --> 02:01:58,560

he's not an observer so so i think he

3572

02:02:02,550 --> 02:02:00,880

needs help uh i think the the you know

3573

02:02:04,550 --> 02:02:02,560

having you involved you know from that

3574

02:02:07,030 --> 02:02:04,560

perspective but then how do we translate

3575

02:02:09,430 --> 02:02:07,040

the signatures from assembly from you

3576

02:02:11,109 --> 02:02:09,440

know can be how do we translate that

3577

02:02:12,870 --> 02:02:11,119

into an actionable metric that will

3578

02:02:13,990 --> 02:02:12,880

allow us to reduce our uncertainty

3579

02:02:15,669 --> 02:02:14,000

getting back to our rubric at the

3580

02:02:16,950 --> 02:02:15,679

beginning of this conversation

3581

02:02:18,870 --> 02:02:16,960

well let me answer

3582

02:02:21,669 --> 02:02:18,880

one direct thing i think we can do this

3583

02:02:22,870 --> 02:02:21,679

with image data and time series data and

3584

02:02:24,229 --> 02:02:22,880

one of the things that would be very

3585

02:02:26,390 --> 02:02:24,239

interesting is like if you take any

3586

02:02:28,229 --> 02:02:26,400

given image on its dimensionality and

3587

02:02:29,830 --> 02:02:28,239

let's say i mean kurt you've got

3588

02:02:32,629 --> 02:02:29,840

assembly in one second it's brilliant

3589

02:02:34,390 --> 02:02:32,639

right you can apply the same thing to

3590

02:02:36,390 --> 02:02:34,400

two dimensional images and also time

3591

02:02:39,589 --> 02:02:36,400

series images of course you have to

3592

02:02:41,270 --> 02:02:39,599

define your axioms precisely like when

3593

02:02:42,629 --> 02:02:41,280

you're looking at how this image image

3594

02:02:44,790 --> 02:02:42,639

can be created it's very rare you see

3595

02:02:46,070 --> 02:02:44,800

like a straight edge in nature it just

3596

02:02:48,550 --> 02:02:46,080

doesn't happen right so you're looking

3597

02:02:51,109 --> 02:02:48,560

for yeah i mean and so i i think that's

3598

02:02:52,709 --> 02:02:51,119

right and i i what i would say um

3599

02:02:54,310 --> 02:02:52,719

quickly is

3600

02:02:56,790 --> 02:02:54,320

i've looked at these pentagon images and

3601  
02:02:58,790 --> 02:02:56,800  
i spoke to someone who was responsible

3602  
02:03:01,030 --> 02:02:58,800  
for releasing some of them and i was

3603  
02:03:02,550 --> 02:03:01,040  
like are you just trying to basically

3604  
02:03:04,070 --> 02:03:02,560  
are you just were you bored one day or

3605  
02:03:05,270 --> 02:03:04,080  
did you need more funding or something

3606  
02:03:07,750 --> 02:03:05,280  
why did you do it they were like no

3607  
02:03:09,669 --> 02:03:07,760  
actually we genuinely think

3608  
02:03:11,589 --> 02:03:09,679  
public paid for this data in a way and

3609  
02:03:13,350 --> 02:03:11,599  
we're just throwing it out there so what

3610  
02:03:14,870 --> 02:03:13,360  
i when i try to get out of them what

3611  
02:03:16,550 --> 02:03:14,880  
they thought they wouldn't tell me so

3612  
02:03:18,470 --> 02:03:16,560  
what do you think of these images i mean

3613  
02:03:20,470 --> 02:03:18,480

you must have i've looked at them i've

3614

02:03:22,950 --> 02:03:20,480

listened to people on podcasts on joe

3615

02:03:24,830 --> 02:03:22,960

rogan's podcast in particular and looked

3616

02:03:27,109 --> 02:03:24,840

at the data and there's all this

3617

02:03:28,470 --> 02:03:27,119

mischaracterization of different people

3618

02:03:30,550 --> 02:03:28,480

looking at different

3619

02:03:32,390 --> 02:03:30,560

data sets and saying things like there's

3620

02:03:35,270 --> 02:03:32,400

this object that i think brian you've

3621

02:03:37,589 --> 02:03:35,280

talked about this this this this uh this

3622

02:03:40,550 --> 02:03:37,599

tic-tac that went from supposedly you

3623

02:03:42,390 --> 02:03:40,560

know um very high up to 50 feet off the

3624

02:03:43,750 --> 02:03:42,400

ocean in like a second

3625

02:03:45,430 --> 02:03:43,760

um

3626

02:03:46,790 --> 02:03:45,440

but kurt you have a look at this data

3627

02:03:49,430 --> 02:03:46,800

what do you think of it do you think

3628

02:03:51,589 --> 02:03:49,440

it's compelling or or are you frustrated

3629

02:03:53,109 --> 02:03:51,599

about the quality or

3630

02:03:54,709 --> 02:03:53,119

what what is your opinion i think it's

3631

02:03:57,189 --> 02:03:54,719

sad that people

3632

02:03:58,390 --> 02:03:57,199

hold these as as evidence of ufos

3633

02:03:59,910 --> 02:03:58,400

because i don't think

3634

02:04:02,229 --> 02:03:59,920

they are necessarily i think that

3635

02:04:03,990 --> 02:04:02,239

they're extremely poor evidence and what

3636

02:04:05,589 --> 02:04:04,000

about sightings what about what about

3637

02:04:07,510 --> 02:04:05,599

eyewitnesses

3638

02:04:09,189 --> 02:04:07,520

that's why all of it has to be looked at

3639

02:04:10,870 --> 02:04:09,199

so when someone if someone is to tell me

3640

02:04:12,470 --> 02:04:10,880

that bigfoot exists and i ask for

3641

02:04:13,830 --> 02:04:12,480

footage and then they show me some

3642

02:04:15,990 --> 02:04:13,840

pixelated video i don't think that

3643

02:04:18,709 --> 02:04:16,000

that's great evidence for bigfoot now

3644

02:04:20,310 --> 02:04:18,719

that in tandem with a variety of stories

3645

02:04:22,790 --> 02:04:20,320

from people who we would think of as

3646

02:04:24,870 --> 02:04:22,800

credible in any other situation that in

3647

02:04:27,109 --> 02:04:24,880

tandem with let's say a rape trial we

3648

02:04:29,669 --> 02:04:27,119

would send someone to jail based on two

3649

02:04:31,910 --> 02:04:29,679

or three witness testimonies and yet we

3650

02:04:35,270 --> 02:04:31,920

have a team of people who are extremely

3651

02:04:37,189 --> 02:04:35,280

credible who testify to the strangeness

3652

02:04:39,189 --> 02:04:37,199

of this phenomenon and then we don't we

3653

02:04:40,790 --> 02:04:39,199

think well perhaps their eyes are

3654

02:04:42,550 --> 02:04:40,800

misleading them well i don't think

3655

02:04:44,310 --> 02:04:42,560

that's reasonable so i think it's

3656

02:04:46,149 --> 02:04:44,320

strange i don't find any single one of

3657

02:04:48,149 --> 02:04:46,159

the videos to be compelling i find the

3658

02:04:49,669 --> 02:04:48,159

set of videos to be somewhat compelling

3659

02:04:52,950 --> 02:04:49,679

that there's something strange happening

3660

02:04:55,189 --> 02:04:52,960

but i find the total set of i'm

3661

02:04:57,109 --> 02:04:55,199

putting evidence in scare quotes here

3662

02:04:58,870 --> 02:04:57,119

evidence of ufos to be

3663

02:05:01,270 --> 02:04:58,880

interesting and i also don't believe

3664

02:05:03,669 --> 02:05:01,280

that we want to believe in ufos i know

3665

02:05:04,470 --> 02:05:03,679

that you said that brian i know

3666

02:05:05,589 --> 02:05:04,480

well

3667

02:05:07,589 --> 02:05:05,599

i want to believe in i want to have

3668

02:05:08,709 --> 02:05:07,599

evidence yeah yeah well you also

3669

02:05:10,550 --> 02:05:08,719

mentioned that we have this need to

3670

02:05:12,470 --> 02:05:10,560

believe in external life and i don't

3671

02:05:13,910 --> 02:05:12,480

think that's true for me personally i

3672

02:05:16,390 --> 02:05:13,920

hope that all of what's happening with

3673

02:05:18,470 --> 02:05:16,400

ufos is false well lee said something

3674

02:05:20,550 --> 02:05:18,480

sorry kurt well i'm just afraid of the

3675

02:05:22,390 --> 02:05:20,560

implications and i think that anyone who

3676

02:05:24,149 --> 02:05:22,400

seriously thinks about this perhaps

3677

02:05:25,990 --> 02:05:24,159

should be because it may indicate that

3678

02:05:28,070 --> 02:05:26,000

we're not at the top of the food chain

3679

02:05:29,589 --> 02:05:28,080

it may mean that we don't mean what we

3680

02:05:31,589 --> 02:05:29,599

think we mean in terms of our place in

3681

02:05:33,189 --> 02:05:31,599

the universe our purpose even i feel the

3682

02:05:34,629 --> 02:05:33,199

same way about the prospects of hell i

3683

02:05:36,390 --> 02:05:34,639

don't want to believe in hell not that i

3684

02:05:38,310 --> 02:05:36,400

do but i don't want to believe in it in

3685

02:05:40,149 --> 02:05:38,320

some ways i don't want to believe in god

3686

02:05:41,990 --> 02:05:40,159

in some ways i find comfort in that

3687

02:05:43,510 --> 02:05:42,000

consciousness ends so there are so many

3688

02:05:45,510 --> 02:05:43,520

beliefs that people say well people have

3689

02:05:47,830 --> 02:05:45,520

a need to believe in in god people have

3690

02:05:49,830 --> 02:05:47,840

a need to believe in ufos some do some

3691

02:05:53,270 --> 02:05:49,840

don't and i think that if you seriously

3692

02:05:54,629 --> 02:05:53,280

thought about ufos perhaps

3693

02:05:56,950 --> 02:05:54,639

perhaps you would want to believe that

3694

02:05:59,270 --> 02:05:56,960

they don't exist when i say ufos i mean

3695

02:06:00,629 --> 02:05:59,280

obviously ufos exist the alien life

3696

02:06:02,709 --> 02:06:00,639

that's supposedly behind it is what i'm

3697

02:06:04,390 --> 02:06:02,719

referring to well i think that

3698

02:06:06,229 --> 02:06:04,400

exemplifies why you're

3699

02:06:08,390 --> 02:06:06,239

one of the best in the business kurt and

3700

02:06:09,430 --> 02:06:08,400

what you do on this on this channel uh

3701

02:06:11,990 --> 02:06:09,440

and that you

3702

02:06:15,270 --> 02:06:12,000

have uh this you know kind of humility

3703

02:06:18,149 --> 02:06:15,280

epis epistemological humility

3704

02:06:20,790 --> 02:06:18,159

but you also have a tenacity and that is

3705

02:06:22,790 --> 02:06:20,800

a rare combination um i think you know

3706

02:06:23,510 --> 02:06:22,800

one one nice place maybe to wrap up and

3707

02:06:25,430 --> 02:06:23,520

then

3708

02:06:27,589 --> 02:06:25,440

you know lee is often

3709

02:06:29,030 --> 02:06:27,599

i claim in a good sense you know my

3710

02:06:31,430 --> 02:06:29,040

belief fundamentally is that no one's an

3711

02:06:33,669 --> 02:06:31,440

atheist everyone has a religion you know

3712

02:06:35,350 --> 02:06:33,679

for some even that don't go to you know

3713

02:06:37,750 --> 02:06:35,360

church or synagogue you know that

3714

02:06:39,910 --> 02:06:37,760

religion as i documented my first book

3715

02:06:42,149 --> 02:06:39,920

losing the nobel prize it is often the

3716

02:06:43,990 --> 02:06:42,159

nobel prize and this is kind of a kosher

3717

02:06:45,830 --> 02:06:44,000

idol you know that yeah it doesn't cause

3718

02:06:47,270 --> 02:06:45,840

that much harm and yeah funding

3719

02:06:48,950 --> 02:06:47,280

decisions are made about it and you know

3720

02:06:50,550 --> 02:06:48,960

lee's mentioned it more times than i

3721

02:06:52,790 --> 02:06:50,560

have today and it's obviously you know

3722

02:06:54,950 --> 02:06:52,800

top of mind for many scientists and and

3723

02:06:55,910 --> 02:06:54,960

zyga's hopefully he would win it i don't

3724

02:06:57,750 --> 02:06:55,920

have anything against the people that

3725

02:07:00,470 --> 02:06:57,760

win it i've interviewed a dozen of them

3726

02:07:02,310 --> 02:07:00,480

on my show but on the other hand um you

3727

02:07:04,950 --> 02:07:02,320

know there even lack of a religion

3728

02:07:07,830 --> 02:07:04,960

secularism um i think that there is a

3729

02:07:09,990 --> 02:07:07,840

religion of scientism which is that uh

3730

02:07:11,589 --> 02:07:10,000

science can provide meaning and i'd like

3731

02:07:13,830 --> 02:07:11,599

to push back on that i'd like to explore

3732

02:07:15,990 --> 02:07:13,840

what lee and you think kurt about this

3733

02:07:18,229 --> 02:07:16,000

very notion in other words uh the word

3734

02:07:20,870 --> 02:07:18,239

science in in in

3735

02:07:22,950 --> 02:07:20,880

in in greek uh means knowledge it

3736

02:07:24,870 --> 02:07:22,960

doesn't mean wisdom you know sapien

3737

02:07:26,709 --> 02:07:24,880

means wisdom you know one who knows that

3738

02:07:28,870 --> 02:07:26,719

he knows sapienism i talked about this

3739

02:07:30,229 --> 02:07:28,880

lex friedman on the podcast just came

3740

02:07:32,950 --> 02:07:30,239

out and look forward by the way to lee

3741

02:07:35,589 --> 02:07:32,960

cronin who inspired me you know to to

3742

02:07:38,709 --> 02:07:35,599

you know get connected to lex again uh

3743

02:07:40,149 --> 02:07:38,719

you know lex uh hosted lee before me and

3744

02:07:42,069 --> 02:07:40,159

lee helped me prepare a lot for my

3745

02:07:43,430 --> 02:07:42,079

episode because he was on lex's show and

3746

02:07:44,470 --> 02:07:43,440

he'll hopefully have that episode out

3747

02:07:45,589 --> 02:07:44,480

soon too

3748

02:07:47,350 --> 02:07:45,599

allegedly

3749

02:07:48,629 --> 02:07:47,360

i can't wait to see that one but you

3750

02:07:50,390 --> 02:07:48,639

know i talked about this you know that

3751

02:07:52,790 --> 02:07:50,400

that i don't get any meaning from

3752

02:07:54,550 --> 02:07:52,800

science i think scientific science is

3753

02:07:56,310 --> 02:07:54,560

intrinsically inherently you know we may

3754

02:07:59,109 --> 02:07:56,320

have curiosity and the motto of my

3755

02:08:01,189 --> 02:07:59,119

channel is abc always be curious uh but

3756

02:08:03,350 --> 02:08:01,199

curiosity and wisdom don't necessarily

3757

02:08:05,430 --> 02:08:03,360

go together and i documented many times

3758

02:08:06,950 --> 02:08:05,440

you know nobel laureates that were nazis

3759

02:08:09,189 --> 02:08:06,960

you know and had great knowledge and

3760

02:08:11,030 --> 02:08:09,199

used their knowledge of of of chemicals

3761

02:08:12,629 --> 02:08:11,040

and you know forefathers you know fritz

3762

02:08:14,709 --> 02:08:12,639

haber you know leak

3763

02:08:16,950 --> 02:08:14,719

way more engineered safer yeah yeah yeah

3764

02:08:19,270 --> 02:08:16,960

it's evil you know and he was a jew and

3765

02:08:20,950 --> 02:08:19,280

his and his and his uh his icon b

3766

02:08:22,870 --> 02:08:20,960

eventually led to the gassing of many of

3767

02:08:24,629 --> 02:08:22,880

his own family members so anyway don't

3768

02:08:26,950 --> 02:08:24,639

look to science for wisdom so if you

3769

02:08:29,430 --> 02:08:26,960

can't look into it for wisdom

3770

02:08:30,870 --> 02:08:29,440

why do we look to it for meaning

3771

02:08:32,709 --> 02:08:30,880

so lee

3772

02:08:34,229 --> 02:08:32,719

i can i can give you a quick answer but

3773

02:08:36,470 --> 02:08:34,239

maybe it's your show where do you want

3774

02:08:39,189 --> 02:08:36,480

to go first yeah here's what i suggest i

3775

02:08:40,870 --> 02:08:39,199

suggest that we take a bathroom break

3776

02:08:42,709 --> 02:08:40,880

and then brian you check with your wife

3777

02:08:44,229 --> 02:08:42,719

see if it's okay if you keep talking for

3778

02:08:45,910 --> 02:08:44,239

a little while longer and leave with

3779

02:08:47,430 --> 02:08:45,920

whoever you have to speak to as well

3780

02:08:48,709 --> 02:08:47,440

because there are some audiences he has

3781

02:08:50,229 --> 02:08:48,719

to talk to the queen there are some

3782

02:08:52,950 --> 02:08:50,239

audience questions we haven't gotten to

3783

02:08:55,030 --> 02:08:52,960

oh yeah i'd like to get to those

3784

02:08:57,189 --> 02:08:55,040

all right yeah yeah i've got i've got 25

3785

02:08:58,149 --> 02:08:57,199

minutes this just in my wife says 25

3786

02:08:59,910 --> 02:08:58,159

more months

3787

02:09:02,149 --> 02:08:59,920

i'll take a two-minute break yeah yeah

3788

02:09:03,990 --> 02:09:02,159

and also quickly before we go so

3789

02:09:05,589 --> 02:09:04,000

lee do you have anything to promote i'll

3790

02:09:06,790 --> 02:09:05,599

make this transition smooth once we edit

3791

02:09:08,069 --> 02:09:06,800

this

3792

02:09:10,069 --> 02:09:08,079

do you oh

3793

02:09:13,270 --> 02:09:10,079

like a podcast channel or something

3794

02:09:15,109 --> 02:09:13,280

no i'm i'm i'm i i i'm pr i promote

3795

02:09:17,350 --> 02:09:15,119

house we're on the clubhouse a lot i

3796

02:09:18,470 --> 02:09:17,360

mean i i what am i promoting i'm i think

3797

02:09:20,229 --> 02:09:18,480

that um

3798

02:09:21,990 --> 02:09:20,239

i just want people to kind of ask more

3799

02:09:24,069 --> 02:09:22,000

questions in an unfriend in in an

3800

02:09:25,990 --> 02:09:24,079

unframed way and and know that they can

3801

02:09:26,629 --> 02:09:26,000

get framed you know

3802

02:09:29,830 --> 02:09:26,639

i

3803

02:09:32,629 --> 02:09:29,840

for me we'll talk about when we come

3804

02:09:34,709 --> 02:09:32,639

back from break but i genuinely love

3805

02:09:36,470 --> 02:09:34,719

not knowing and then finding a little

3806

02:09:38,790 --> 02:09:36,480

dent and then getting something yeah

3807

02:09:39,910 --> 02:09:38,800

it's like climbing a hill okay so yeah

3808

02:09:41,830 --> 02:09:39,920

the answer is no he doesn't have

3809

02:09:44,390 --> 02:09:41,840

anything but you should

3810

02:09:45,510 --> 02:09:44,400

you should go and look at that

3811

02:09:47,430 --> 02:09:45,520

i need to go to the toilet as well yeah

3812

02:09:48,550 --> 02:09:47,440

yeah because i wanted to just promote

3813

02:09:50,149 --> 02:09:48,560

right now and then let's go to the

3814

02:09:51,910 --> 02:09:50,159

washroom so people can click on this so

3815

02:09:53,589 --> 02:09:51,920

brian has losing the nobel prize as a

3816

02:09:55,589 --> 02:09:53,599

book you also have into the impossible

3817

02:09:56,950 --> 02:09:55,599

which is a book as well as a podcast and

3818

02:09:58,470 --> 02:09:56,960

the links are in the description i have

3819

02:10:00,709 --> 02:09:58,480

purchased both of them

3820

02:10:02,229 --> 02:10:00,719

additionally brian your interview with

3821

02:10:04,950 --> 02:10:02,239

lex friedman just came out either today

3822

02:10:06,229 --> 02:10:04,960

or yesterday so that's fresh and lee you

3823

02:10:07,030 --> 02:10:06,239

have a ted talk

3824

02:10:09,189 --> 02:10:07,040

and

3825

02:10:10,870 --> 02:10:09,199

i believe i believe an upcoming lex

3826

02:10:12,390 --> 02:10:10,880

freeman podcast interview hopefully

3827

02:10:15,510 --> 02:10:12,400

allegedly i'm not saying anything

3828

02:10:18,310 --> 02:10:15,520

brian's building not me on lex's podcast

3829

02:10:20,229 --> 02:10:18,320

we have alex has an image of me and lee

3830

02:10:21,750 --> 02:10:20,239

talking on my podcast so it's definitely

3831

02:10:24,069 --> 02:10:21,760

coming out people who are watching just

3832

02:10:26,149 --> 02:10:24,079

click on those links and look up

3833

02:10:32,950 --> 02:10:26,159

lee and brian's

3834

02:10:36,229 --> 02:10:34,390

you should know that

3835

02:10:38,390 --> 02:10:36,239

releasing in just a couple hours is the

3836

02:10:40,149 --> 02:10:38,400

stephon alexander interview and that one

3837

02:10:41,589 --> 02:10:40,159

we talk about matrix models and string

3838

02:10:43,350 --> 02:10:41,599

theory it's super interesting look

3839

02:10:45,350 --> 02:10:43,360

forward to that it's premiering in about

3840

02:10:47,430 --> 02:10:45,360

three hours

3841

02:10:48,790 --> 02:10:47,440

stefan alexander coincidentally or

3842

02:10:50,229 --> 02:10:48,800

perhaps not coincidentally is one of

3843

02:10:52,069 --> 02:10:50,239

brian keating's best friends if not his

3844

02:10:54,709 --> 02:10:52,079

best friend so are you at home are you

3845

02:10:59,589 --> 02:10:58,069

this is my home office oh i'm actually

3846

02:11:01,589 --> 02:10:59,599

i'm actually in fact in there in the

3847

02:11:04,390 --> 02:11:01,599

corner there that is the cellular

3848

02:11:06,550 --> 02:11:04,400

automata running in 3d in my led cube

3849

02:11:07,830 --> 02:11:06,560

that's interesting in fact it's conway's

3850

02:11:08,870 --> 02:11:07,840

game of life

3851

02:11:10,870 --> 02:11:08,880

um

3852

02:11:14,069 --> 02:11:10,880

you incorrectly implemented boundary

3853

02:11:15,830 --> 02:11:14,079

conditions because i'm rubbish at that

3854

02:11:17,990 --> 02:11:15,840

interesting okay

3855

02:11:19,430 --> 02:11:18,000

my lab is moving the next way we're in

3856

02:11:20,470 --> 02:11:19,440

glasgow i'm in the old in the chemistry

3857

02:11:21,669 --> 02:11:20,480

department which is a lovely old

3858

02:11:24,069 --> 02:11:21,679

building

3859

02:11:27,109 --> 02:11:24,079

but it's not quite fit for purpose and

3860

02:11:28,390 --> 02:11:27,119

i'm moving my team onto a new floor

3861

02:11:29,830 --> 02:11:28,400

and we've got um

3862

02:11:31,830 --> 02:11:29,840

all these fume hoods all kitted out for

3863

02:11:34,149 --> 02:11:31,840

all the digital camera history kit

3864

02:11:36,629 --> 02:11:34,159

so the the dream

3865

02:11:39,830 --> 02:11:36,639

experiment that i wanted to build

3866

02:11:41,189 --> 02:11:39,840

ten years ago will be constructed

3867

02:11:43,270 --> 02:11:41,199

in march

3868

02:11:45,430 --> 02:11:43,280

and we have the assembly meter

3869

02:11:48,149 --> 02:11:45,440

so you never know

3870

02:11:50,229 --> 02:11:48,159

by april 2024 we might have the answer

3871

02:11:52,550 --> 02:11:50,239

or an answer but

3872

02:11:54,790 --> 02:11:52,560

uh yeah so but i've been doing a lot of

3873

02:11:56,709 --> 02:11:54,800

work at home obviously with covid

3874

02:12:00,950 --> 02:11:56,719

we've all been trapped but now covey is

3875

02:12:02,709 --> 02:12:00,960

almost hopefully cross whatever unless

3876

02:12:03,669 --> 02:12:02,719

unless the person who wrote covet i'm

3877

02:12:07,270 --> 02:12:03,679

joking

3878

02:12:09,109 --> 02:12:07,280

has updated the firmware

3879

02:12:11,270 --> 02:12:09,119

i saw that on so it's like there's lots

3880

02:12:13,270 --> 02:12:11,280

of jokes at the moment about that

3881

02:12:15,189 --> 02:12:13,280

you know the problem with you know i was

3882

02:12:16,390 --> 02:12:15,199

listening some of your jokes brian but

3883

02:12:18,470 --> 02:12:16,400

was it someone about the problem of

3884

02:12:20,629 --> 02:12:18,480

omicron if we don't solve it now

3885

02:12:23,030 --> 02:12:20,639

you know what comes after omikron

3886

02:12:24,790 --> 02:12:23,040

is pie and that just goes on forever ah

3887

02:12:26,629 --> 02:12:24,800

that's hilarious

3888

02:12:29,270 --> 02:12:26,639

who said that

3889

02:12:32,790 --> 02:12:29,280

oh it was on a it was on a podcast i

3890

02:12:35,430 --> 02:12:32,800

heard a uk political podcast um

3891

02:12:37,990 --> 02:12:35,440

called the bunker

3892

02:12:40,310 --> 02:12:38,000

so all the load of left wingers we what

3893

02:12:43,189 --> 02:12:40,320

we're sad about brexit oh i mean i'm sad

3894

02:12:44,709 --> 02:12:43,199

about brexit but um no politics here

3895

02:12:45,669 --> 02:12:44,719

okay so let's get to some audience

3896

02:12:47,910 --> 02:12:45,679

questions

3897

02:12:50,069 --> 02:12:47,920

also well another time we can talk about

3898

02:12:51,830 --> 02:12:50,079

free will in time

3899

02:12:53,990 --> 02:12:51,840

we started off with that and i'm so

3900

02:12:55,910 --> 02:12:54,000

excited we can solve we can solve time

3901  
02:12:57,340 --> 02:12:55,920  
consciousness and free will in one easy

3902  
02:13:00,310 --> 02:12:57,350  
podcast

3903  
02:13:02,950 --> 02:13:00,320  
[Laughter]

3904  
02:13:04,069 --> 02:13:02,960  
okay well briefly quickly

3905  
02:13:05,430 --> 02:13:04,079  
lee when you said that time is

3906  
02:13:06,550 --> 02:13:05,440  
fundamental i don't know if you actually

3907  
02:13:08,069 --> 02:13:06,560  
said that but when you you were talking

3908  
02:13:09,750 --> 02:13:08,079  
about entropic time is what we normally

3909  
02:13:12,470 --> 02:13:09,760  
think of as physicists as

3910  
02:13:14,550 --> 02:13:12,480  
as precipitating the arrow of time and

3911  
02:13:16,550 --> 02:13:14,560  
you're saying that well that may be the

3912  
02:13:17,990 --> 02:13:16,560  
wrong way of going about it so are your

3913  
02:13:21,830 --> 02:13:18,000

views more aligned with lee because lee

3914

02:13:25,270 --> 02:13:23,669

but briefly lee if you don't mind oh

3915

02:13:27,510 --> 02:13:25,280

sorry he hasn't lee smalling yeah yeah

3916

02:13:29,189 --> 02:13:27,520

sorry yeah yeah well so i first met lee

3917

02:13:31,030 --> 02:13:29,199

smolin and i told him my theory thomas

3918

02:13:32,550 --> 02:13:31,040

oh that's my theory and i'm like wow our

3919

02:13:34,870 --> 02:13:32,560

names are both lee

3920

02:13:37,030 --> 02:13:34,880

yeah so i mine is slightly more dramatic

3921

02:13:39,350 --> 02:13:37,040

and remember i'm a professional idiot

3922

02:13:41,750 --> 02:13:39,360

regis idiot and what i mean by that is

3923

02:13:44,390 --> 02:13:41,760

that um i don't get confined by

3924

02:13:46,550 --> 02:13:44,400

discipline boundaries so it was when i

3925

02:13:48,310 --> 02:13:46,560

first told sarah my theory of time she

3926

02:13:50,229 --> 02:13:48,320

was just like this just can't be true

3927

02:13:51,910 --> 02:13:50,239

you know this is just but all i'm saying

3928

02:13:53,589 --> 02:13:51,920

is that there is no such thing as space

3929

02:13:56,950 --> 02:13:53,599

there is time okay

3930

02:13:58,470 --> 02:13:56,960

and from and time creates space right in

3931

02:14:01,990 --> 02:13:58,480

some mechanism that we don't really

3932

02:14:04,229 --> 02:14:02,000

understand and um that breaks in

3933

02:14:05,510 --> 02:14:04,239

everything we need i tried to argue with

3934

02:14:07,589 --> 02:14:05,520

sean carroll about this but he didn't

3935

02:14:08,950 --> 02:14:07,599

even argue he said no you're just wrong

3936

02:14:10,550 --> 02:14:08,960

i was like well i said well my theory is

3937

02:14:13,030 --> 02:14:10,560

better time can go forward and backwards

3938

02:14:16,069 --> 02:14:13,040

and i'm like that breaks causality so

3939

02:14:16,870 --> 02:14:16,079

time is primal time creates space

3940

02:14:21,669 --> 02:14:16,880

and

3941

02:14:23,669 --> 02:14:21,679

amount of time that has existed in our

3942

02:14:26,229 --> 02:14:23,679

current universe right that doesn't mean

3943

02:14:28,149 --> 02:14:26,239

there aren't things outside our universe

3944

02:14:30,149 --> 02:14:28,159

and uh and it works a bit like that and

3945

02:14:32,550 --> 02:14:30,159

that's why assembly

3946

02:14:34,470 --> 02:14:32,560

helps us quantify that through assembly

3947

02:14:36,390 --> 02:14:34,480

is almost like looks at the degree of

3948

02:14:39,030 --> 02:14:36,400

asymmetry since the beginning of time

3949

02:14:40,550 --> 02:14:39,040

that's recorded but i can i can budge on

3950

02:14:42,069 --> 02:14:40,560

some of it but that's it in two or three

3951

02:14:43,830 --> 02:14:42,079

sentences yeah we'll talk about that

3952

02:14:45,430 --> 02:14:43,840

we'll perhaps have another podcast and

3953

02:14:47,589 --> 02:14:45,440

so people who are watching if you have

3954

02:14:49,510 --> 02:14:47,599

questions for brian and or lee leave

3955

02:14:51,910 --> 02:14:49,520

them below okay brian do you have any

3956

02:14:53,430 --> 02:14:51,920

quick comments on the nature of time

3957

02:14:54,470 --> 02:14:53,440

before we get to the questions from the

3958

02:14:56,550 --> 02:14:54,480

audience

3959

02:14:58,069 --> 02:14:56,560

well i think you know time again is one

3960

02:15:00,069 --> 02:14:58,079

of these things that you know we kind of

3961

02:15:01,350 --> 02:15:00,079

know it when we see it it's it's like

3962

02:15:03,430 --> 02:15:01,360

you know what does it

3963

02:15:04,950 --> 02:15:03,440

feel like to be a bat you know nagel's

3964

02:15:06,470 --> 02:15:04,960

question you know it's always just like

3965

02:15:08,790 --> 02:15:06,480

we don't know

3966

02:15:11,030 --> 02:15:08,800

and i find that uh

3967

02:15:12,629 --> 02:15:11,040

sort of interpretable in the sense of we

3968

02:15:14,870 --> 02:15:12,639

know it when we feel it we know when we

3969

02:15:16,390 --> 02:15:14,880

see it we have biological clocks

3970

02:15:18,229 --> 02:15:16,400

we're turning grayer and grayer kurt

3971

02:15:20,790 --> 02:15:18,239

doesn't know that yet uh but but someday

3972

02:15:23,669 --> 02:15:20,800

he will uh we take comfort that his

3973

02:15:25,109 --> 02:15:23,679

diminution and beauty will only only uh

3974

02:15:26,550 --> 02:15:25,119

catch up to art well you look like buzz

3975

02:15:28,069 --> 02:15:26,560

lightyear man like that's a huge

3976

02:15:29,270 --> 02:15:28,079

compliment someone in the lex comments

3977

02:15:30,709 --> 02:15:29,280

said that and i thought man that's

3978

02:15:32,069 --> 02:15:30,719

exactly right and you're an astronomer

3979

02:15:33,910 --> 02:15:32,079

as well and lee you're a great looking

3980

02:15:36,229 --> 02:15:33,920

guy yeah i remember when i saw you i'm

3981

02:15:39,830 --> 02:15:36,239

like this is a good looking guy i don't

3982

02:15:43,270 --> 02:15:41,669

you're a good-looking guy too brian yeah

3983

02:15:45,030 --> 02:15:43,280

thank you very much but that means he

3984

02:15:46,870 --> 02:15:45,040

lives in a bubble you know you're power

3985

02:15:47,990 --> 02:15:46,880

more you're a powerful looking guy brian

3986

02:15:49,990 --> 02:15:48,000

i'd say that

3987

02:15:52,310 --> 02:15:50,000

thank you thank you i do have a strong

3988

02:15:53,910 --> 02:15:52,320

aroma well well i'd rather be

3989

02:15:55,830 --> 02:15:53,920

okay never mind

3990

02:15:57,830 --> 02:15:55,840

so time you know i had talked about this

3991

02:16:00,069 --> 02:15:57,840

with frank wilczyk on on my into the

3992

02:16:01,430 --> 02:16:00,079

impossible podcast i said what is time

3993

02:16:04,310 --> 02:16:01,440

you know just like i asked lee what is

3994

02:16:05,990 --> 02:16:04,320

life um yeah i asked uh other people

3995

02:16:07,750 --> 02:16:06,000

helping out philip goff on i'll ask him

3996

02:16:09,750 --> 02:16:07,760

what is consciousness you know it's like

3997

02:16:11,270 --> 02:16:09,760

we know it when we see it frank said to

3998

02:16:13,270 --> 02:16:11,280

me will chuck said you know time is what

3999

02:16:15,030 --> 02:16:13,280

clock's mentioned all right thanks a lot

4000

02:16:16,390 --> 02:16:15,040

you know yeah but anything could be a

4001  
02:16:18,870 --> 02:16:16,400  
clock so i think what's interesting is

4002  
02:16:20,709 --> 02:16:18,880  
to pursue the path that lee has pursued

4003  
02:16:23,109 --> 02:16:20,719  
uh you know what is the simplest mall

4004  
02:16:24,950 --> 02:16:23,119  
you know chemical that can form

4005  
02:16:27,109 --> 02:16:24,960  
with with inspiration with direction

4006  
02:16:28,550 --> 02:16:27,119  
towards evolutionary purposes and he has

4007  
02:16:30,950 --> 02:16:28,560  
simulations that you can see in his ted

4008  
02:16:33,270 --> 02:16:30,960  
talk about that's brilliant um i think

4009  
02:16:34,870 --> 02:16:33,280  
uh there's a experiment done at nist and

4010  
02:16:36,950 --> 02:16:34,880  
i'm going to have a nicole halpern

4011  
02:16:39,110 --> 02:16:36,960  
younger on who's a brilliant scientist

4012  
02:16:41,429 --> 02:16:39,120  
at nist in maryland and she has a new

4013  
02:16:43,429 --> 02:16:41,439

book called quantum steampunk which is

4014

02:16:46,629 --> 02:16:43,439

really delightful kind of in the vein of

4015

02:16:48,309 --> 02:16:46,639

a roger penrose emperor's new new mind

4016

02:16:49,990 --> 02:16:48,319

uh in which she talks about you know

4017

02:16:52,070 --> 02:16:50,000

what is the world's simplest clock and

4018

02:16:54,309 --> 02:16:52,080

on my channel i make explainer videos

4019

02:16:57,990 --> 02:16:54,319

and one i did is what is time and and

4020

02:16:59,669 --> 02:16:58,000

how can you understand time um by making

4021

02:17:01,589 --> 02:16:59,679

the world's simplest clock and what is a

4022

02:17:02,629 --> 02:17:01,599

clock something that ticks okay well

4023

02:17:04,070 --> 02:17:02,639

what is something that takes what has

4024

02:17:05,990 --> 02:17:04,080

quantum states and i think the

4025

02:17:08,469 --> 02:17:06,000

revolution that uh would be interesting

4026

02:17:09,990 --> 02:17:08,479

for another podcast maybe lee and and

4027

02:17:12,230 --> 02:17:10,000

kurt will come on my podcast maybe with

4028

02:17:14,629 --> 02:17:12,240

avi loeb we can have a knockdown drag

4029

02:17:16,709 --> 02:17:14,639

out a conversation lee smallin just get

4030

02:17:18,870 --> 02:17:16,719

everybody in there mosh pit uh is to

4031

02:17:20,790 --> 02:17:18,880

talk about well what are the quantum

4032

02:17:22,950 --> 02:17:20,800

implications you know there's quantum

4033

02:17:25,190 --> 02:17:22,960

thermodynamics that's coming to the

4034

02:17:26,549 --> 02:17:25,200

front things like silard entropy and

4035

02:17:28,469 --> 02:17:26,559

stuff that lee knows about that i'm just

4036

02:17:29,910 --> 02:17:28,479

learning about i think these are all

4037

02:17:31,270 --> 02:17:29,920

really fruitful and i wonder how that

4038

02:17:34,309 --> 02:17:31,280

could feed into things that lee is

4039

02:17:36,309 --> 02:17:34,319

working on but yeah for now maybe um you

4040

02:17:37,990 --> 02:17:36,319

want to talk about uh meaning from

4041

02:17:39,270 --> 02:17:38,000

science or do you want to talk audience

4042

02:17:40,549 --> 02:17:39,280

questions i want to do i want to make

4043

02:17:41,990 --> 02:17:40,559

sure that we answer all the audience

4044

02:17:44,469 --> 02:17:42,000

yeah let's get to the audience so this

4045

02:17:46,790 --> 02:17:44,479

one comes from

4046

02:17:48,790 --> 02:17:46,800

sneaky toaster

4047

02:17:50,870 --> 02:17:48,800

questions my kids that was the my first

4048

02:17:52,309 --> 02:17:50,880

choice for my middle child's middle name

4049

02:17:53,429 --> 02:17:52,319

so the question is eric weinstein and

4050

02:17:55,190 --> 02:17:53,439

others are advocating for the

4051  
02:17:57,669 --> 02:17:55,200  
irrefutable data the government has on

4052  
02:17:59,349 --> 02:17:57,679  
uap's ufos to be released to the science

4053  
02:18:02,389 --> 02:17:59,359  
community should the science community

4054  
02:18:06,950 --> 02:18:04,950  
well i've pushed back with uh respect to

4055  
02:18:09,030 --> 02:18:06,960  
eric i've told them on clubhouse chats

4056  
02:18:11,589 --> 02:18:09,040  
on my you know what what do you mean

4057  
02:18:13,349 --> 02:18:11,599  
like the data like data is the data the

4058  
02:18:15,190 --> 02:18:13,359  
hubble deep field like if there are

4059  
02:18:17,429 --> 02:18:15,200  
aliens you know in the universe then you

4060  
02:18:19,429 --> 02:18:17,439  
know there's uh 10 to the fifth or ten

4061  
02:18:21,669 --> 02:18:19,439  
to the fourth galaxies in the hubble

4062  
02:18:23,110 --> 02:18:21,679  
ultra deep field then you know there's

4063  
02:18:25,190 --> 02:18:23,120

probably an awful lot of aliens in there

4064

02:18:26,790 --> 02:18:25,200

you know go go for it but but but i

4065

02:18:28,870 --> 02:18:26,800

wonder you know is that really true

4066

02:18:30,870 --> 02:18:28,880

there's data again the hubble deep field

4067

02:18:32,309 --> 02:18:30,880

tells you exactly one thing as far as i

4068

02:18:34,230 --> 02:18:32,319

can tell maybe it tells you a little bit

4069

02:18:37,349 --> 02:18:34,240

more it allows you to estimate with

4070

02:18:39,669 --> 02:18:37,359

about 50 uncertainty and again the issue

4071

02:18:41,589 --> 02:18:39,679

is not the error it's not the uh value

4072

02:18:43,750 --> 02:18:41,599

that is measured the mantissa you know

4073

02:18:45,429 --> 02:18:43,760

it is the error bars that's where the

4074

02:18:47,270 --> 02:18:45,439

science comes in i can measure something

4075

02:18:49,190 --> 02:18:47,280

even i could go into lee's lab and make

4076

02:18:51,429 --> 02:18:49,200

some chemical reactions and you know i'd

4077

02:18:53,270 --> 02:18:51,439

probably make  $\text{HO}_2$  or you know whatever i

4078

02:18:55,429 --> 02:18:53,280

screw up everything i i joke that when i

4079

02:18:57,830 --> 02:18:55,439

did biology i would dissect the frog the

4080

02:19:01,190 --> 02:18:57,840

frog would live i'm terrible at these

4081

02:19:02,950 --> 02:19:01,200

wet sciences but the error bars that's

4082

02:19:05,030 --> 02:19:02,960

where the scientist comes out and i

4083

02:19:07,030 --> 02:19:05,040

think unless you tell me what is your

4084

02:19:09,270 --> 02:19:07,040

way of doing what's called a blind

4085

02:19:11,910 --> 02:19:09,280

analysis here's an example with my

4086

02:19:13,589 --> 02:19:11,920

telescopes i measure data i measure data

4087

02:19:15,270 --> 02:19:13,599

from the big bang the origin of the

4088

02:19:16,870 --> 02:19:15,280

universe the origin of the elements

4089

02:19:18,950 --> 02:19:16,880

called the cosmic microwave background

4090

02:19:20,629 --> 02:19:18,960

radiation if i make an observation of

4091

02:19:22,549 --> 02:19:20,639

the polarization looking for waves of

4092

02:19:24,469 --> 02:19:22,559

gravity that could indicate the presence

4093

02:19:27,429 --> 02:19:24,479

of an early exponential phase of

4094

02:19:29,990 --> 02:19:27,439

inflationary expansion which is you know

4095

02:19:32,309 --> 02:19:30,000

surely could garner many many accolades

4096

02:19:35,830 --> 02:19:32,319

and satiate our knowledge

4097

02:19:38,070 --> 02:19:35,840

of perhaps all of the conjectures about

4098

02:19:39,190 --> 02:19:38,080

things called the multiverse well if i

4099

02:19:41,429 --> 02:19:39,200

do that

4100

02:19:43,750 --> 02:19:41,439

and i make a claim i have to show that

4101

02:19:45,509 --> 02:19:43,760

that data is immune from dust

4102

02:19:47,429 --> 02:19:45,519

but i also have to show that the data i

4103

02:19:49,429 --> 02:19:47,439

got on tuesday is the same as the data i

4104

02:19:50,870 --> 02:19:49,439

got on a wednesday and that the data i

4105

02:19:52,309 --> 02:19:50,880

got when the telescope was slewing to

4106

02:19:53,349 --> 02:19:52,319

the left at four degrees per second is

4107

02:19:54,710 --> 02:19:53,359

the same as the one and slew to the

4108

02:19:56,309 --> 02:19:54,720

right at four degrees for a second

4109

02:19:57,110 --> 02:19:56,319

that's a critical sorry i was gonna

4110

02:19:58,630 --> 02:19:57,120

start

4111

02:20:00,150 --> 02:19:58,640

to interrupt but i i want to frame

4112

02:20:01,590 --> 02:20:00,160

something here because this is almost

4113

02:20:04,630 --> 02:20:01,600

getting why i was saying about avi

4114

02:20:06,550 --> 02:20:04,640

earlier and also um er what eric is

4115

02:20:08,389 --> 02:20:06,560

saying is that when he says show us the

4116

02:20:10,790 --> 02:20:08,399

data it's almost like there's like he's

4117

02:20:12,790 --> 02:20:10,800

kind of invoking some kind of conspiracy

4118

02:20:14,950 --> 02:20:12,800

and stuff and there's all these you know

4119

02:20:17,190 --> 02:20:14,960

little green men and what brian is just

4120

02:20:19,670 --> 02:20:17,200

really precisely i know what we want to

4121

02:20:21,110 --> 02:20:19,680

know is at this spot on earth at this

4122

02:20:22,469 --> 02:20:21,120

time when this was happening what was

4123

02:20:25,110 --> 02:20:22,479

happening show a show and show us so

4124

02:20:26,550 --> 02:20:25,120

we've got a comparable data control

4125

02:20:27,750 --> 02:20:26,560

sorry to interrupt you brian but i think

4126  
02:20:30,950 --> 02:20:27,760  
it's really important that we because

4127  
02:20:32,389 --> 02:20:30,960  
we're both eye to eye on this yeah

4128  
02:20:34,710 --> 02:20:32,399  
the point is you have to tell me ahead

4129  
02:20:37,110 --> 02:20:34,720  
of time when i do an analysis we have to

4130  
02:20:38,950 --> 02:20:37,120  
show in a blind analysis what the error

4131  
02:20:41,270 --> 02:20:38,960  
bar will get for a variety of different

4132  
02:20:43,349 --> 02:20:41,280  
scenarios until you tell me i might give

4133  
02:20:44,389 --> 02:20:43,359  
you data but until you tell me and

4134  
02:20:45,830 --> 02:20:44,399  
actually we don't even do it because

4135  
02:20:47,750 --> 02:20:45,840  
it's a tremendous amount of work for us

4136  
02:20:49,190 --> 02:20:47,760  
to process data in a way that another

4137  
02:20:51,429 --> 02:20:49,200  
person could come in to understand

4138  
02:20:54,070 --> 02:20:51,439

calibration flat fielding spectral

4139

02:20:55,670 --> 02:20:54,080

spectral line uh flat um dark currents

4140

02:20:57,270 --> 02:20:55,680

all the things that go into just imaging

4141

02:20:58,710 --> 02:20:57,280

and imaging is simple compared to

4142

02:21:00,150 --> 02:20:58,720

measuring the cmb

4143

02:21:02,230 --> 02:21:00,160

just in terms of like these detectors

4144

02:21:03,429 --> 02:21:02,240

have been around 40 years longer than

4145

02:21:05,349 --> 02:21:03,439

the type of detectors that i'm working

4146

02:21:07,750 --> 02:21:05,359

with um i'm not saying it's easier or

4147

02:21:09,750 --> 02:21:07,760

harder globally or more important but

4148

02:21:11,190 --> 02:21:09,760

the bottom line is i have to my student

4149

02:21:12,950 --> 02:21:11,200

has to tell me how she's going to

4150

02:21:15,429 --> 02:21:12,960

analyze the data and how she's going to

4151  
02:21:17,670 --> 02:21:15,439  
assess the final error bar long before

4152  
02:21:20,230 --> 02:21:17,680  
we unblind and let her see the results

4153  
02:21:21,830 --> 02:21:20,240  
so tell me how could you mistakenly

4154  
02:21:23,670 --> 02:21:21,840  
interpret in the image which i don't

4155  
02:21:25,990 --> 02:21:23,680  
think is really as probative as spectral

4156  
02:21:27,910 --> 02:21:26,000  
data or radar data whatever but let's

4157  
02:21:29,590 --> 02:21:27,920  
just stipulate it as tell me how you're

4158  
02:21:32,550 --> 02:21:29,600  
going to interpret to guard against this

4159  
02:21:34,469 --> 02:21:32,560  
feynman said you fooling yourself and

4160  
02:21:36,150 --> 02:21:34,479  
you everyone i'm looking at you out

4161  
02:21:37,910 --> 02:21:36,160  
there you are the easiest person to fool

4162  
02:21:39,349 --> 02:21:37,920  
i'm happy to share data and i'll

4163  
02:21:41,349 --> 02:21:39,359

advocate for you

4164

02:21:43,349 --> 02:21:41,359

about getting data out of the galileo

4165

02:21:45,030 --> 02:21:43,359

project however you have to do some

4166

02:21:46,230 --> 02:21:45,040

legwork too you can't say oh they're

4167

02:21:47,910 --> 02:21:46,240

hiding it from me therefore they're

4168

02:21:49,190 --> 02:21:47,920

hiding something forever no

4169

02:21:50,150 --> 02:21:49,200

tell me what you're going to do with it

4170

02:21:52,389 --> 02:21:50,160

tell me how you're going to prove

4171

02:21:54,070 --> 02:21:52,399

yourself wrong and so that i will say to

4172

02:21:58,230 --> 02:21:54,080

you you are my fellow scientist even

4173

02:22:03,190 --> 02:22:00,389

okay this was a live chat question

4174

02:22:06,150 --> 02:22:03,200

someone wants to know lee tom poliska

4175

02:22:08,309 --> 02:22:06,160

tom polesky asks lee why hasn't your

4176  
02:22:12,309 --> 02:22:08,319  
seti experiment with spectrograph in the

4177  
02:22:14,550 --> 02:22:12,319  
infrared been done by anyone yet

4178  
02:22:16,230 --> 02:22:14,560  
because i happen to have a big mouth and

4179  
02:22:18,630 --> 02:22:16,240  
like all the stuff happening in the lab

4180  
02:22:20,790 --> 02:22:18,640  
i always talk about fraud publish it but

4181  
02:22:22,230 --> 02:22:20,800  
the paper's almost finished and when

4182  
02:22:24,070 --> 02:22:22,240  
people said to me you couldn't possibly

4183  
02:22:25,510 --> 02:22:24,080  
get assembly number our mass spectator

4184  
02:22:27,349 --> 02:22:25,520  
and we did i think but we can do it with

4185  
02:22:29,830 --> 02:22:27,359  
a thing called nmr nuclear magnetic

4186  
02:22:32,309 --> 02:22:29,840  
resonance and infrared and we've just

4187  
02:22:34,230 --> 02:22:32,319  
done it and we proved it works so i very

4188  
02:22:36,950 --> 02:22:34,240

much hope that once we get this out

4189

02:22:40,070 --> 02:22:36,960

there that we will put out enough um

4190

02:22:41,510 --> 02:22:40,080

data and uh and the algorithm required

4191

02:22:43,349 --> 02:22:41,520

for people to start the next square and

4192

02:22:46,790 --> 02:22:43,359

indeed there are people who are going to

4193

02:22:48,950 --> 02:22:46,800

be getting um spectroscopy uh especially

4194

02:22:50,630 --> 02:22:48,960

spectroscopic data from out the solar

4195

02:22:52,870 --> 02:22:50,640

system which want to try with try this

4196

02:22:55,830 --> 02:22:52,880

with but we need to be cautious because

4197

02:22:57,270 --> 02:22:55,840

the resolution is really so poor there's

4198

02:22:59,750 --> 02:22:57,280

limited amount of things we can do but

4199

02:23:01,910 --> 02:22:59,760

my dream would be to put a spectrometer

4200

02:23:04,150 --> 02:23:01,920

an infrared spectrometer in in orbit

4201  
02:23:06,550 --> 02:23:04,160  
above venus there's a lot of and maybe

4202  
02:23:08,309 --> 02:23:06,560  
one in orbit maybe in titan and we could

4203  
02:23:10,710 --> 02:23:08,319  
do exactly that experiment so it's a

4204  
02:23:13,270 --> 02:23:10,720  
really good point and literally assembly

4205  
02:23:15,030 --> 02:23:13,280  
theory was kind of invented last year

4206  
02:23:17,110 --> 02:23:15,040  
we published the paper the experiment

4207  
02:23:19,030 --> 02:23:17,120  
the mass effect paper in may

4208  
02:23:20,630 --> 02:23:19,040  
we've been working on several theory

4209  
02:23:22,630 --> 02:23:20,640  
papers and more experimental paper and

4210  
02:23:24,790 --> 02:23:22,640  
that's just coming so yeah it's really

4211  
02:23:26,790 --> 02:23:24,800  
literally hot off the press so it's not

4212  
02:23:29,030 --> 02:23:26,800  
made up it works but i just need to

4213  
02:23:31,349 --> 02:23:29,040

literally get it into a pre-print in

4214

02:23:33,110 --> 02:23:31,359

publication and i'm talking to various

4215

02:23:34,710 --> 02:23:33,120

organizations that may or may not have

4216

02:23:36,870 --> 02:23:34,720

lots of money and may or may not have

4217

02:23:38,870 --> 02:23:36,880

lots of maybe private and public that

4218

02:23:42,150 --> 02:23:38,880

are planning missions

4219

02:23:43,429 --> 02:23:42,160

and um and i'm advocating very strongly

4220

02:23:45,510 --> 02:23:43,439

for us to do that

4221

02:23:47,830 --> 02:23:45,520

send a telescope they can do infrared

4222

02:23:51,110 --> 02:23:47,840

spectroscopy all around the solar system

4223

02:23:53,030 --> 02:23:51,120

and map the assembliness of everything

4224

02:23:55,910 --> 02:23:53,040

okay this question comes from vissen

4225

02:23:58,150 --> 02:23:55,920

cosmin this is to both of you ask all of

4226

02:24:00,150 --> 02:23:58,160

your materialist guests to give one

4227

02:24:05,670 --> 02:24:00,160

single example of something outside of

4228

02:24:09,110 --> 02:24:07,510

i think there are

4229

02:24:10,389 --> 02:24:09,120

great difficulties in doing that simply

4230

02:24:11,830 --> 02:24:10,399

because we are

4231

02:24:14,150 --> 02:24:11,840

the ghost in the machine that is

4232

02:24:17,270 --> 02:24:14,160

defining a what consciousness is what

4233

02:24:18,790 --> 02:24:17,280

are experiences what is materialistic or

4234

02:24:19,670 --> 02:24:18,800

not i should say that you know i'm much

4235

02:24:21,910 --> 02:24:19,680

more

4236

02:24:24,790 --> 02:24:21,920

much less materialistic than i assume

4237

02:24:27,429 --> 02:24:24,800

lee is i know elias i don't know so much

4238

02:24:29,830 --> 02:24:27,439

about kurt but i'd love to know more

4239

02:24:31,349 --> 02:24:29,840

in that there are um what what i usually

4240

02:24:33,750 --> 02:24:31,359

talk about is

4241

02:24:36,630 --> 02:24:33,760

you know are there is there permission

4242

02:24:38,550 --> 02:24:36,640

to believe not not the proof i said this

4243

02:24:40,790 --> 02:24:38,560

on lex's pocket like i don't care if i

4244

02:24:42,790 --> 02:24:40,800

believe in god you know like

4245

02:24:44,870 --> 02:24:42,800

does god need me does god care about

4246

02:24:47,349 --> 02:24:44,880

brian keating who gives a crime you know

4247

02:24:49,510 --> 02:24:47,359

um you know maybe maybe if god believes

4248

02:24:51,510 --> 02:24:49,520

in me you know if god exists but the

4249

02:24:53,429 --> 02:24:51,520

question of whether or not you i'm a

4250

02:24:55,429 --> 02:24:53,439

behaviorist so i think that people

4251

02:24:57,670 --> 02:24:55,439

manifest how they behave

4252

02:24:59,670 --> 02:24:57,680

the underlying consciousness that they

4253

02:25:01,990 --> 02:24:59,680

are internalized have that they have

4254

02:25:04,550 --> 02:25:02,000

internalized is is manifest externally

4255

02:25:07,190 --> 02:25:04,560

by their behaviors so i look to things

4256

02:25:10,070 --> 02:25:07,200

like religion in a very practical sense

4257

02:25:12,870 --> 02:25:10,080

uh can this give can this give community

4258

02:25:16,309 --> 02:25:12,880

can this give a purpose can this without

4259

02:25:18,630 --> 02:25:16,319

necessarily accepting the reality

4260

02:25:20,550 --> 02:25:18,640

as provable in a scientific context i

4261

02:25:22,950 --> 02:25:20,560

don't think you can prove or disprove

4262

02:25:25,830 --> 02:25:22,960

and i give upgrade my religious friends

4263

02:25:27,429 --> 02:25:25,840

too i say if you don't learn science

4264

02:25:29,110 --> 02:25:27,439

you're you're basically just you know

4265

02:25:30,870 --> 02:25:29,120

kind of living in this in this bubble if

4266

02:25:32,870 --> 02:25:30,880

you don't learn because science may

4267

02:25:35,030 --> 02:25:32,880

actually bolster your faith

4268

02:25:37,349 --> 02:25:35,040

as i said you know lexis podcast i've

4269

02:25:39,670 --> 02:25:37,359

said other places you know what if the

4270

02:25:42,309 --> 02:25:39,680

fact that we can perceive an infinite

4271

02:25:45,270 --> 02:25:42,319

spectrum of colors an infinite diversity

4272

02:25:47,510 --> 02:25:45,280

of life an infinite number of tastes and

4273

02:25:49,670 --> 02:25:47,520

you know dimensionality of what it could

4274

02:25:51,910 --> 02:25:49,680

be otherwise and the fact that the

4275

02:25:55,910 --> 02:25:51,920

universe is extravagant

4276

02:25:58,150 --> 02:25:55,920

is potentially uh a clue a symbol

4277

02:25:59,670 --> 02:25:58,160

a talisman i'm not saying it's proof of

4278

02:26:00,790 --> 02:25:59,680

course because i don't think there can

4279

02:26:03,270 --> 02:26:00,800

be proof

4280

02:26:05,190 --> 02:26:03,280

but um but i think those are sort of a

4281

02:26:07,190 --> 02:26:05,200

non-materialistic but again it's

4282

02:26:08,950 --> 02:26:07,200

materialistic and a reductionist sense

4283

02:26:11,429 --> 02:26:08,960

because i do believe that you can

4284

02:26:13,510 --> 02:26:11,439

practice it for your own benefit you can

4285

02:26:16,070 --> 02:26:13,520

you can glean wisdom from it you can

4286

02:26:18,230 --> 02:26:16,080

glean experience community charity

4287

02:26:19,429 --> 02:26:18,240

things that improve you stoicism you

4288

02:26:21,110 --> 02:26:19,439

know i'm one of the few people i read

4289

02:26:23,429 --> 02:26:21,120

the christian bible every day in the

4290

02:26:25,590 --> 02:26:23,439

jewish bible every day i read the stoics

4291

02:26:26,950 --> 02:26:25,600

the ancient greeks the romans

4292

02:26:28,790 --> 02:26:26,960

these are things that i think broaden

4293

02:26:30,150 --> 02:26:28,800

your mind whether you believe it has to

4294

02:26:31,910 --> 02:26:30,160

be true or not

4295

02:26:33,510 --> 02:26:31,920

um so i'm more of a pragmatist i would

4296

02:26:35,270 --> 02:26:33,520

say in terms of what consciousness

4297

02:26:36,230 --> 02:26:35,280

things could not be explainable via

4298

02:26:37,270 --> 02:26:36,240

science

4299

02:26:39,110 --> 02:26:37,280

i'm going to ask you one more time

4300

02:26:43,750 --> 02:26:39,120

simply so can you point to something

4301  
02:26:47,590 --> 02:26:46,309  
lee what would you say i can i i would

4302  
02:26:49,110 --> 02:26:47,600  
say there's lots of things that exist

4303  
02:26:50,469 --> 02:26:49,120  
outside consciousness but i think we

4304  
02:26:52,389 --> 02:26:50,479  
have to do that doing that null

4305  
02:26:54,309 --> 02:26:52,399  
experiment is hard right

4306  
02:26:56,389 --> 02:26:54,319  
i think that the causal chain that gave

4307  
02:26:58,710 --> 02:26:56,399  
gave rise to how chemistry so i'm going

4308  
02:27:00,309 --> 02:26:58,720  
to give the boring answer but i think

4309  
02:27:01,190 --> 02:27:00,319  
that um the

4310  
02:27:07,190 --> 02:27:01,200  
the

4311  
02:27:09,510 --> 02:27:07,200  
exists outside consciousness because it

4312  
02:27:11,590 --> 02:27:09,520  
had to invent consciousness i would be

4313  
02:27:13,190 --> 02:27:11,600

interested to know if computation is a

4314

02:27:15,270 --> 02:27:13,200

fundamental thing in the universe that

4315

02:27:17,830 --> 02:27:15,280

didn't need to go through consciousness

4316

02:27:19,750 --> 02:27:17,840

um that's an interesting question but my

4317

02:27:21,429 --> 02:27:19,760

my simple answer is i think that a lot

4318

02:27:23,750 --> 02:27:21,439

of you the universe exists outside of

4319

02:27:24,710 --> 02:27:23,760

consciousness but i will never

4320

02:27:26,950 --> 02:27:24,720

really

4321

02:27:28,870 --> 02:27:26,960

convincingly be able to prove it because

4322

02:27:30,950 --> 02:27:28,880

i am a conscious entity

4323

02:27:32,309 --> 02:27:30,960

just to make it clear because i want to

4324

02:27:34,309 --> 02:27:32,319

make sure this person doesn't write in

4325

02:27:35,830 --> 02:27:34,319

the comments say they equivocated what

4326

02:27:38,150 --> 02:27:35,840

is one example of something that is

4327

02:27:40,150 --> 02:27:38,160

outside consciousness

4328

02:27:42,389 --> 02:27:40,160

i think understanding consciousness i

4329

02:27:44,230 --> 02:27:42,399

think the meta problem of

4330

02:27:45,830 --> 02:27:44,240

you know what is it like to be a bad how

4331

02:27:47,510 --> 02:27:45,840

do you how do you separate in the heart

4332

02:27:48,870 --> 02:27:47,520

you know david charles is coming on my

4333

02:27:51,510 --> 02:27:48,880

show in a couple weeks i'll certainly

4334

02:27:53,030 --> 02:27:51,520

ask him this question oh you're saying

4335

02:27:55,110 --> 02:27:53,040

yeah you're saying something beyond

4336

02:27:56,469 --> 02:27:55,120

conscious comprehension intrinsically

4337

02:27:57,830 --> 02:27:56,479

right is that why

4338

02:27:59,830 --> 02:27:57,840

i think here's what the person is

4339

02:28:01,990 --> 02:27:59,840

getting at let's imagine i say x is

4340

02:28:04,150 --> 02:28:02,000

outside consciousness well that x

4341

02:28:05,510 --> 02:28:04,160

appears to you in your own consciousness

4342

02:28:07,110 --> 02:28:05,520

so it's not technically outside

4343

02:28:10,389 --> 02:28:07,120

consciousness now you can think maybe it

4344

02:28:12,309 --> 02:28:10,399

can exist besides me outside of me but

4345

02:28:15,270 --> 02:28:12,319

even that itself is an idea within

4346

02:28:17,190 --> 02:28:15,280

consciousness the easy answer right and

4347

02:28:19,590 --> 02:28:17,200

i think brian well i mean i think brian

4348

02:28:20,790 --> 02:28:19,600

might agree with this is like i'm not i

4349

02:28:22,790 --> 02:28:20,800

i think that

4350

02:28:24,469 --> 02:28:22,800

um the ground truth for quantum

4351

02:28:26,070 --> 02:28:24,479

mechanics appears to be outside of

4352

02:28:28,469 --> 02:28:26,080

consciousness because quantum mechanics

4353

02:28:30,550 --> 02:28:28,479

wasn't constructed of conscious beings

4354

02:28:32,230 --> 02:28:30,560

and then we get all us and it's shown by

4355

02:28:35,270 --> 02:28:32,240

you know there are people who are

4356

02:28:37,590 --> 02:28:35,280

closets many worlds people right

4357

02:28:39,670 --> 02:28:37,600

and they get really stuck another thing

4358

02:28:40,950 --> 02:28:39,680

is that before that

4359

02:28:42,230 --> 02:28:40,960

i can

4360

02:28:44,150 --> 02:28:42,240

imagine

4361

02:28:46,710 --> 02:28:44,160

that there might be something outside of

4362

02:28:49,349 --> 02:28:46,720

the universe that is entirely separate

4363

02:28:51,190 --> 02:28:49,359

to this universe i can imagine it

4364

02:28:52,870 --> 02:28:51,200

but i just but i there is something

4365

02:28:55,670 --> 02:28:52,880

beyond my imagination because clearly

4366

02:28:57,270 --> 02:28:55,680

what can it be right i mean i could say

4367

02:28:59,270 --> 02:28:57,280

this is really like me saying i can

4368

02:29:01,830 --> 02:28:59,280

imagine all the set of prime numbers but

4369

02:29:03,429 --> 02:29:01,840

i can't tell you what the next one is

4370

02:29:05,190 --> 02:29:03,439

and that's really important so i think

4371

02:29:06,950 --> 02:29:05,200

there are things outside of that

4372

02:29:09,910 --> 02:29:06,960

intrinsically outside of consciousness

4373

02:29:11,750 --> 02:29:09,920

and and um and i think that we have to

4374

02:29:14,790 --> 02:29:11,760

be humble because i think even if we

4375

02:29:16,790 --> 02:29:14,800

think we could nail everything

4376

02:29:18,870 --> 02:29:16,800

i mean actually i'm i'm not religious

4377

02:29:22,070 --> 02:29:18,880

right but i have a great deal of respect

4378

02:29:24,790 --> 02:29:22,080

for uh religious people i do not like

4379

02:29:27,030 --> 02:29:24,800

the approach that richard dawkins and

4380

02:29:28,309 --> 02:29:27,040

lawrence krauss take to people who have

4381

02:29:30,469 --> 02:29:28,319

religion and say they're stupid because

4382

02:29:32,790 --> 02:29:30,479

they're not they have belief

4383

02:29:34,630 --> 02:29:32,800

and i have beliefs and my beliefs are

4384

02:29:36,230 --> 02:29:34,640

kind of a bit boring but i do have

4385

02:29:38,469 --> 02:29:36,240

beliefs and one of the reasons why i get

4386

02:29:40,070 --> 02:29:38,479

a buzz out of science is um i'm taking

4387

02:29:41,110 --> 02:29:40,080

something in my belief box and putting

4388

02:29:43,270 --> 02:29:41,120

it into my

4389

02:29:45,429 --> 02:29:43,280

fact box and it's not that i'm trying to

4390

02:29:47,270 --> 02:29:45,439

disprove god but it's like i'm going

4391

02:29:49,030 --> 02:29:47,280

through this process of actually

4392

02:29:50,389 --> 02:29:49,040

understanding more about the universe

4393

02:29:52,790 --> 02:29:50,399

the more in awe of it and the more i

4394

02:29:54,469 --> 02:29:52,800

know there's more belief and so i don't

4395

02:29:56,150 --> 02:29:54,479

think ever again that's the answer so i

4396

02:29:58,790 --> 02:29:56,160

think of course intrinsically there must

4397

02:30:00,150 --> 02:29:58,800

be things i think is this provable i

4398

02:30:01,830 --> 02:30:00,160

think we would need to get a proper

4399

02:30:03,349 --> 02:30:01,840

philosopher who would take us through

4400

02:30:04,710 --> 02:30:03,359

the thought processes and understanding

4401

02:30:06,950 --> 02:30:04,720

how to set up the axioms and the

4402

02:30:08,550 --> 02:30:06,960

argument but i believe my crude answer

4403

02:30:11,429 --> 02:30:08,560

would be probably almost yes there's

4404

02:30:13,349 --> 02:30:11,439

lots outside of our consciousness

4405

02:30:14,790 --> 02:30:13,359

okay this question comes from david and

4406

02:30:16,309 --> 02:30:14,800

it's directed toward you lee but you can

4407

02:30:18,950 --> 02:30:16,319

comment on it as well

4408

02:30:21,830 --> 02:30:18,960

brian in what sense does lee think that

4409

02:30:23,910 --> 02:30:21,840

we need new laws for life like extra

4410

02:30:27,510 --> 02:30:23,920

stuff at the fundamental level or some

4411

02:30:29,590 --> 02:30:27,520

emergent higher level type of stuff

4412

02:30:32,550 --> 02:30:29,600

well um i've already said it i think

4413

02:30:34,870 --> 02:30:32,560

that so not new laws necessarily but i

4414

02:30:36,469 --> 02:30:34,880

think that i well i would say that we we

4415

02:30:39,349 --> 02:30:36,479

can get rid of some laws get rid of the

4416

02:30:40,790 --> 02:30:39,359

second law and account for it correctly

4417

02:30:42,150 --> 02:30:40,800

so i think there's a new law needed

4418

02:30:44,070 --> 02:30:42,160

there so we have to remove the second

4419

02:30:46,150 --> 02:30:44,080

law we have to deal with the fact that

4420

02:30:48,630 --> 02:30:46,160

we require order at the beginning again

4421

02:30:49,990 --> 02:30:48,640

get rid of the second law have time so i

4422

02:30:52,150 --> 02:30:50,000

i don't think there's a the nice thing

4423

02:30:54,309 --> 02:30:52,160

about this is it's provable it's gonna

4424

02:30:56,150 --> 02:30:54,319

be experimentally tractable so i'm not

4425

02:30:58,710 --> 02:30:56,160

saying we need to tear up all the rules

4426  
02:30:59,670 --> 02:30:58,720  
i'm just saying that newtonian mechanics

4427  
02:31:04,070 --> 02:30:59,680  
um

4428  
02:31:04,950 --> 02:31:04,080  
and and i think i would say something

4429  
02:31:11,830 --> 02:31:04,960  
very

4430  
02:31:14,309 --> 02:31:11,840  
i think lisa molin has the same idea

4431  
02:31:16,790 --> 02:31:14,319  
that everything in the universe every

4432  
02:31:19,030 --> 02:31:16,800  
object and every event is unique because

4433  
02:31:20,870 --> 02:31:19,040  
it has a unique place in the universe

4434  
02:31:22,950 --> 02:31:20,880  
as i said to the person we talked about

4435  
02:31:24,550 --> 02:31:22,960  
earlier when i went to austin i flew to

4436  
02:31:26,150 --> 02:31:24,560  
austin i've been austin before and i

4437  
02:31:27,670 --> 02:31:26,160  
flew back to london

4438  
02:31:29,429 --> 02:31:27,680

i've been to those places before but

4439

02:31:31,349 --> 02:31:29,439

i've no i've never been there before

4440

02:31:33,110 --> 02:31:31,359

because the planet in a different place

4441

02:31:35,270 --> 02:31:33,120

in our solar system and our solar

4442

02:31:37,670 --> 02:31:35,280

system's a different part in space

4443

02:31:40,870 --> 02:31:37,680

and so i think that we need to

4444

02:31:42,630 --> 02:31:40,880

understand that time is not reversible

4445

02:31:45,590 --> 02:31:42,640

and that physicists should stop be given

4446

02:31:47,190 --> 02:31:45,600

a free get out of jail card allowing

4447

02:31:50,150 --> 02:31:47,200

time travel because i think there's

4448

02:31:51,830 --> 02:31:50,160

cheating causality so i would say ask

4449

02:31:53,590 --> 02:31:51,840

that question is that we need to be

4450

02:31:55,110 --> 02:31:53,600

clear about causation

4451  
02:32:01,270 --> 02:31:55,120  
from

4452  
02:32:03,590 --> 02:32:01,280  
rocks to rachmaninoff so i think yes we

4453  
02:32:06,790 --> 02:32:03,600  
need a new formulation of the laws but

4454  
02:32:08,389 --> 02:32:06,800  
it's not magic it's just reframing

4455  
02:32:11,349 --> 02:32:08,399  
brian

4456  
02:32:13,429 --> 02:32:11,359  
well i'd say they're um it's poetic it's

4457  
02:32:15,670 --> 02:32:13,439  
their certain romanticism about what

4458  
02:32:17,670 --> 02:32:15,680  
lee's talking about i think strictly

4459  
02:32:19,910 --> 02:32:17,680  
speaking you know i don't i always say

4460  
02:32:22,550 --> 02:32:19,920  
you know cosmology is the one

4461  
02:32:24,550 --> 02:32:22,560  
specialization of physics that doesn't

4462  
02:32:26,630 --> 02:32:24,560  
require biology you know it's like

4463  
02:32:28,870 --> 02:32:26,640

almost everything else yeah uh to to

4464

02:32:30,950 --> 02:32:28,880

instantiate itself um or perhaps the

4465

02:32:32,070 --> 02:32:30,960

other way around i never make use of

4466

02:32:33,190 --> 02:32:32,080

when i teach my undergraduates say

4467

02:32:35,190 --> 02:32:33,200

you're gonna learn thermodynamics

4468

02:32:36,710 --> 02:32:35,200

electromagnetism nuclear physics

4469

02:32:39,030 --> 02:32:36,720

particle physics but you're not gonna

4470

02:32:40,630 --> 02:32:39,040

learn anything about biophysics or you

4471

02:32:42,150 --> 02:32:40,640

know you'll even learn some chemistry

4472

02:32:44,230 --> 02:32:42,160

right we'll talk a little bit about the

4473

02:32:46,389 --> 02:32:44,240

formation of the chemical elements

4474

02:32:47,990 --> 02:32:46,399

but um that being said i don't think

4475

02:32:51,830 --> 02:32:48,000

that there's anything

4476  
02:32:54,950 --> 02:32:51,840  
to learn about  $g$  minus 2 of the muon or

4477  
02:32:57,030 --> 02:32:54,960  
of sterile neutrinos or you know from a

4478  
02:32:59,190 --> 02:32:57,040  
new interpretation that involves life i

4479  
02:33:00,790 --> 02:32:59,200  
think you know much much like i joke

4480  
02:33:03,510 --> 02:33:00,800  
about this like string theory is the

4481  
02:33:05,429 --> 02:33:03,520  
best theory ever made to describe

4482  
02:33:07,670 --> 02:33:05,439  
problems in string theory in other words

4483  
02:33:08,790 --> 02:33:07,680  
there will be new technology there'll be

4484  
02:33:15,990 --> 02:33:08,800  
new

4485  
02:33:17,590 --> 02:33:16,000  
approach the problem the essence of life

4486  
02:33:19,110 --> 02:33:17,600  
and don't forget erin schrodinger

4487  
02:33:20,469 --> 02:33:19,120  
recently canceled by the way did you

4488  
02:33:22,150 --> 02:33:20,479

hear about that the schrodinger's been

4489

02:33:24,870 --> 02:33:22,160

cancel um

4490

02:33:27,030 --> 02:33:24,880

finally uh for for some sexual

4491

02:33:27,990 --> 02:33:27,040

improprieties uh that are quite awful if

4492

02:33:29,670 --> 02:33:28,000

true

4493

02:33:31,750 --> 02:33:29,680

uh but the bottom line is no i don't

4494

02:33:34,150 --> 02:33:31,760

think that to understand um that there

4495

02:33:36,230 --> 02:33:34,160

may be additional forces and fields

4496

02:33:37,990 --> 02:33:36,240

gauge bosons and so forth at the in the

4497

02:33:40,870 --> 02:33:38,000

standard model there probably certainly

4498

02:33:42,710 --> 02:33:40,880

are i don't know um and uh but but i

4499

02:33:46,309 --> 02:33:42,720

don't think that those will necessitate

4500

02:33:48,630 --> 02:33:46,319

or require uh the conceptions of life to

4501

02:33:50,309 --> 02:33:48,640

be uh emergent and within them

4502

02:33:52,389 --> 02:33:50,319

so i've pushed back to brian slightly i

4503

02:33:54,389 --> 02:33:52,399

want to push for i agree with what brian

4504

02:33:57,510 --> 02:33:54,399

said but i think he's kind of

4505

02:33:59,750 --> 02:33:57,520

causation physics doesn't have causation

4506

02:34:02,230 --> 02:33:59,760

at this in in the standard model in the

4507

02:34:04,550 --> 02:34:02,240

core models we call it and that is a big

4508

02:34:06,469 --> 02:34:04,560

error and i am really certain very

4509

02:34:08,950 --> 02:34:06,479

strongly with some courage and humility

4510

02:34:10,870 --> 02:34:08,960

that i think that we need to add that in

4511

02:34:12,389 --> 02:34:10,880

and i think brian correct me if i'm

4512

02:34:14,389 --> 02:34:12,399

wrong because we were kind of left the

4513

02:34:15,910 --> 02:34:14,399

ring now we're kind of like we've we've

4514

02:34:18,630 --> 02:34:15,920

i don't know if it's a draw or there was

4515

02:34:19,670 --> 02:34:18,640

a who went on point but i would say that

4516

02:34:23,190 --> 02:34:19,680

really

4517

02:34:24,070 --> 02:34:23,200

um we do need causation at the beginning

4518

02:34:25,990 --> 02:34:24,080

um

4519

02:34:27,830 --> 02:34:26,000

then that is that that shouldn't be that

4520

02:34:30,870 --> 02:34:27,840

shouldn't be because when i speak to

4521

02:34:32,469 --> 02:34:30,880

frank we'll check about it he just

4522

02:34:34,070 --> 02:34:32,479

he just i mean i have speaking to him

4523

02:34:35,750 --> 02:34:34,080

about it and he was very

4524

02:34:37,190 --> 02:34:35,760

very good he's very smart he's a bit

4525

02:34:38,550 --> 02:34:37,200

cheeky you know he should do this and

4526

02:34:40,309 --> 02:34:38,560

some people get prizes for that and i

4527

02:34:41,190 --> 02:34:40,319

was like it's just a prize dude who

4528

02:34:43,750 --> 02:34:41,200

cares

4529

02:34:45,590 --> 02:34:43,760

tell me if causation is at the beginning

4530

02:34:46,790 --> 02:34:45,600

and i couldn't work on it you know i

4531

02:34:49,110 --> 02:34:46,800

mean there are people that talk about

4532

02:34:51,830 --> 02:34:49,120

the causal you know the structure joe

4533

02:34:53,830 --> 02:34:51,840

amagio lee smolin stephan alexander's

4534

02:34:56,790 --> 02:34:53,840

the going to be on soon on on this very

4535

02:34:58,950 --> 02:34:56,800

podcast so yeah no i i agree um i would

4536

02:35:01,270 --> 02:34:58,960

i would you know maybe maybe just just

4537

02:35:03,910 --> 02:35:01,280

kind of rectify my comment by saying i

4538

02:35:05,830 --> 02:35:03,920

don't personally have much you know

4539

02:35:07,590 --> 02:35:05,840

faith in say the wolf rami and which is

4540

02:35:09,510 --> 02:35:07,600

the most kind of like life like you know

4541

02:35:11,590 --> 02:35:09,520

at least in terms of complexity

4542

02:35:14,230 --> 02:35:11,600

and rules and algorithmically uh

4543

02:35:16,309 --> 02:35:14,240

computable um assets that that will you

4544

02:35:18,389 --> 02:35:16,319

know make concrete astrophysical

4545

02:35:21,750 --> 02:35:18,399

predictions that laws will emerge from

4546

02:35:22,950 --> 02:35:21,760

it um and maybe it may be that you know

4547

02:35:24,790 --> 02:35:22,960

understanding life allows us to

4548

02:35:27,349 --> 02:35:24,800

understand artificial intelligence which

4549

02:35:29,590 --> 02:35:27,359

then allows us to make up new laws i'm

4550

02:35:31,429 --> 02:35:29,600

also kind of a ai minimalist but but

4551  
02:35:32,790 --> 02:35:31,439  
that's really a podcast for another time

4552  
02:35:34,389 --> 02:35:32,800  
because i i would just think that the

4553  
02:35:36,070 --> 02:35:34,399  
wife and kids will come and get me soon

4554  
02:35:37,349 --> 02:35:36,080  
curt okay so then this is the last one

4555  
02:35:39,349 --> 02:35:37,359  
and it relates to what you said about

4556  
02:35:41,510 --> 02:35:39,359  
causation okay why is this this is from

4557  
02:35:43,270 --> 02:35:41,520  
kamar 910 why is there something rather

4558  
02:35:45,349 --> 02:35:43,280  
than nothing and lee when you say

4559  
02:35:47,510 --> 02:35:45,359  
causation so physicists obviously study

4560  
02:35:48,870 --> 02:35:47,520  
causal structures like brian mentioned

4561  
02:35:50,150 --> 02:35:48,880  
but those usually mean you're within the

4562  
02:35:52,630 --> 02:35:50,160  
light cone and it's as simple as that

4563  
02:35:54,309 --> 02:35:52,640

not this caused this so when you have a

4564

02:35:55,830 --> 02:35:54,319

model of causation which i'm unsure how

4565

02:35:57,670 --> 02:35:55,840

one could formulate that how does that

4566

02:35:59,750 --> 02:35:57,680

not lead to an infinite regress or

4567

02:36:01,510 --> 02:35:59,760

either an uncaused cause that at some

4568

02:36:02,870 --> 02:36:01,520

point especially if you consider time to

4569

02:36:04,469 --> 02:36:02,880

be fundamental

4570

02:36:05,910 --> 02:36:04,479

which ties into why is there something

4571

02:36:07,110 --> 02:36:05,920

rather than nothing which is kamar's

4572

02:36:08,950 --> 02:36:07,120

question

4573

02:36:10,630 --> 02:36:08,960

yeah let me give you two cent summary so

4574

02:36:12,550 --> 02:36:10,640

the theory paper i'm just finishing with

4575

02:36:13,830 --> 02:36:12,560

sarah right now actually tackles that

4576

02:36:15,670 --> 02:36:13,840

very question

4577

02:36:17,510 --> 02:36:15,680

and and it's to accept that there are

4578

02:36:20,150 --> 02:36:17,520

there at the beginning there is no

4579

02:36:21,429 --> 02:36:20,160

causation and but that causation gets

4580

02:36:23,670 --> 02:36:21,439

baked in

4581

02:36:25,670 --> 02:36:23,680

when when information can be stored

4582

02:36:27,349 --> 02:36:25,680

about the past that can affect something

4583

02:36:29,590 --> 02:36:27,359

differently in the future and it's

4584

02:36:31,110 --> 02:36:29,600

really as simple as that and the only

4585

02:36:33,110 --> 02:36:31,120

reason physicists have missed it is

4586

02:36:35,190 --> 02:36:33,120

because they call screen it out

4587

02:36:37,030 --> 02:36:35,200

so all i'm asked all i'm slightly asking

4588

02:36:39,110 --> 02:36:37,040

for is to remove entropy

4589

02:36:41,510 --> 02:36:39,120

change it to assembly have time going

4590

02:36:43,670 --> 02:36:41,520

forward and suddenly you do have causal

4591

02:36:45,830 --> 02:36:43,680

cones and those causal cones actually

4592

02:36:47,510 --> 02:36:45,840

are limited by the light cone and i

4593

02:36:49,750 --> 02:36:47,520

think that brian and i one day will be

4594

02:36:51,590 --> 02:36:49,760

talking about assembly cosmology and

4595

02:36:53,190 --> 02:36:51,600

we'll be looking for those artifacts out

4596

02:36:54,790 --> 02:36:53,200

there but i think we'll we're a little

4597

02:36:57,110 --> 02:36:54,800

bit far away from that i need to prove

4598

02:37:00,150 --> 02:36:57,120

the theory do the experiments get the

4599

02:37:01,830 --> 02:37:00,160

data show the error convince peers

4600

02:37:03,990 --> 02:37:01,840

because right now it's just a kind of

4601  
02:37:05,349 --> 02:37:04,000  
cool idea a bit like lots of things in

4602  
02:37:07,429 --> 02:37:05,359  
string theory and you get that

4603  
02:37:09,190 --> 02:37:07,439  
mathematical structure in reality

4604  
02:37:10,389 --> 02:37:09,200  
and i think we'll be able to but we'll

4605  
02:37:13,349 --> 02:37:10,399  
have to be held account on that so it's

4606  
02:37:15,349 --> 02:37:13,359  
a really good question um but i'm pretty

4607  
02:37:17,110 --> 02:37:15,359  
sure i know where it is

4608  
02:37:18,710 --> 02:37:17,120  
what we're doing right i'm also going to

4609  
02:37:20,230 --> 02:37:18,720  
re-ask you to leave so you can expound

4610  
02:37:21,590 --> 02:37:20,240  
some more but brian has to go so brian

4611  
02:37:23,670 --> 02:37:21,600  
please

4612  
02:37:25,270 --> 02:37:23,680  
uh so again the question from kumar

4613  
02:37:27,750 --> 02:37:25,280

again is why is there something rather

4614

02:37:29,510 --> 02:37:27,760

than nothing okay so what i thought lee

4615

02:37:31,110 --> 02:37:29,520

might say is the why questions are kind

4616

02:37:32,469 --> 02:37:31,120

of anathema even though they're the most

4617

02:37:34,870 --> 02:37:32,479

interesting questions and the most

4618

02:37:36,950 --> 02:37:34,880

natural questions my my toddler will ask

4619

02:37:38,070 --> 02:37:36,960

me why why why and of course lee as a

4620

02:37:39,590 --> 02:37:38,080

parent kurt doesn't know this yet

4621

02:37:42,070 --> 02:37:39,600

because he's not a dad yet but please

4622

02:37:43,910 --> 02:37:42,080

god you'll be a father soon uh kurt you

4623

02:37:46,469 --> 02:37:43,920

and your lovely wife but lee knows the

4624

02:37:48,309 --> 02:37:46,479

ultimate causal chain with an infinite

4625

02:37:51,910 --> 02:37:48,319

series of why questions lee how do we

4626  
02:37:56,309 --> 02:37:54,469  
i guess so i mean i just say just tell

4627  
02:37:57,990 --> 02:37:56,319  
them to look for themselves or to shut

4628  
02:38:00,389 --> 02:37:58,000  
up asking the question right the answer

4629  
02:38:02,710 --> 02:38:00,399  
is why why why why why why why because i

4630  
02:38:03,750 --> 02:38:02,720  
said so okay there is a way we use

4631  
02:38:04,790 --> 02:38:03,760  
regression

4632  
02:38:06,469 --> 02:38:04,800  
right

4633  
02:38:08,150 --> 02:38:06,479  
because i said so but look you have a

4634  
02:38:10,389 --> 02:38:08,160  
point you have an origin

4635  
02:38:11,910 --> 02:38:10,399  
and you have a cause and effect now the

4636  
02:38:13,429 --> 02:38:11,920  
infinite regress isn't infinite what

4637  
02:38:15,270 --> 02:38:13,439  
happens is this is i just don't want to

4638  
02:38:17,670 --> 02:38:15,280

this is the mechanism selection so what

4639

02:38:19,190 --> 02:38:17,680

this person i'm sorry you have to get

4640

02:38:20,550 --> 02:38:19,200

you have to brian has to go and i'm

4641

02:38:21,910 --> 02:38:20,560

going to talk to you about so you can

4642

02:38:23,429 --> 02:38:21,920

keep talking about that but after brian

4643

02:38:25,429 --> 02:38:23,439

goes i know what it's like to have a

4644

02:38:28,710 --> 02:38:25,439

wife that wants you to come immediately

4645

02:38:30,710 --> 02:38:28,720

no no i mean mine too i think lee is is

4646

02:38:32,630 --> 02:38:30,720

is uh is correct and i and i do want to

4647

02:38:34,469 --> 02:38:32,640

see this and maybe i'll talk with sarah

4648

02:38:37,349 --> 02:38:34,479

about that when she comes on my show

4649

02:38:39,670 --> 02:38:37,359

but um but ultimately why questions are

4650

02:38:42,070 --> 02:38:39,680

not necessarily part of what scientists

4651  
02:38:44,230 --> 02:38:42,080  
should do why implies a meaning and i

4652  
02:38:46,389 --> 02:38:44,240  
think meaning you know it will bring up

4653  
02:38:48,550 --> 02:38:46,399  
questions of you know teleological

4654  
02:38:50,469 --> 02:38:48,560  
implications uh and i i don't mean that

4655  
02:38:52,230 --> 02:38:50,479  
they're necessarily anathema but usually

4656  
02:38:54,309 --> 02:38:52,240  
when people ask why they mean how or

4657  
02:38:56,389 --> 02:38:54,319  
what um you know how did how did the

4658  
02:38:58,309 --> 02:38:56,399  
causal chain get established

4659  
02:39:00,550 --> 02:38:58,319  
those have great answers in in in

4660  
02:39:02,309 --> 02:39:00,560  
cosmology as well except they have great

4661  
02:39:04,389 --> 02:39:02,319  
problems too and great mysteries and lee

4662  
02:39:06,309 --> 02:39:04,399  
alluded to three hours ago now almost

4663  
02:39:08,309 --> 02:39:06,319

which was you know how did the whole

4664

02:39:10,710 --> 02:39:08,319

thing get kicked off and and what was

4665

02:39:12,630 --> 02:39:10,720

the initial generation of you know a a

4666

02:39:15,030 --> 02:39:12,640

universe and and so forth you could ask

4667

02:39:17,670 --> 02:39:15,040

why is there a universe but i think that

4668

02:39:19,429 --> 02:39:17,680

the question of of of why first of all

4669

02:39:20,790 --> 02:39:19,439

could be trivial if it didn't exist we

4670

02:39:22,790 --> 02:39:20,800

wouldn't be here asking why it doesn't

4671

02:39:25,190 --> 02:39:22,800

exist um

4672

02:39:26,389 --> 02:39:25,200

and uh and and there's your whiskey

4673

02:39:28,309 --> 02:39:26,399

that's wonderful i wish i could have

4674

02:39:30,469 --> 02:39:28,319

some scottish some scottish coffee at

4675

02:39:31,910 --> 02:39:30,479

this time of the day um but uh but in

4676

02:39:34,070 --> 02:39:31,920

reality

4677

02:39:35,830 --> 02:39:34,080

in cosmology as as kurt now you and i

4678

02:39:37,190 --> 02:39:35,840

talked you know i only i only have one

4679

02:39:38,550 --> 02:39:37,200

regret when it comes to kurds that i was

4680

02:39:40,550 --> 02:39:38,560

on his channel when it had the square

4681

02:39:42,309 --> 02:39:40,560

root of the number of viewers that it

4682

02:39:44,630 --> 02:39:42,319

does now and it deserves the square of

4683

02:39:46,710 --> 02:39:44,640

the number or if not more uh but but we

4684

02:39:48,309 --> 02:39:46,720

talked about briefly you know what are

4685

02:39:50,950 --> 02:39:48,319

the laws of physics are they so-called

4686

02:39:52,710 --> 02:39:50,960

geodesically complete can we extrapolate

4687

02:39:54,150 --> 02:39:52,720

the laws and chain of causality within

4688

02:39:55,750 --> 02:39:54,160

the light code when you have a

4689

02:39:57,590 --> 02:39:55,760

singularity and lee mentioned

4690

02:39:59,830 --> 02:39:57,600

singularity a few times i happen to not

4691

02:40:01,270 --> 02:39:59,840

to believe that there is a quantum

4692

02:40:02,630 --> 02:40:01,280

theory of gravity at least i don't

4693

02:40:04,550 --> 02:40:02,640

believe is as well motivated i think

4694

02:40:05,910 --> 02:40:04,560

physicists get distracted by it i think

4695

02:40:07,750 --> 02:40:05,920

that they're pursuing the theory of

4696

02:40:09,510 --> 02:40:07,760

everything for the grandeur the glory

4697

02:40:11,270 --> 02:40:09,520

the the accolades that einstein never

4698

02:40:13,750 --> 02:40:11,280

lived up to that's the very first

4699

02:40:15,030 --> 02:40:13,760

paragraph of michio kako's new book uh

4700

02:40:16,309 --> 02:40:15,040

you know einstein died with his

4701  
02:40:18,070 --> 02:40:16,319  
unfinished symphony that he couldn't

4702  
02:40:19,429 --> 02:40:18,080  
come up with a theory of everything no

4703  
02:40:22,150 --> 02:40:19,439  
despite that being the name of this

4704  
02:40:23,750 --> 02:40:22,160  
channel i think the gut is almost you

4705  
02:40:25,510 --> 02:40:23,760  
know being overlooked the grand unified

4706  
02:40:27,270 --> 02:40:25,520  
theory we don't understand how the lower

4707  
02:40:29,349 --> 02:40:27,280  
energy forces or the higher energy force

4708  
02:40:31,030 --> 02:40:29,359  
are unified let alone how all four are

4709  
02:40:33,510 --> 02:40:31,040  
unified and who

4710  
02:40:36,150 --> 02:40:33,520  
if not you know uh one of us has the

4711  
02:40:37,830 --> 02:40:36,160  
temerity to say that there has to be a

4712  
02:40:40,070 --> 02:40:37,840  
law of quantum gravity what if there's

4713  
02:40:42,630 --> 02:40:40,080

not so i'll channel my inner uh you know

4714

02:40:44,389 --> 02:40:42,640

lee and and say you know i don't believe

4715

02:40:46,150 --> 02:40:44,399

that there is quantum gravity because i

4716

02:40:47,670 --> 02:40:46,160

want to inspire my colleagues to think

4717

02:40:49,910 --> 02:40:47,680

harder about it and we've been going

4718

02:40:52,550 --> 02:40:49,920

about this for decades now with little

4719

02:40:53,750 --> 02:40:52,560

signs of progress um not to say to stop

4720

02:40:56,469 --> 02:40:53,760

even string theory which i have my

4721

02:40:58,630 --> 02:40:56,479

problems with um uh but the alternative

4722

02:40:59,990 --> 02:40:58,640

as they say you know uh the the string

4723

02:41:01,670 --> 02:41:00,000

theory is the worst theory except for

4724

02:41:03,270 --> 02:41:01,680

all the others uh that could be true

4725

02:41:04,870 --> 02:41:03,280

according to whitten

4726

02:41:06,710 --> 02:41:04,880

but but i think ultimately the why

4727

02:41:09,349 --> 02:41:06,720

questions are the most interesting but

4728

02:41:11,990 --> 02:41:09,359

we should be careful not to ask for

4729

02:41:14,230 --> 02:41:12,000

motivation i think that evokes teleology

4730

02:41:15,750 --> 02:41:14,240

but but also we should be very precise

4731

02:41:17,270 --> 02:41:15,760

we should answer all the how questions

4732

02:41:19,030 --> 02:41:17,280

as galileo said

4733

02:41:21,510 --> 02:41:19,040

measure what is measurable and make

4734

02:41:23,349 --> 02:41:21,520

measurable what is not yet so

4735

02:41:24,469 --> 02:41:23,359

and as experimentalists lee and i try to

4736

02:41:26,230 --> 02:41:24,479

do that

4737

02:41:27,670 --> 02:41:26,240

yeah that's a great way to end it put it

4738

02:41:29,590 --> 02:41:27,680

i agree

4739

02:41:31,190 --> 02:41:29,600

thank you so much to the both of you i

4740

02:41:32,790 --> 02:41:31,200

appreciate it and the audience does as

4741

02:41:34,389 --> 02:41:32,800

well

4742

02:41:35,990 --> 02:41:34,399

my pleasure thank you kurt and thank you

4743

02:41:37,590 --> 02:41:36,000

lee i can't wait to be uh together with

4744

02:41:39,429 --> 02:41:37,600

both of you guys at some point in the

4745

02:41:41,750 --> 02:41:39,439

near future light cone

4746

02:41:42,790 --> 02:41:41,760

and all the links yeah and all of the

4747

02:41:45,429 --> 02:41:42,800

links to

4748

02:41:47,110 --> 02:41:45,439

lee cronin's and brian keating's work

4749

02:41:48,790 --> 02:41:47,120

are in the description

4750

02:41:51,270 --> 02:41:48,800

thank you

4751  
02:41:52,630 --> 02:41:51,280  
okay thanks guys good job okay so lee i

4752  
02:41:54,469 --> 02:41:52,640  
know i was cutting you off but i know

4753  
02:41:56,630 --> 02:41:54,479  
brian has to go did you want to expand

4754  
02:41:58,309 --> 02:41:56,640  
on what you were saying before

4755  
02:42:00,070 --> 02:41:58,319  
yeah just very quickly so this whole

4756  
02:42:01,670 --> 02:42:00,080  
idea for infinite regress doesn't have

4757  
02:42:03,429 --> 02:42:01,680  
to happen if you haven't if you have an

4758  
02:42:05,750 --> 02:42:03,439  
origin and you have some events to

4759  
02:42:07,750 --> 02:42:05,760  
happen like the the events are random

4760  
02:42:08,950 --> 02:42:07,760  
but as soon as they start to

4761  
02:42:10,870 --> 02:42:08,960  
um

4762  
02:42:12,710 --> 02:42:10,880  
although they're random as they go on in

4763  
02:42:14,469 --> 02:42:12,720

time they become contingent

4764

02:42:16,070 --> 02:42:14,479

because what happens in the future has

4765

02:42:17,349 --> 02:42:16,080

some relationship to that in the past

4766

02:42:18,710 --> 02:42:17,359

and as long as you don't call screen it

4767

02:42:21,510 --> 02:42:18,720

out now

4768

02:42:23,270 --> 02:42:21,520

when you start to then create an object

4769

02:42:24,230 --> 02:42:23,280

that can then that object can then

4770

02:42:26,389 --> 02:42:24,240

actually

4771

02:42:28,150 --> 02:42:26,399

interact on the infinite regress don't

4772

02:42:30,230 --> 02:42:28,160

go back in the loop but not back to the

4773

02:42:32,389 --> 02:42:30,240

beginning and give

4774

02:42:34,070 --> 02:42:32,399

some knowledge from the future if you

4775

02:42:36,389 --> 02:42:34,080

like to the past

4776

02:42:38,469 --> 02:42:36,399

um then that infinite regress is not an

4777

02:42:39,990 --> 02:42:38,479

infinite regress it's just selection so

4778

02:42:41,670 --> 02:42:40,000

what that means is you have a series of

4779

02:42:43,349 --> 02:42:41,680

processes where you make an object so

4780

02:42:44,870 --> 02:42:43,359

let's just say you've got some

4781

02:42:46,469 --> 02:42:44,880

um some

4782

02:42:47,910 --> 02:42:46,479

uh chemistry occurring you've got let's

4783

02:42:49,030 --> 02:42:47,920

say you have two different streams of

4784

02:42:50,790 --> 02:42:49,040

chemistry

4785

02:42:52,150 --> 02:42:50,800

and they're random right but then in

4786

02:42:53,990 --> 02:42:52,160

each stream so you've got stream a

4787

02:42:55,349 --> 02:42:54,000

random stream b random and they're

4788

02:42:57,910 --> 02:42:55,359

becoming less random there's some

4789

02:43:00,070 --> 02:42:57,920

structure and then stream a

4790

02:43:02,550 --> 02:43:00,080

is able to interact with stream b

4791

02:43:04,389 --> 02:43:02,560

and to change the reaction

4792

02:43:06,469 --> 02:43:04,399

um so it can act back on itself with

4793

02:43:09,030 --> 02:43:06,479

more efficiency so that's something that

4794

02:43:11,110 --> 02:43:09,040

b can act back on itself yeah and then

4795

02:43:12,550 --> 02:43:11,120

you basically then then you get all

4796

02:43:14,710 --> 02:43:12,560

sorts of crazy things going because then

4797

02:43:16,790 --> 02:43:14,720

a and b become intertwined and mutually

4798

02:43:19,270 --> 02:43:16,800

dependent and then that goes up and then

4799

02:43:21,270 --> 02:43:19,280

this process of selection

4800

02:43:24,710 --> 02:43:21,280

starts to transition and i think that's

4801  
02:43:26,630 --> 02:43:24,720  
the secret but i haven't got there yet

4802  
02:43:28,309 --> 02:43:26,640  
we have seen evidence of this in the

4803  
02:43:30,790 --> 02:43:28,319  
laboratory

4804  
02:43:33,190 --> 02:43:30,800  
and i think this is the answer to the

4805  
02:43:35,590 --> 02:43:33,200  
origin of life but we need to literally

4806  
02:43:37,190 --> 02:43:35,600  
run the experiment put a heavy emphasis

4807  
02:43:39,670 --> 02:43:37,200  
on selection and i'm wondering does

4808  
02:43:42,309 --> 02:43:39,680  
section selection in your model of life

4809  
02:43:43,910 --> 02:43:42,319  
come prior to reproducing and variations

4810  
02:43:46,389 --> 02:43:43,920  
sounds like variation was there though

4811  
02:43:47,910 --> 02:43:46,399  
in the b a and the b yes so variation

4812  
02:43:49,670 --> 02:43:47,920  
was first that produced selection which

4813  
02:43:52,309 --> 02:43:49,680

then produced actually

4814

02:43:54,550 --> 02:43:52,319

yeah when you have heterogeneity

4815

02:43:57,910 --> 02:43:54,560

and then you can get selection

4816

02:43:58,870 --> 02:43:57,920

uh and um this kind of variation and and

4817

02:44:01,030 --> 02:43:58,880

things

4818

02:44:03,429 --> 02:44:01,040

interacting and evolution can actually

4819

02:44:05,349 --> 02:44:03,439

still occur on very long time scales and

4820

02:44:07,429 --> 02:44:05,359

these in these on these on these

4821

02:44:09,429 --> 02:44:07,439

infinite timelines if you like and what

4822

02:44:12,870 --> 02:44:09,439

happens is that biology weaponizes

4823

02:44:15,510 --> 02:44:12,880

evolution through through autonomous um

4824

02:44:17,750 --> 02:44:15,520

reproduction because it like grabs all

4825

02:44:19,269 --> 02:44:17,760

those causal chains and can combine them

4826  
02:44:21,910 --> 02:44:19,279  
together in one object and the way it

4827  
02:44:24,309 --> 02:44:21,920  
weaponizes is it basically

4828  
02:44:26,230 --> 02:44:24,319  
replicates the genome stores information

4829  
02:44:28,070 --> 02:44:26,240  
very efficiently from the environment

4830  
02:44:30,550 --> 02:44:28,080  
and then adapts and it can

4831  
02:44:33,190 --> 02:44:30,560  
basically produce lots of attempts

4832  
02:44:35,830 --> 02:44:33,200  
at copying itself with slightly

4833  
02:44:38,230 --> 02:44:35,840  
different causal structures and so why i

4834  
02:44:40,070 --> 02:44:38,240  
see biology is biology is like a

4835  
02:44:42,469 --> 02:44:40,080  
it creates evolution which is an

4836  
02:44:44,950 --> 02:44:42,479  
amplifier for selection

4837  
02:44:46,870 --> 02:44:44,960  
and all the universe is trying to do is

4838  
02:44:48,950 --> 02:44:46,880

become fitter

4839

02:44:50,230 --> 02:44:48,960

i see i i'm having a difficult time

4840

02:44:51,670 --> 02:44:50,240

understanding it and i think it's

4841

02:44:53,750 --> 02:44:51,680

because i don't know what definition of

4842

02:44:55,190 --> 02:44:53,760

cause you're using to say that there was

4843

02:44:56,790 --> 02:44:55,200

a first cause that came from something

4844

02:44:58,389 --> 02:44:56,800

that was uncaused so i think that's

4845

02:45:00,230 --> 02:44:58,399

where my what i'm just saying you've

4846

02:45:02,150 --> 02:45:00,240

just got basically let's think about

4847

02:45:04,710 --> 02:45:02,160

symmetry breaking so you've got a highly

4848

02:45:05,910 --> 02:45:04,720

symmetrical system and then uh things

4849

02:45:08,309 --> 02:45:05,920

interact

4850

02:45:10,150 --> 02:45:08,319

and time because the thing is this is

4851

02:45:12,070 --> 02:45:10,160

where physicists get really stuck in

4852

02:45:13,510 --> 02:45:12,080

that if you've got a time symmetric

4853

02:45:15,190 --> 02:45:13,520

system where does the symmetry breaking

4854

02:45:18,150 --> 02:45:15,200

come from you have to add something in

4855

02:45:21,590 --> 02:45:20,030

some heterogeneity in

4856

02:45:24,309 --> 02:45:21,600

homogeneity

4857

02:45:25,750 --> 02:45:24,319

if you have time you break that symmetry

4858

02:45:27,269 --> 02:45:25,760

necessarily

4859

02:45:29,349 --> 02:45:27,279

so there's something really interesting

4860

02:45:30,790 --> 02:45:29,359

that we don't understand about time but

4861

02:45:33,429 --> 02:45:30,800

um but that's probably for another

4862

02:45:35,030 --> 02:45:33,439

podcast sure man

4863

02:45:36,469 --> 02:45:35,040

and the door's open if you ever want to

4864

02:45:38,070 --> 02:45:36,479

come back on and talk about that yeah

4865

02:45:40,150 --> 02:45:38,080

absolutely yeah yeah it was really

4866

02:45:42,630 --> 02:45:40,160

really we you were very patient with us

4867

02:45:44,630 --> 02:45:42,640

so it's good because i think brian brian

4868

02:45:45,910 --> 02:45:44,640

is a really great debater and it's good

4869

02:45:48,550 --> 02:45:45,920

you know i've got a lot of respect for

4870

02:45:50,309 --> 02:45:48,560

him and what he's doing and he's really

4871

02:45:51,750 --> 02:45:50,319

he's his mission is very good the way

4872

02:45:53,750 --> 02:45:51,760

he's being precise i'm learning a lot

4873

02:45:55,510 --> 02:45:53,760

from him so it was a pleasure honor

4874

02:45:57,510 --> 02:45:55,520

indeed to kind of be with both of you

4875

02:45:59,750 --> 02:45:57,520

guys and talking yeah so the honors

4876

02:46:01,269 --> 02:45:59,760

online man thank you so much

4877

02:46:02,710 --> 02:46:01,279

all right you have a nice day see you

4878

02:46:04,550 --> 02:46:02,720

take care man and any notes that you

4879

02:46:06,630 --> 02:46:04,560

have for me just email me and we can

4880

02:46:07,830 --> 02:46:06,640

absolutely we'll communicate there i'll

4881

02:46:09,190 --> 02:46:07,840

stay and talk to the audience for a

4882

02:46:11,349 --> 02:46:09,200

little bit sorry

4883

02:46:13,110 --> 02:46:11,359

impressed by the questions that also uh

4884

02:46:15,269 --> 02:46:13,120

that you really hadn't looked up the

4885

02:46:17,910 --> 02:46:15,279

assembly theory so i'll ask you about it

4886

02:46:20,870 --> 02:46:17,920

sometimes it's really good all right man

4887

02:46:22,389 --> 02:46:20,880

take care bye bye

4888

02:46:23,830 --> 02:46:22,399

theory of everyone with tyler goldstein

4889

02:46:25,510 --> 02:46:23,840

asks why does he think quantum mechanics

4890

02:46:26,870 --> 02:46:25,520

is outside of consciousness that was my

4891

02:46:28,389 --> 02:46:26,880

question as well

4892

02:46:29,830 --> 02:46:28,399

because you have to presume something

4893

02:46:31,190 --> 02:46:29,840

exists outside of consciousness in order

4894

02:46:32,870 --> 02:46:31,200

to prove that something exists outside

4895

02:46:35,110 --> 02:46:32,880

of it

4896

02:46:36,309 --> 02:46:35,120

thank you travis thank you

4897

02:46:38,550 --> 02:46:36,319

lj

4898

02:46:40,790 --> 02:46:38,560

thank you project malice thank you

4899

02:46:42,469 --> 02:46:40,800

sendip thank you corey

4900

02:46:44,870 --> 02:46:42,479

thank you phillip

4901

02:46:46,550 --> 02:46:44,880

thank you zen jari

4902

02:46:48,070 --> 02:46:46,560

one more time there's a podcast coming

4903

02:46:50,389 --> 02:46:48,080

out in about two

4904

02:46:52,550 --> 02:46:50,399

hours or so with stefan alexander that's

4905

02:46:54,150 --> 02:46:52,560

actually a fantastic podcast i was

4906

02:46:57,910 --> 02:46:54,160

holding off on publishing that for a

4907

02:47:01,429 --> 02:46:59,670

i think i thought it was incomplete and

4908

02:47:02,790 --> 02:47:01,439

i wanted to speak to with stefan some

4909

02:47:06,150 --> 02:47:02,800

more

4910

02:47:09,030 --> 02:47:06,160

and make it

4911

02:47:11,110 --> 02:47:09,040

into a fuller package however as i was

4912

02:47:13,030 --> 02:47:11,120

editing it today it seems like wow it's

4913

02:47:14,950 --> 02:47:13,040

a wonderful podcast so i expect it to do

4914

02:47:19,190 --> 02:47:14,960

well and it's a different podcast it's

4915

02:47:23,269 --> 02:47:21,030

generally when i talk to the physicists

4916

02:47:25,030 --> 02:47:23,279

it gets far more technical than

4917

02:47:27,030 --> 02:47:25,040

virtually any of the other podcasts and

4918

02:47:28,870 --> 02:47:27,040

there's a reason for that i think that's

4919

02:47:30,790 --> 02:47:28,880

i think there is a lacking

4920

02:47:32,070 --> 02:47:30,800

of that type of content someone wants to

4921

02:47:33,269 --> 02:47:32,080

know humphrey wants to know what was it

4922

02:47:35,190 --> 02:47:33,279

like spending four hours with chris

4923

02:47:38,630 --> 02:47:35,200

langan it was actually longer the

4924

02:47:44,710 --> 02:47:42,710

hey i like chris chris is a is chris is

4925

02:47:47,429 --> 02:47:44,720

he's obstreperous

4926

02:47:49,349 --> 02:47:47,439

seemingly but he's a teddy bear

4927

02:47:51,510 --> 02:47:49,359

at least to me

4928

02:47:52,950 --> 02:47:51,520

so i like chris i can understand why

4929

02:47:54,790 --> 02:47:52,960

people

4930

02:47:57,429 --> 02:47:54,800

consider him to be abrasive but that's

4931

02:47:59,670 --> 02:47:57,439

no but even if he is that's no

4932

02:48:01,030 --> 02:47:59,680

well many of the most intelligent people

4933

02:48:03,349 --> 02:48:01,040

can be

4934

02:48:04,309 --> 02:48:03,359

and it's that's an ad hominem if one

4935

02:48:06,870 --> 02:48:04,319

wants to

4936

02:48:08,630 --> 02:48:06,880

discount his ideas based on that okay

4937

02:48:10,309 --> 02:48:08,640

well

4938

02:48:13,190 --> 02:48:10,319

take care everyone thank you so much for

4939

02:48:16,870 --> 02:48:15,110

the podcast is now finished if you'd

4940

02:48:19,990 --> 02:48:16,880

like to support conversations like this

4941

02:48:24,150 --> 02:48:20,000

then do consider going to [patreon.com](https://patreon.com)

4942

02:48:26,790 --> 02:48:24,160

c-u-r-t j-a-i-m-u-n-g-a-l

4943

02:48:28,550 --> 02:48:26,800

that is kurt jaimungle it's support from

4944

02:48:30,389 --> 02:48:28,560

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