



**BRIAN
KEATING**

**TESTING
NATURE'S
PATTERNS**

1
00:00:04,309 --> 00:00:02,710
all right i'm here with professor brian

2
00:00:07,430 --> 00:00:04,319
keating

3
00:00:09,190 --> 00:00:07,440
the magnanimous and beatific brian

4
00:00:10,790 --> 00:00:09,200
keating you should check out his youtube

5
00:00:13,190 --> 00:00:10,800
channel because he interviews plenty of

6
00:00:14,789 --> 00:00:13,200
physicists as well as people who are

7
00:00:17,189 --> 00:00:14,799
watching this may be familiar with like

8
00:00:18,470 --> 00:00:17,199
dave rubin some other of guests which

9
00:00:19,590 --> 00:00:18,480
i'm not sure why you're interviewing

10
00:00:23,590 --> 00:00:19,600
them but we're going to get to that

11
00:00:25,830 --> 00:00:23,600
which for example the beyond meet people

12
00:00:27,429 --> 00:00:25,840
okay first of all let's get get through

13
00:00:28,870 --> 00:00:27,439

the questions one by one

14

00:00:30,950 --> 00:00:28,880

what are your goals

15

00:00:33,030 --> 00:00:30,960

explain to the audience what you do with

16

00:00:35,750 --> 00:00:33,040

your channel what your goals are as you

17

00:00:39,590 --> 00:00:35,760

as a professor for your life

18

00:00:42,069 --> 00:00:39,600

yeah so uh my basic dictum in life is

19

00:00:43,510 --> 00:00:42,079

that it's incredibly short and you have

20

00:00:45,190 --> 00:00:43,520

to make the most of it and you have to

21

00:00:47,750 --> 00:00:45,200

do everything you can

22

00:00:49,510 --> 00:00:47,760

until we invent time travel

23

00:00:50,229 --> 00:00:49,520

we have to do everything we can in order

24

00:00:53,510 --> 00:00:50,239

to

25

00:00:56,310 --> 00:00:53,520

make each moment as meaningful as

26

00:00:58,790 --> 00:00:56,320

invested in with meaning as possible

27

00:01:01,510 --> 00:00:58,800

and so i do that in in different ways

28

00:01:03,270 --> 00:01:01,520

different habits rituals practices

29

00:01:06,469 --> 00:01:03,280

but one thing i've always wanted to do

30

00:01:08,070 --> 00:01:06,479

is to write a book and leave a legacy as

31

00:01:11,030 --> 00:01:08,080

a as an author

32

00:01:13,510 --> 00:01:11,040

and i've learned so much from other

33

00:01:15,030 --> 00:01:13,520

authors that i wanted to

34

00:01:18,390 --> 00:01:15,040

start something especially during this

35

00:01:21,510 --> 00:01:18,400

time of covid to give back to people

36

00:01:24,550 --> 00:01:21,520

that have been my silent mentors or

37

00:01:25,510 --> 00:01:24,560

distant learning mentors namely folks

38

00:01:27,510 --> 00:01:25,520

like

39

00:01:30,070 --> 00:01:27,520

as you mentioned michael shermer has

40

00:01:31,429 --> 00:01:30,080

been on my podcast uh we've had people

41

00:01:34,069 --> 00:01:31,439

like we

42

00:01:35,350 --> 00:01:34,079

david kaiser very famous and well-known

43

00:01:36,950 --> 00:01:35,360

physicist

44

00:01:38,310 --> 00:01:36,960

all the way down to people that have

45

00:01:39,749 --> 00:01:38,320

influenced my life personally that

46

00:01:41,590 --> 00:01:39,759

haven't written books

47

00:01:43,670 --> 00:01:41,600

such as jim simons who he had on the

48

00:01:45,910 --> 00:01:43,680

podcast for father's day

49

00:01:47,749 --> 00:01:45,920

and again following carl sagan's dictum

50

00:01:49,429 --> 00:01:47,759

that books are magic books are proof

51
00:01:51,910 --> 00:01:49,439
that human beings can work magic you

52
00:01:54,230 --> 00:01:51,920
have an author's voice possibly a long

53
00:01:56,389 --> 00:01:54,240
dead author from communicating from

54
00:01:58,389 --> 00:01:56,399
hundreds or maybe thousands of years ago

55
00:02:00,149 --> 00:01:58,399
in the case of you know i read a lot of

56
00:02:03,109 --> 00:02:00,159
the bible and things like that we can

57
00:02:04,950 --> 00:02:03,119
get into and uh how it influences me

58
00:02:07,670 --> 00:02:04,960
is uh you get to

59
00:02:09,270 --> 00:02:07,680
create the sort of um artificial i call

60
00:02:10,869 --> 00:02:09,280
it artificial wisdom

61
00:02:12,309 --> 00:02:10,879
we hear a lot i'm sure you've had a lot

62
00:02:14,229 --> 00:02:12,319
of contact with people that study

63
00:02:16,150 --> 00:02:14,239

artificial intelligence what i'm more

64

00:02:18,550 --> 00:02:16,160

interested in is artificial wisdom

65

00:02:20,390 --> 00:02:18,560

namely how can you accrue wisdom without

66

00:02:22,630 --> 00:02:20,400

going through all the experiences that

67

00:02:25,589 --> 00:02:22,640

other brilliant people have gone through

68

00:02:27,670 --> 00:02:25,599

so i love to read books i love to write

69

00:02:29,990 --> 00:02:27,680

books i'm thinking about my second book

70

00:02:32,869 --> 00:02:30,000

now as we speak and putting it together

71

00:02:34,229 --> 00:02:32,879

based on a lot of the interviews and

72

00:02:36,229 --> 00:02:34,239

things that have emerged from the

73

00:02:39,589 --> 00:02:36,239

conversations with these luminaries that

74

00:02:41,350 --> 00:02:39,599

i'm really fortunate to talk to

75

00:02:42,949 --> 00:02:41,360

how are you defining wisdom

76

00:02:44,630 --> 00:02:42,959

in artificialism

77

00:02:46,470 --> 00:02:44,640

so artificial wisdom is just kind of a

78

00:02:48,229 --> 00:02:46,480

play-off on artificial intelligence

79

00:02:50,790 --> 00:02:48,239

namely that

80

00:02:53,350 --> 00:02:50,800

that you have uh an awful lot of

81

00:02:55,509 --> 00:02:53,360

knowledge that's available to humanity

82

00:02:58,790 --> 00:02:55,519

through things wikipedia the internet

83

00:03:00,869 --> 00:02:58,800

etc but uh and in fact i remind people

84

00:03:03,110 --> 00:03:00,879

that the word science in latin means

85

00:03:05,750 --> 00:03:03,120

knowledge doesn't mean wisdom wisdom is

86

00:03:08,070 --> 00:03:05,760

the ability to synthesize fat pieces of

87

00:03:11,110 --> 00:03:08,080

knowledge in a way that we don't know

88

00:03:14,149 --> 00:03:11,120

but may be uniquely human and i think

89

00:03:15,910 --> 00:03:14,159

synthesizing it to avoid we we i'm also

90

00:03:18,229 --> 00:03:15,920

a private pilot if like tiny little

91

00:03:19,910 --> 00:03:18,239

planes and one of the things we say is

92

00:03:21,830 --> 00:03:19,920

uh you have to learn from the mistakes

93

00:03:23,750 --> 00:03:21,840

of others because you won't live long

94

00:03:25,830 --> 00:03:23,760

enough to make them all yourself

95

00:03:27,750 --> 00:03:25,840

so that's sort of the you know kind of

96

00:03:29,270 --> 00:03:27,760

the ten thousand hour rule applied to

97

00:03:32,550 --> 00:03:29,280

pilots which i think is one of malcolm

98

00:03:34,149 --> 00:03:32,560

gladwell's examples of of you know truly

99

00:03:36,550 --> 00:03:34,159

outstanding pilots are those that have

100

00:03:39,350 --> 00:03:36,560

obtained 10 000 hours and you can only

101
00:03:41,750 --> 00:03:39,360
get that far if you've done things and

102
00:03:43,589 --> 00:03:41,760
benefited from others wisdom the

103
00:03:45,190 --> 00:03:43,599
situations that they've been in so that

104
00:03:47,030 --> 00:03:45,200
you don't have to go through it so it's

105
00:03:48,869 --> 00:03:47,040
not just about knowledge i mean

106
00:03:50,630 --> 00:03:48,879
i think derek sivers once said you know

107
00:03:52,630 --> 00:03:50,640
if if it was all about knowledge we'd

108
00:03:54,949 --> 00:03:52,640
all be billionaires with six-pack abs

109
00:03:55,670 --> 00:03:54,959
there's an abundance of knowledge wisdom

110
00:04:03,110 --> 00:03:55,680
is

111
00:04:05,830 --> 00:04:03,120
that you get into some coherent form of

112
00:04:08,390 --> 00:04:05,840
of life message or wit or vision which

113
00:04:10,630 --> 00:04:08,400

is what i try to maintain

114

00:04:12,869 --> 00:04:10,640

have you heard of john vervicky

115

00:04:16,550 --> 00:04:12,879

no i haven't who is that kirk cognitive

116

00:04:18,069 --> 00:04:16,560

scientist from u of t so um okay

117

00:04:20,229 --> 00:04:18,079

i also interviewed there's two

118

00:04:22,550 --> 00:04:20,239

interviews with him on my channel oh

119

00:04:24,070 --> 00:04:22,560

cool he extensively studies wisdom from

120

00:04:25,189 --> 00:04:24,080

a cognitive science

121

00:04:26,830 --> 00:04:25,199

perspective

122

00:04:28,390 --> 00:04:26,840

oh wow

123

00:04:29,909 --> 00:04:28,400

yeah listen to them

124

00:04:31,510 --> 00:04:29,919

yeah okay maybe we'll get into you'll

125

00:04:33,990 --> 00:04:31,520

help me get in touch with them now you

126

00:04:35,510 --> 00:04:34,000

mentioned that the mind might not be

127

00:04:40,150 --> 00:04:35,520

the human mind might be uniquely

128

00:04:41,990 --> 00:04:40,160

predisposed or capable of wisdom that is

129

00:04:43,510 --> 00:04:42,000

the distilling of so much knowledge down

130

00:04:44,950 --> 00:04:43,520

to something that's practical which

131

00:04:46,230 --> 00:04:44,960

implies a goal and then we can talk

132

00:04:48,070 --> 00:04:46,240

about what where do you get those goals

133

00:04:49,510 --> 00:04:48,080

from later when we get to the biblical

134

00:04:51,110 --> 00:04:49,520

section

135

00:04:52,950 --> 00:04:51,120

do you happen to do you think that the

136

00:04:55,430 --> 00:04:52,960

mind can be mechanized

137

00:04:58,550 --> 00:04:55,440

that is what i mean is that

138

00:05:00,950 --> 00:04:58,560

a machine can simulate the mind

139

00:05:02,790 --> 00:05:00,960

yeah so i've had some conversations with

140

00:05:04,310 --> 00:05:02,800

people about this and actually the most

141

00:05:05,189 --> 00:05:04,320

interesting people i've talked to are

142

00:05:07,909 --> 00:05:05,199

people

143

00:05:09,590 --> 00:05:07,919

uh in the realm of music and the arts i

144

00:05:11,189 --> 00:05:09,600

interviewed a

145

00:05:12,870 --> 00:05:11,199

controversial but interesting very

146

00:05:14,790 --> 00:05:12,880

interesting person named zubi he's a

147

00:05:17,590 --> 00:05:14,800

musician in the uk

148

00:05:19,590 --> 00:05:17,600

that he does a lot of rap and improv

149

00:05:22,230 --> 00:05:19,600

based rap music he's also very

150

00:05:23,670 --> 00:05:22,240

knowledgeable about jazz etc and i also

151

00:05:25,189 --> 00:05:23,680

interviewed a very my one of my best

152

00:05:27,270 --> 00:05:25,199

friends stephan alexander who's a

153

00:05:28,950 --> 00:05:27,280

professional jazz musician but also

154

00:05:31,029 --> 00:05:28,960

professor of theoretical physics at

155

00:05:31,909 --> 00:05:31,039

brown university where i went to grad

156

00:05:34,710 --> 00:05:31,919

school

157

00:05:35,670 --> 00:05:34,720

and uh these two gentlemen have the idea

158

00:05:37,830 --> 00:05:35,680

that

159

00:05:39,830 --> 00:05:37,840

music can be synthesized and it can be

160

00:05:42,870 --> 00:05:39,840

made by computers but there's something

161

00:05:45,590 --> 00:05:42,880

uniquely um almost almost endemic to

162

00:05:47,590 --> 00:05:45,600

human beings that allows for

163

00:05:49,749 --> 00:05:47,600

sort of what what stefan calls this path

164

00:05:52,310 --> 00:05:49,759

integral approach where the mind is

165

00:05:54,710 --> 00:05:52,320

exploring and seeking out ways to

166

00:05:57,350 --> 00:05:54,720

minimize a quantity we physicists call

167

00:05:59,670 --> 00:05:57,360

action and he's doing it doing it in a

168

00:06:01,110 --> 00:05:59,680

way that a computer can solve you know

169

00:06:02,790 --> 00:06:01,120

theoretically can reduce what's called a

170

00:06:04,950 --> 00:06:02,800

lagrangian or solve this action

171

00:06:06,790 --> 00:06:04,960

principle the integral of lagrangian but

172

00:06:08,629 --> 00:06:06,800

uh but it may not be able to create that

173

00:06:11,830 --> 00:06:08,639

idea you know the the notion of an

174

00:06:13,990 --> 00:06:11,840

artificial physicist um that max tegmark

175

00:06:16,790 --> 00:06:14,000

who's also a friend and colleague has

176

00:06:18,950 --> 00:06:16,800

proposed um you know the ability to

177

00:06:21,430 --> 00:06:18,960

replicate the laws of physics merely

178

00:06:22,309 --> 00:06:21,440

based on computing power seems dubious

179

00:06:25,110 --> 00:06:22,319

to me

180

00:06:26,950 --> 00:06:25,120

i'm not saying it's impossible but

181

00:06:29,350 --> 00:06:26,960

these metrics that we have are often

182

00:06:31,749 --> 00:06:29,360

superimposed upon biases that the

183

00:06:33,350 --> 00:06:31,759

individuals who program the artificial

184

00:06:34,550 --> 00:06:33,360

intelligence is the machine learning

185

00:06:36,390 --> 00:06:34,560

algorithms

186

00:06:39,270 --> 00:06:36,400

unconsciously or sometimes consciously

187

00:06:41,510 --> 00:06:39,280

bestow upon that so the turing test you

188

00:06:43,270 --> 00:06:41,520

know is the classic definition um it

189

00:06:45,029 --> 00:06:43,280

turns out you know turing turing almost

190

00:06:47,110 --> 00:06:45,039

inadvertently came up with it or he he

191

00:06:49,029 --> 00:06:47,120

wasn't necessarily thinking about it the

192

00:06:51,189 --> 00:06:49,039

way that we think about it now but he

193

00:06:53,189 --> 00:06:51,199

was so prescient that he really presaged

194

00:06:55,189 --> 00:06:53,199

the fact that yeah this question of

195

00:06:57,110 --> 00:06:55,199

whether or not a computer an artificial

196

00:06:59,830 --> 00:06:57,120

intel general artificial intelligence

197

00:07:02,309 --> 00:06:59,840

could mimic a human being is is

198

00:07:03,189 --> 00:07:02,319

certainly a very very interesting topic

199

00:07:05,430 --> 00:07:03,199

to me

200

00:07:08,309 --> 00:07:05,440

and i've actually talked about it uh

201
00:07:09,430 --> 00:07:08,319
recently with uh who did i talk about

202
00:07:11,430 --> 00:07:09,440
this week

203
00:07:14,230 --> 00:07:11,440
i think it was james altucher who's like

204
00:07:16,710 --> 00:07:14,240
a pundit blogger a prolific podcaster

205
00:07:18,390 --> 00:07:16,720
author and and he was saying yeah like

206
00:07:20,710 --> 00:07:18,400
the turn test you could think about it

207
00:07:23,990 --> 00:07:20,720
being passed right now like sometimes um

208
00:07:26,309 --> 00:07:24,000
i give a i give my uh my ipad to my to

209
00:07:27,670 --> 00:07:26,319
my i have young kids i'll give an ipad

210
00:07:28,870 --> 00:07:27,680
to them they'll play with it and then

211
00:07:30,309 --> 00:07:28,880
they'll come back to me and later on

212
00:07:32,390 --> 00:07:30,319
they'll like swipe my face like they're

213
00:07:33,670 --> 00:07:32,400

trying to change the page in my face you

214

00:07:35,270 --> 00:07:33,680

know unfortunately for them it doesn't

215

00:07:37,189 --> 00:07:35,280

change the way i look

216

00:07:39,189 --> 00:07:37,199

but um but it made me think like could

217

00:07:41,189 --> 00:07:39,199

you could the turing test be kind of age

218

00:07:44,390 --> 00:07:41,199

dependent could you could could the

219

00:07:47,029 --> 00:07:44,400

turing test be uh passed already for

220

00:07:49,670 --> 00:07:47,039

very highly intelligent uh animals like

221

00:07:51,110 --> 00:07:49,680

uh like bonobos or what have you in

222

00:07:53,749 --> 00:07:51,120

other words you could actually pass it

223

00:07:55,189 --> 00:07:53,759

already or young children uh so a young

224

00:07:56,629 --> 00:07:55,199

child wouldn't know if it's their dad

225

00:07:59,110 --> 00:07:56,639

talking to them or an artificial

226

00:08:01,189 --> 00:07:59,120

intelligence so i i those are very

227

00:08:04,070 --> 00:08:01,199

fascinating questions i don't know

228

00:08:05,510 --> 00:08:04,080

however um again what is the impact

229

00:08:06,869 --> 00:08:05,520

because i don't i'm not an expert in

230

00:08:10,469 --> 00:08:06,879

this field but

231

00:08:13,189 --> 00:08:10,479

what is the uniquely human aspect of

232

00:08:16,790 --> 00:08:13,199

intelligence that proves so

233

00:08:18,390 --> 00:08:16,800

uh resistant to perfect mimicry in i.e

234

00:08:20,390 --> 00:08:18,400

the turing test i just it's not

235

00:08:21,990 --> 00:08:20,400

something i personally you know

236

00:08:24,869 --> 00:08:22,000

investigated very deeply but i think it

237

00:08:26,710 --> 00:08:24,879

is a very important question

238

00:08:28,629 --> 00:08:26,720

i was reading recently mind machines and

239

00:08:30,629 --> 00:08:28,639

girdle by lucas have you heard of that

240

00:08:31,990 --> 00:08:30,639

paper i've heard of it yes i haven't

241

00:08:35,750 --> 00:08:32,000

read it

242

00:08:39,509 --> 00:08:37,589

that a machine can simulate any aspect

243

00:08:41,110 --> 00:08:39,519

of the mind when not every aspect and

244

00:08:43,269 --> 00:08:41,120

that seems like a contradiction but you

245

00:08:45,190 --> 00:08:43,279

can also think of it like a machine can

246

00:08:47,350 --> 00:08:45,200

simulate any natural number but not

247

00:08:48,790 --> 00:08:47,360

every natural number right and it can do

248

00:08:50,310 --> 00:08:48,800

things better than human beings right i

249

00:08:51,750 --> 00:08:50,320

mean you know one of the you know what

250

00:08:53,910 --> 00:08:51,760

one of the best uses of a quantum

251
00:08:55,590 --> 00:08:53,920
computer is that a classical computer

252
00:08:57,430 --> 00:08:55,600
can't model right that's a quantum

253
00:09:00,310 --> 00:08:57,440
computer in other words a quantum

254
00:09:03,110 --> 00:09:00,320
computer is the ideal device if you will

255
00:09:05,590 --> 00:09:03,120
technology to model quantum processes

256
00:09:08,630 --> 00:09:05,600
lagrangians hamiltonians the question is

257
00:09:10,230 --> 00:09:08,640
as you say you know because it surpasses

258
00:09:11,990 --> 00:09:10,240
any human being or any conventional

259
00:09:14,070 --> 00:09:12,000
silicon computer or whatever classical

260
00:09:16,150 --> 00:09:14,080
computer uh does that mean it could do

261
00:09:17,670 --> 00:09:16,160
so in every field

262
00:09:19,590 --> 00:09:17,680
it's hard to say yes i guess that paper

263
00:09:21,190 --> 00:09:19,600

you're saying argues no

264

00:09:23,990 --> 00:09:21,200

yeah and it says we need to make a

265

00:09:26,230 --> 00:09:24,000

delineation between superiority and

266

00:09:28,630 --> 00:09:26,240

equivalence so a computer can be much

267

00:09:29,829 --> 00:09:28,640

better than us and it is in various

268

00:09:32,790 --> 00:09:29,839

aspects but it doesn't mean it's

269

00:09:34,310 --> 00:09:32,800

equivalent and he gives

270

00:09:36,230 --> 00:09:34,320

an in-principle argument for why it

271

00:09:38,150 --> 00:09:36,240

can't be used in girdle but if it's a

272

00:09:40,230 --> 00:09:38,160

formal system that's consistent and

273

00:09:41,750 --> 00:09:40,240

sound then

274

00:09:44,070 --> 00:09:41,760

it can there are statements that it

275

00:09:45,430 --> 00:09:44,080

can't prove to be true but we can see

276

00:09:48,150 --> 00:09:45,440

when we stand outside the system that

277

00:09:49,670 --> 00:09:48,160

it's true and just based on that alone

278

00:09:52,710 --> 00:09:49,680

there's a difference between our minds

279

00:09:55,750 --> 00:09:54,070

have you studied much of gurdwell's

280

00:09:58,230 --> 00:09:55,760

incompleteness theorem

281

00:09:59,990 --> 00:09:58,240

i i i wouldn't say i've studied it i've

282

00:10:02,949 --> 00:10:00,000

familiarized myself with it in the

283

00:10:05,750 --> 00:10:02,959

following sense that i believe that uh

284

00:10:08,070 --> 00:10:05,760

that physicists have a deep

285

00:10:10,470 --> 00:10:08,080

envy of girdles in completeness theorem

286

00:10:13,509 --> 00:10:10,480

for the following reason it's very hard

287

00:10:15,670 --> 00:10:13,519

to find statements about physics itself

288

00:10:17,590 --> 00:10:15,680

that come from within physics itself in

289

00:10:20,389 --> 00:10:17,600

other words it's very hard to say what

290

00:10:23,430 --> 00:10:20,399

constitutes physics what constitutes

291

00:10:25,269 --> 00:10:23,440

scientific methods uh some as as in your

292

00:10:27,350 --> 00:10:25,279

fellow torontonian or i guess he's in

293

00:10:28,389 --> 00:10:27,360

waterloo but lee smallin who's a very

294

00:10:31,509 --> 00:10:28,399

good friend of mine he'll be on the

295

00:10:32,710 --> 00:10:31,519

podcast soon uh he and i have chatted

296

00:10:35,350 --> 00:10:32,720

about this he actually doesn't even

297

00:10:38,949 --> 00:10:35,360

believe that the scientific method is is

298

00:10:41,269 --> 00:10:38,959

as resilient you know as a truly um

299

00:10:43,350 --> 00:10:41,279

definable conjecture in other words he

300

00:10:45,509 --> 00:10:43,360

argues you know with the kind of carl

301
00:10:47,110 --> 00:10:45,519
sagan or neil degrasse tyson you know

302
00:10:49,509 --> 00:10:47,120
simple statement of what the scientific

303
00:10:51,910 --> 00:10:49,519
method is he argues based on

304
00:10:54,150 --> 00:10:51,920
a book that i can provide for you guys

305
00:10:55,750 --> 00:10:54,160
later but um there's arguments against

306
00:10:57,910 --> 00:10:55,760
the existence of even the scientific

307
00:10:59,670 --> 00:10:57,920
method so now once you have this and you

308
00:11:01,750 --> 00:10:59,680
try to equate it and you're trying to

309
00:11:03,590 --> 00:11:01,760
ask like am i wasting my life like i'm

310
00:11:05,430 --> 00:11:03,600
building this huge observatory with 300

311
00:11:06,389 --> 00:11:05,440
of my most brilliant colleagues in the

312
00:11:08,069 --> 00:11:06,399
world

313
00:11:10,470 --> 00:11:08,079

is it just a waste because ultimately

314

00:11:12,470 --> 00:11:10,480

it's tantamount to astrology now i think

315

00:11:13,509 --> 00:11:12,480

i can make very strong arguments that

316

00:11:16,069 --> 00:11:13,519

it's not

317

00:11:18,230 --> 00:11:16,079

however as we will get to certainly

318

00:11:20,949 --> 00:11:18,240

there are aspects of this of this

319

00:11:22,550 --> 00:11:20,959

pursuit of studying the early universe

320

00:11:24,790 --> 00:11:22,560

that some claim are tantamount to

321

00:11:26,550 --> 00:11:24,800

astrology or tantamount to you know

322

00:11:29,910 --> 00:11:26,560

phrenology or something like this that

323

00:11:31,910 --> 00:11:29,920

we are doing what's that how so

324

00:11:33,430 --> 00:11:31,920

so we can get into that with regard to

325

00:11:35,509 --> 00:11:33,440

string theory the multiverse i saw you

326

00:11:36,470 --> 00:11:35,519

want to talk about that um we should

327

00:11:37,750 --> 00:11:36,480

definitely get into that but just

328

00:11:40,069 --> 00:11:37,760

finishing up on because you asked me

329

00:11:41,990 --> 00:11:40,079

about girdle uh so

330

00:11:44,230 --> 00:11:42,000

what's important about girdle is that it

331

00:11:46,470 --> 00:11:44,240

shows you the limitations of the

332

00:11:48,710 --> 00:11:46,480

mathematical um the mathematical

333

00:11:50,870 --> 00:11:48,720

construct that human beings have

334

00:11:52,630 --> 00:11:50,880

invented and discovered now i say that

335

00:11:54,949 --> 00:11:52,640

because jim simons and i had a wonderful

336

00:11:56,550 --> 00:11:54,959

conversation i asked him is mathematics

337

00:11:59,110 --> 00:11:56,560

invented or discovered and he said it's

338

00:12:02,150 --> 00:11:59,120

both because the only way to find out

339

00:12:03,670 --> 00:12:02,160

what is new is to discover something and

340

00:12:05,750 --> 00:12:03,680

when you discover something new like the

341

00:12:08,310 --> 00:12:05,760

churn simon's relations and differential

342

00:12:11,030 --> 00:12:08,320

forms etc when you do that you learn new

343

00:12:13,190 --> 00:12:11,040

things and you in some sense invent new

344

00:12:15,430 --> 00:12:13,200

technology literally i mean there are

345

00:12:16,790 --> 00:12:15,440

people that say that effectively churn

346

00:12:18,870 --> 00:12:16,800

simon's can be used to derive the

347

00:12:22,230 --> 00:12:18,880

einstein field equation so you know did

348

00:12:24,150 --> 00:12:22,240

einstein uh you know discover that or d

349

00:12:25,509 --> 00:12:24,160

you know did he invent it he used tools

350

00:12:28,470 --> 00:12:25,519

of mathematics that had never been used

351

00:12:30,150 --> 00:12:28,480

in physics so getting back to gurgle i

352

00:12:31,670 --> 00:12:30,160

think that physicists would love to have

353

00:12:33,829 --> 00:12:31,680

a similar statement even though some

354

00:12:35,910 --> 00:12:33,839

mathematicians my friend janet levin who

355

00:12:37,190 --> 00:12:35,920

was on my podcast i haven't released her

356

00:12:38,949 --> 00:12:37,200

episode but she wrote a great book

357

00:12:41,110 --> 00:12:38,959

called the madman dreams of turing

358

00:12:43,509 --> 00:12:41,120

machines and it's about girdle and

359

00:12:46,069 --> 00:12:43,519

turing and this fictitious relationship

360

00:12:47,910 --> 00:12:46,079

between the two of them in vienna

361

00:12:49,590 --> 00:12:47,920

it's an it's a fictional book yeah so

362

00:12:51,670 --> 00:12:49,600

she's a she's an amazing writer she's

363

00:12:54,470 --> 00:12:51,680

written best-selling nonfiction books

364

00:12:57,030 --> 00:12:54,480

about ligo and about uh she's a

365

00:12:59,110 --> 00:12:57,040

physicist as well she's uh yeah she's a

366

00:13:01,509 --> 00:12:59,120

chair named chair professor at barnard

367

00:13:03,829 --> 00:13:01,519

college at columbia university

368

00:13:05,829 --> 00:13:03,839

wow yeah she's amazing i would love to

369

00:13:07,910 --> 00:13:05,839

connect you with her but she she writes

370

00:13:10,150 --> 00:13:07,920

fiction and this book is this is this

371

00:13:12,470 --> 00:13:10,160

fictional kind of character of how they

372

00:13:14,470 --> 00:13:12,480

both you know were led to basically take

373

00:13:17,190 --> 00:13:14,480

their own lives and and what happened

374

00:13:19,829 --> 00:13:17,200

how they did so one did so uh via

375

00:13:21,670 --> 00:13:19,839

ingesting a poisoned apple

376

00:13:24,310 --> 00:13:21,680

and one did so by starving himself to

377

00:13:26,629 --> 00:13:24,320

death and uh and just just the amazing

378

00:13:28,710 --> 00:13:26,639

connections that she draws uh it's been

379

00:13:30,550 --> 00:13:28,720

called like maria popova it's her one of

380

00:13:31,590 --> 00:13:30,560

her favorite books of all time and she's

381

00:13:33,509 --> 00:13:31,600

you know one of the most brilliant

382

00:13:34,389 --> 00:13:33,519

people anyway getting back to girdle so

383

00:13:36,230 --> 00:13:34,399

i would say

384

00:13:37,750 --> 00:13:36,240

i wish that there was and i think many

385

00:13:40,150 --> 00:13:37,760

physicists wish that there was something

386

00:13:42,710 --> 00:13:40,160

besides popper you know popper we can

387

00:13:45,190 --> 00:13:42,720

get into demarcation conjectures

388

00:13:47,750 --> 00:13:45,200

um effectively we don't have a hard and

389

00:13:48,949 --> 00:13:47,760

fast mathematically consistent rule at

390

00:13:50,629 --> 00:13:48,959

least within the realm of

391

00:13:52,550 --> 00:13:50,639

self-consistency that that girdle

392

00:13:54,870 --> 00:13:52,560

delineates we don't have something that

393

00:13:56,870 --> 00:13:54,880

tells me cosmology or you know a

394

00:14:00,150 --> 00:13:56,880

condensed matter physics is a waste of

395

00:14:02,870 --> 00:14:00,160

time because it's it's it's logically as

396

00:14:04,790 --> 00:14:02,880

equivalent to or not to some other

397

00:14:06,949 --> 00:14:04,800

branch of of you know what we can

398

00:14:10,389 --> 00:14:06,959

consider metaphysics or non-physics like

399

00:14:13,590 --> 00:14:10,399

astrology so is cosmology like astrology

400

00:14:15,829 --> 00:14:13,600

we don't have as cleanly divided

401
00:14:18,710 --> 00:14:15,839
demarcations between those despite what

402
00:14:20,710 --> 00:14:18,720
most people think coming from popper

403
00:14:21,829 --> 00:14:20,720
now acid you're an experimentalist the

404
00:14:24,069 --> 00:14:21,839
audience might not know that well we'll

405
00:14:25,350 --> 00:14:24,079
know from the introduction yeah which is

406
00:14:27,829 --> 00:14:25,360
different than most of the people that i

407
00:14:29,030 --> 00:14:27,839
talk to i talk to theoretical physicists

408
00:14:31,030 --> 00:14:29,040
yeah and

409
00:14:33,750 --> 00:14:31,040
and and that puts you in a unique

410
00:14:36,150 --> 00:14:33,760
perspective many theoretical physicists

411
00:14:37,430 --> 00:14:36,160
including penrose and feynman i mean

412
00:14:39,110 --> 00:14:37,440
dyson

413
00:14:40,629 --> 00:14:39,120

believe that that girdles in

414

00:14:43,030 --> 00:14:40,639

completeness theorem has something to

415

00:14:44,550 --> 00:14:43,040

say about our ability to come up

416

00:14:45,829 --> 00:14:44,560

with the theory of everything if they're

417

00:14:47,750 --> 00:14:45,839

ex and

418

00:14:49,110 --> 00:14:47,760

the existence of one as well so whether

419

00:14:51,590 --> 00:14:49,120

or not we can find it and whether or not

420

00:14:53,030 --> 00:14:51,600

existence are two different

421

00:14:55,590 --> 00:14:53,040

topics well

422

00:14:56,870 --> 00:14:55,600

what do you see as an experimentalist

423

00:14:59,350 --> 00:14:56,880

girdles incompleteness theorems

424

00:15:02,150 --> 00:14:59,360

implications for physics itself

425

00:15:04,949 --> 00:15:02,160

yeah so um you know i've had on penrose

426

00:15:07,670 --> 00:15:04,959

i had on dyson many times um and and

427

00:15:10,150 --> 00:15:07,680

penrose many times um and martin reese

428

00:15:12,790 --> 00:15:10,160

and i have had wonderful conversations

429

00:15:13,829 --> 00:15:12,800

as well i would say that exactly as you

430

00:15:15,430 --> 00:15:13,839

know and you know you're the first

431

00:15:16,790 --> 00:15:15,440

person to ever notice this i don't know

432

00:15:19,189 --> 00:15:16,800

if you use like metrics with your

433

00:15:20,710 --> 00:15:19,199

podcast kurt like i always like if i ask

434

00:15:22,470 --> 00:15:20,720

somebody a question they say i've never

435

00:15:24,710 --> 00:15:22,480

thought of that before or i've never

436

00:15:26,550 --> 00:15:24,720

been asked that before or they sit there

437

00:15:28,389 --> 00:15:26,560

like this

438

00:15:29,829 --> 00:15:28,399

that's a sign of a good podcast okay so

439

00:15:31,430 --> 00:15:29,839

i want to give you that little metric

440

00:15:34,069 --> 00:15:31,440

that little uh what do they call that

441

00:15:35,990 --> 00:15:34,079

kpi key performance

442

00:15:37,269 --> 00:15:36,000

good job there so so almost no one has

443

00:15:39,509 --> 00:15:37,279

ever asked me

444

00:15:41,350 --> 00:15:39,519

uh about the unique perspective that an

445

00:15:43,269 --> 00:15:41,360

experimentalist has on this and i think

446

00:15:45,990 --> 00:15:43,279

it's it's it's um it's a little

447

00:15:47,670 --> 00:15:46,000

unfortunate because most many people see

448

00:15:50,069 --> 00:15:47,680

the theoretical physicists the brian

449

00:15:53,269 --> 00:15:50,079

greene's the jana levins like i said the

450

00:15:54,790 --> 00:15:53,279

stefan alexanders jim gates uh lee small

451
00:15:56,870 --> 00:15:54,800
and they see the those are physicists

452
00:15:59,509 --> 00:15:56,880
michio kaku they see those are the

453
00:16:01,670 --> 00:15:59,519
physicists and the the you know and the

454
00:16:03,110 --> 00:16:01,680
brian keatings don't get the attention

455
00:16:05,430 --> 00:16:03,120
i'm clamoring for attention of brian

456
00:16:07,110 --> 00:16:05,440
green but the bottom line is they can

457
00:16:08,870 --> 00:16:07,120
work and i had this conversation with

458
00:16:11,110 --> 00:16:08,880
eric weinstein yesterday just the two of

459
00:16:13,110 --> 00:16:11,120
us uh you know hanging out and chatting

460
00:16:15,350 --> 00:16:13,120
on the phone and i was like look you

461
00:16:17,110 --> 00:16:15,360
know an experimentalist i can point to

462
00:16:19,829 --> 00:16:17,120
the key performance indicators that i

463
00:16:22,949 --> 00:16:19,839

achieved every day i keep a journal i

464

00:16:26,069 --> 00:16:22,959

have um i i have you know metrics for

465

00:16:27,430 --> 00:16:26,079

what i want to succeed in each day

466

00:16:29,430 --> 00:16:27,440

today's list i could show it to you in

467

00:16:31,670 --> 00:16:29,440

my diary across the room yeah talk to

468

00:16:34,150 --> 00:16:31,680

kurt and and you know communicate new

469

00:16:36,310 --> 00:16:34,160

ideas so uh so i keep that now a

470

00:16:38,310 --> 00:16:36,320

theorist might have one or two papers in

471

00:16:40,310 --> 00:16:38,320

his or her career that that's their

472

00:16:43,030 --> 00:16:40,320

entire career now some experimentalists

473

00:16:45,030 --> 00:16:43,040

might not even have uh you know uh more

474

00:16:48,069 --> 00:16:45,040

than that in terms of one experiment my

475

00:16:50,150 --> 00:16:48,079

semi experiments last 10 15 20 years the

476

00:16:51,910 --> 00:16:50,160

ligo experiment lasts 40 years from

477

00:16:55,269 --> 00:16:51,920

beginning to success and we can talk

478

00:16:57,910 --> 00:16:55,279

about what that means uh later but um

479

00:17:00,470 --> 00:16:57,920

but basically an experimentalist has a

480

00:17:02,069 --> 00:17:00,480

certain clock that's ticking within his

481

00:17:04,150 --> 00:17:02,079

or her brain and that clock is saying

482

00:17:06,150 --> 00:17:04,160

what can i accomplish that will provide

483

00:17:08,309 --> 00:17:06,160

crisp new evidence that will reveal

484

00:17:09,990 --> 00:17:08,319

something new about the universe that no

485

00:17:12,789 --> 00:17:10,000

one's ever known before so that my

486

00:17:15,750 --> 00:17:12,799

student can get a phd or a postdoc or i

487

00:17:17,669 --> 00:17:15,760

can get a little uh you know continue

488

00:17:19,669 --> 00:17:17,679

the program of endeavor that i'm trying

489

00:17:21,590 --> 00:17:19,679

to achieve and sometimes they're very

490

00:17:23,829 --> 00:17:21,600

big and sometimes they're very small but

491

00:17:26,549 --> 00:17:23,839

on a daily basis there's a clock ticking

492

00:17:28,309 --> 00:17:26,559

tick tick tick what did i get done what

493

00:17:29,990 --> 00:17:28,319

aspect even if it's a simple thing and

494

00:17:32,470 --> 00:17:30,000

that and that's where i think we have an

495

00:17:34,789 --> 00:17:32,480

advantage because you know as um richard

496

00:17:36,710 --> 00:17:34,799

feynman once said you know

497

00:17:38,230 --> 00:17:36,720

teaching is good for for physicists

498

00:17:40,230 --> 00:17:38,240

because most of the time we're not

499

00:17:42,150 --> 00:17:40,240

productive coming up with qed or some

500

00:17:43,430 --> 00:17:42,160

new theory of physics so at least we

501
00:17:46,150 --> 00:17:43,440
feel like we accomplish something when

502
00:17:49,750 --> 00:17:46,160
we talk i feel like that i get to teach

503
00:17:52,390 --> 00:17:49,760
and i get to learn uh by experimentation

504
00:17:54,230 --> 00:17:52,400
every day thinking about not exactly how

505
00:17:56,789 --> 00:17:54,240
to test whether or not the universe had

506
00:17:58,950 --> 00:17:56,799
a singular origin in in the big bang

507
00:18:01,350 --> 00:17:58,960
which is a very important part of my

508
00:18:03,270 --> 00:18:01,360
overall mission that's what i call the

509
00:18:05,350 --> 00:18:03,280
big picture strategic thinking of an

510
00:18:06,870 --> 00:18:05,360
experimentalist what big questions do i

511
00:18:09,270 --> 00:18:06,880
want the answer to do neutrinos have

512
00:18:12,070 --> 00:18:09,280
mass what are the masses of neutrinos is

513
00:18:14,150 --> 00:18:12,080

there um a cp violation in the early

514

00:18:15,990 --> 00:18:14,160

universe those are huge the tactical

515

00:18:17,830 --> 00:18:16,000

day-to-day activities that an

516

00:18:19,110 --> 00:18:17,840

experimentalist does is probably very

517

00:18:20,630 --> 00:18:19,120

different from what a theorist does and

518

00:18:23,590 --> 00:18:20,640

i've written works with theorists a lot

519

00:18:25,510 --> 00:18:23,600

of my ideas is guided by theorists

520

00:18:28,390 --> 00:18:25,520

but on the other hand i can point to

521

00:18:30,630 --> 00:18:28,400

specific tactics every day that are

522

00:18:32,950 --> 00:18:30,640

metrics towards the ultimate strategic

523

00:18:34,470 --> 00:18:32,960

victory that i hope to achieve and so i

524

00:18:36,710 --> 00:18:34,480

think it's a different perspective it's

525

00:18:39,669 --> 00:18:36,720

more practical it's more it's sort of

526

00:18:41,430 --> 00:18:39,679

more um it's more quotidian but on the

527

00:18:43,270 --> 00:18:41,440

same token i think it's just as

528

00:18:45,750 --> 00:18:43,280

important as the theoretical guidance

529

00:18:48,630 --> 00:18:45,760

that we get and furthermore you can

530

00:18:50,230 --> 00:18:48,640

produce i i feel like theorists are and

531

00:18:52,070 --> 00:18:50,240

i love theories but you know my father

532

00:18:53,350 --> 00:18:52,080

was a theoretical physicist yeah so i'm

533

00:18:55,270 --> 00:18:53,360

going to say there's no insult to all

534

00:18:57,430 --> 00:18:55,280

you theory but phys theoretical fizz are

535

00:18:58,950 --> 00:18:57,440

kind of like bosons not bozos but you

536

00:19:00,950 --> 00:18:58,960

can create like a lot of them doing the

537

00:19:02,390 --> 00:19:00,960

same kind of cool stuff and but they

538

00:19:04,710 --> 00:19:02,400

won't be able to see if it's right or

539

00:19:06,549 --> 00:19:04,720

wrong until a fermionic experimentalist

540

00:19:08,070 --> 00:19:06,559

comes along and says that doesn't comp

541

00:19:09,190 --> 00:19:08,080

you know we don't we don't play nicely

542

00:19:12,310 --> 00:19:09,200

right we're not going to just accept

543

00:19:14,390 --> 00:19:12,320

some theory because it's beautiful

544

00:19:16,470 --> 00:19:14,400

in some ways that well

545

00:19:18,070 --> 00:19:16,480

ultimately the experimentalists are the

546

00:19:20,390 --> 00:19:18,080

ground of physics because you can come

547

00:19:21,669 --> 00:19:20,400

up with ideas as as much as you want and

548

00:19:24,549 --> 00:19:21,679

i think that one of the reasons why

549

00:19:25,510 --> 00:19:24,559

theoretical physicists can get much more

550

00:19:26,630 --> 00:19:25,520

play

551
00:19:28,950 --> 00:19:26,640
on

552
00:19:29,990 --> 00:19:28,960
in the public sciences because

553
00:19:31,110 --> 00:19:30,000
i'd like to know your thoughts i don't

554
00:19:33,110 --> 00:19:31,120
know if this is true but this is what i

555
00:19:34,310 --> 00:19:33,120
think is that they can be expansive and

556
00:19:35,510 --> 00:19:34,320
they can be

557
00:19:38,470 --> 00:19:35,520
mystical

558
00:19:39,590 --> 00:19:38,480
but the experimentalist job is to be

559
00:19:41,590 --> 00:19:39,600
careful

560
00:19:42,710 --> 00:19:41,600
and say no it's it's

561
00:19:44,070 --> 00:19:42,720
yeah

562
00:19:45,990 --> 00:19:44,080
that's right theoretical exactly right

563
00:19:48,070 --> 00:19:46,000

maybe maybe and that's more intriguing

564

00:19:51,190 --> 00:19:48,080

to the public because

565

00:19:53,110 --> 00:19:51,200

the experimentalist is a

566

00:19:55,190 --> 00:19:53,120

be fastidious and meticulous and exact

567

00:19:56,310 --> 00:19:55,200

and precise absolutely mathematician

568

00:19:57,510 --> 00:19:56,320

needs to be that same way and you can

569

00:20:00,150 --> 00:19:57,520

make an analogy between theoretical

570

00:20:01,750 --> 00:20:00,160

systems but that's not my father used to

571

00:20:03,909 --> 00:20:01,760

say the same thing you say actually you

572

00:20:05,830 --> 00:20:03,919

need to know you need to be better than

573

00:20:07,830 --> 00:20:05,840

a theorist because you don't have to

574

00:20:09,909 --> 00:20:07,840

create new theories but if you don't

575

00:20:10,950 --> 00:20:09,919

understand how the theories work you're

576

00:20:12,630 --> 00:20:10,960

you know in his words you say you're

577

00:20:14,870 --> 00:20:12,640

just like a plumber and i'm not

578

00:20:16,470 --> 00:20:14,880

disparaging plumbers i love plumbers my

579

00:20:17,830 --> 00:20:16,480

cousins apply you know so don't take

580

00:20:19,830 --> 00:20:17,840

this the wrong way but you're just like

581

00:20:21,430 --> 00:20:19,840

doing a technical task you're not

582

00:20:23,510 --> 00:20:21,440

actually doing it for the right reason

583

00:20:25,110 --> 00:20:23,520

which is to understand using the

584

00:20:27,750 --> 00:20:25,120

principle of right reason what is the

585

00:20:29,830 --> 00:20:27,760

importance of this undertaking that

586

00:20:31,270 --> 00:20:29,840

you're that you're pursuing so you know

587

00:20:32,710 --> 00:20:31,280

i always make sure my students my

588

00:20:35,350 --> 00:20:32,720

students spend almost as much time

589

00:20:36,630 --> 00:20:35,360

reading theoretical papers and in fact

590

00:20:37,430 --> 00:20:36,640

as you just said

591

00:21:22,789 --> 00:20:37,440

i

592

00:21:24,870 --> 00:21:22,799

podcast theme at the arthur c clarke

593

00:21:26,549 --> 00:21:24,880

center

594

00:21:28,470 --> 00:21:26,559

but ultimately what i'm concerned with

595

00:21:30,070 --> 00:21:28,480

is i've got you know hopefully 50 60

596

00:21:31,510 --> 00:21:30,080

years left i don't know how much you

597

00:21:32,870 --> 00:21:31,520

know i'll be cognizant and be able to

598

00:21:35,029 --> 00:21:32,880

understand it i want to know what i can

599

00:21:38,070 --> 00:21:35,039

accomplish that's practical that's

600

00:21:39,990 --> 00:21:38,080

decisive and that as you said that i in

601
00:21:42,149 --> 00:21:40,000
my book losing the nobel prize i talk

602
00:21:44,310 --> 00:21:42,159
about how experimentalists are kind of

603
00:21:47,750 --> 00:21:44,320
like exterminators our job is to kill

604
00:21:48,950 --> 00:21:47,760
off the bugs in theories and destroy

605
00:21:51,190 --> 00:21:48,960
theories that don't comport with

606
00:21:53,430 --> 00:21:51,200
evidence we're not required to create

607
00:21:56,149 --> 00:21:53,440
new theories although i've worked to try

608
00:21:58,710 --> 00:21:56,159
to understand maybe phenomenology is the

609
00:22:00,149 --> 00:21:58,720
best way to describe it and and also

610
00:22:02,310 --> 00:22:00,159
look what are the limitations of

611
00:22:04,149 --> 00:22:02,320
experiments don't forget most of my

612
00:22:04,870 --> 00:22:04,159
career i'm looking at noise i'm looking

613
00:22:08,390 --> 00:22:04,880

at

614

00:22:11,029 --> 00:22:08,400

like noise which can be mimicked is the

615

00:22:13,190 --> 00:22:11,039

most highly entropic form of radiation

616

00:22:15,990 --> 00:22:13,200

that exists how do you distinguish that

617

00:22:17,750 --> 00:22:16,000

disentangle that from other sources of

618

00:22:20,149 --> 00:22:17,760

contamination from the ground which is

619

00:22:22,230 --> 00:22:20,159

100 times brighter the sun which is a

620

00:22:24,470 --> 00:22:22,240

thousand times hotter how do you go

621

00:22:26,149 --> 00:22:24,480

about doing that and so most of our time

622

00:22:28,549 --> 00:22:26,159

is looking for ways to prove ourselves

623

00:22:31,350 --> 00:22:28,559

wrong which is feynman said is the job

624

00:22:33,190 --> 00:22:31,360

to not be uh to not be fooled

625

00:22:35,909 --> 00:22:33,200

i i think i did myself a great

626

00:22:37,750 --> 00:22:35,919

disservice when i was in university in

627

00:22:39,590 --> 00:22:37,760

in that i

628

00:22:41,270 --> 00:22:39,600

disregarded experimental physics i

629

00:22:43,270 --> 00:22:41,280

despised my there was a second year

630

00:22:45,669 --> 00:22:43,280

requirement for experimental physics and

631

00:22:47,270 --> 00:22:45,679

i just it was never explained to me why

632

00:22:48,789 --> 00:22:47,280

you add the error bars in in the way

633

00:22:49,909 --> 00:22:48,799

that you do and i understand now it has

634

00:22:51,830 --> 00:22:49,919

something to do with taylor expansion

635

00:22:53,909 --> 00:22:51,840

but i never gropped it i didn't

636

00:22:56,230 --> 00:22:53,919

understand it yeah i didn't want to

637

00:22:58,070 --> 00:22:56,240

spend the time to and i regret that

638

00:22:58,870 --> 00:22:58,080

because i think that

639

00:23:00,310 --> 00:22:58,880

as

640

00:23:01,510 --> 00:23:00,320

part of my mission is to come up with a

641

00:23:02,870 --> 00:23:01,520

theory of everything or integrate the

642

00:23:05,350 --> 00:23:02,880

other theories of everything or find the

643

00:23:07,110 --> 00:23:05,360

best candidate i

644

00:23:08,470 --> 00:23:07,120

i see that as a

645

00:23:10,470 --> 00:23:08,480

large

646

00:23:12,390 --> 00:23:10,480

area that i'm lacking that would have

647

00:23:14,630 --> 00:23:12,400

significantly helped me yeah you know

648

00:23:16,789 --> 00:23:14,640

what scientists don't data analysis

649

00:23:18,549 --> 00:23:16,799

right so what scientists and it's not

650

00:23:19,990 --> 00:23:18,559

you know i don't want to like take the

651
00:23:21,029 --> 00:23:20,000
blame off you entirely because i you

652
00:23:22,710 --> 00:23:21,039
know this is the first time we're

653
00:23:24,390 --> 00:23:22,720
talking but but i do want to say that we

654
00:23:26,549 --> 00:23:24,400
don't teach experimental physics

655
00:23:28,149 --> 00:23:26,559
properly in my opinion we teach it

656
00:23:29,830 --> 00:23:28,159
typically we have a can package

657
00:23:30,870 --> 00:23:29,840
experiment that we know works how do we

658
00:23:33,190 --> 00:23:30,880
know it works because somebody won a

659
00:23:35,110 --> 00:23:33,200
nobel prize you know the davis and germa

660
00:23:36,549 --> 00:23:35,120
experiment michaelson morley you know so

661
00:23:38,630 --> 00:23:36,559
you can go through all these different

662
00:23:40,310 --> 00:23:38,640
nobel prize winning experiments and then

663
00:23:43,350 --> 00:23:40,320

you get this uh assumption that

664

00:23:45,350 --> 00:23:43,360

everything is uh is essentially these

665

00:23:47,270 --> 00:23:45,360

neat little packages and as i said

666

00:23:49,029 --> 00:23:47,280

before what i spend most of my time

667

00:23:50,630 --> 00:23:49,039

looking for is noise and a lot of

668

00:23:52,149 --> 00:23:50,640

experimentalists do this but there's two

669

00:23:53,909 --> 00:23:52,159

different types of noise there's the

670

00:23:54,950 --> 00:23:53,919

statistical noise that more and more

671

00:23:57,430 --> 00:23:54,960

experiments and more and more

672

00:23:59,350 --> 00:23:57,440

observations can reduce to you know

673

00:24:00,710 --> 00:23:59,360

almost negligible values and then

674

00:24:02,870 --> 00:24:00,720

there's a much more important class

675

00:24:04,870 --> 00:24:02,880

called systematic uncertainties and

676
00:24:06,390 --> 00:24:04,880
those are the most challenging because

677
00:24:08,230 --> 00:24:06,400
they require

678
00:24:09,909 --> 00:24:08,240
as this is a huge theme of the book

679
00:24:11,590 --> 00:24:09,919
losing the nobel prize which i thought

680
00:24:14,310 --> 00:24:11,600
was a unique contribution because i'm

681
00:24:16,070 --> 00:24:14,320
not brian greene i'm not michio kaku i'm

682
00:24:18,390 --> 00:24:16,080
not neil degrasse tyson i'm not a

683
00:24:20,549 --> 00:24:18,400
theorist i'm going gonna tell you why is

684
00:24:22,470 --> 00:24:20,559
it that certain people lost nobel prizes

685
00:24:24,310 --> 00:24:22,480
why did certain people win nobel prizes

686
00:24:25,750 --> 00:24:24,320
and it comes down to understanding the

687
00:24:27,510 --> 00:24:25,760
fundamental difference of being an

688
00:24:29,269 --> 00:24:27,520

experimental physicist which is you're

689

00:24:30,870 --> 00:24:29,279

always looking to prove yourself wrong

690

00:24:33,350 --> 00:24:30,880

and furthermore you're always trying to

691

00:24:35,990 --> 00:24:33,360

nail down these systematic errors and to

692

00:24:37,590 --> 00:24:36,000

do that generalize outside of physics

693

00:24:39,190 --> 00:24:37,600

it probably does you know it probably

694

00:24:41,430 --> 00:24:39,200

does because i think there's bias and

695

00:24:43,669 --> 00:24:41,440

there's systemic features of of other

696

00:24:45,190 --> 00:24:43,679

features of inquiry not just in the

697

00:24:47,190 --> 00:24:45,200

physical sciences

698

00:24:49,190 --> 00:24:47,200

but people notice it every day like i

699

00:24:51,029 --> 00:24:49,200

said uh in my book i talk about you know

700

00:24:52,549 --> 00:24:51,039

if you have dirt on your windshield you

701
00:24:54,549 --> 00:24:52,559
know how do you know you have dirt well

702
00:24:56,310 --> 00:24:54,559
you you you see a diminution of

703
00:24:58,149 --> 00:24:56,320
intensity of light or whatever i go

704
00:25:00,710 --> 00:24:58,159
through an example of that uh and what

705
00:25:02,310 --> 00:25:00,720
do you do to get to get to see if uh to

706
00:25:05,029 --> 00:25:02,320
see if you can make a difference and and

707
00:25:06,950 --> 00:25:05,039
get rid of it well you uh remove it by

708
00:25:08,549 --> 00:25:06,960
water and then you do an a b comparison

709
00:25:09,909 --> 00:25:08,559
so you're actually doing an experiment

710
00:25:12,470 --> 00:25:09,919
you're seeing what was the difference

711
00:25:14,390 --> 00:25:12,480
between before and after and in this

712
00:25:15,830 --> 00:25:14,400
case we looked at uh you know we're

713
00:25:17,110 --> 00:25:15,840

looking at this light now is it brighter

714

00:25:18,950 --> 00:25:17,120

yeah now the light's brighter okay so it

715

00:25:20,230 --> 00:25:18,960

had a difference if it made it worse if

716

00:25:22,310 --> 00:25:20,240

you washed it with concrete you know

717

00:25:23,750 --> 00:25:22,320

then it wouldn't get better so um so

718

00:25:25,990 --> 00:25:23,760

thinking about things in terms of a

719

00:25:29,029 --> 00:25:26,000

systematic error is something that will

720

00:25:30,789 --> 00:25:29,039

require you to do another experiment and

721

00:25:33,590 --> 00:25:30,799

in my case with the bicep experiment and

722

00:25:35,590 --> 00:25:33,600

my colleagues we failed to do a separate

723

00:25:37,029 --> 00:25:35,600

experiment by ourselves we tried to do

724

00:25:39,190 --> 00:25:37,039

it in different ways that i described in

725

00:25:40,549 --> 00:25:39,200

the book i won't get into here but we

726
00:25:42,710 --> 00:25:40,559
failed to do an experiment which would

727
00:25:44,710 --> 00:25:42,720
have ruled out the ultimate source of

728
00:25:47,029 --> 00:25:44,720
the signal we claimed were inflationary

729
00:25:49,590 --> 00:25:47,039
gravitational waves which is cosmic dust

730
00:25:51,190 --> 00:25:49,600
in our milky way galaxy that required a

731
00:25:53,190 --> 00:25:51,200
separate experiment to get rid of and

732
00:25:54,950 --> 00:25:53,200
now we all know that and so now in the

733
00:25:56,950 --> 00:25:54,960
simon's observatory pictured behind me

734
00:25:58,470 --> 00:25:56,960
here in the atacama desert of chile and

735
00:26:00,789 --> 00:25:58,480
in the bicep array experiment my

736
00:26:02,390 --> 00:26:00,799
colleagues are running at the south pole

737
00:26:04,789 --> 00:26:02,400
we now have the capability to measure

738
00:26:05,510 --> 00:26:04,799

not just the nobel gold winning dust

739

00:26:07,350 --> 00:26:05,520

coal

740

00:26:08,870 --> 00:26:07,360

gold winning gravitational wave

741

00:26:09,590 --> 00:26:08,880

signature if it exists which we don't

742

00:26:11,510 --> 00:26:09,600

know

743

00:26:13,669 --> 00:26:11,520

but also does simultaneously and you

744

00:26:15,510 --> 00:26:13,679

measure the cosmic signal plus the dust

745

00:26:17,430 --> 00:26:15,520

signal and then you measure the dust

746

00:26:18,950 --> 00:26:17,440

signal by itself you subtract it from

747

00:26:21,669 --> 00:26:18,960

the cosmic plus dust and what you're

748

00:26:24,149 --> 00:26:21,679

left with is cosmic fascinating man yeah

749

00:26:26,950 --> 00:26:24,159

is that okay so in math and in physics

750

00:26:29,909 --> 00:26:26,960

in theoretical physics there are seminal

751

00:26:31,990 --> 00:26:29,919

books like calculus on manifolds

752

00:26:34,070 --> 00:26:32,000

that's fact that's mathematics then

753

00:26:37,750 --> 00:26:34,080

there's

754

00:26:38,789 --> 00:26:37,760

de facto text on quantum mechanics or

755

00:26:40,390 --> 00:26:38,799

quantum field

756

00:26:42,149 --> 00:26:40,400

is there

757

00:26:44,549 --> 00:26:42,159

you know i i i

758

00:26:47,669 --> 00:26:45,830

i shouldn't have done this but when i

759

00:26:49,590 --> 00:26:47,679

was younger and i was arrogant and i

760

00:26:51,909 --> 00:26:49,600

ridiculed experimental like like a

761

00:26:54,070 --> 00:26:51,919

theoretical physicist would they view it

762

00:26:56,149 --> 00:26:54,080

i'm sure you know this and you must boil

763

00:26:58,710 --> 00:26:56,159

with hatred that they view it much like

764

00:26:59,669 --> 00:26:58,720

engineering yeah and engineering is just

765

00:27:01,350 --> 00:26:59,679

as i said

766

00:27:02,950 --> 00:27:01,360

you know no offense to plumbers but yeah

767

00:27:05,029 --> 00:27:02,960

that's the way a lot of theorists view

768

00:27:06,950 --> 00:27:05,039

it in fact one of my friends uh i won't

769

00:27:08,230 --> 00:27:06,960

say his name because he's a brilliant uh

770

00:27:10,789 --> 00:27:08,240

he's a brilliant physicist and there

771

00:27:13,029 --> 00:27:10,799

aren't too many in the in his department

772

00:27:14,710 --> 00:27:13,039

uh you know he's like okay so what what

773

00:27:16,630 --> 00:27:14,720

you know did you change a valve today

774

00:27:17,590 --> 00:27:16,640

like did you do a carburetor tune up and

775

00:27:19,430 --> 00:27:17,600

again

776

00:27:20,870 --> 00:27:19,440

he didn't you know we were friends but

777

00:27:22,710 --> 00:27:20,880

he come into the lab and i'd be like

778

00:27:25,269 --> 00:27:22,720

well did you write the same paper again

779

00:27:27,750 --> 00:27:25,279

you know about uh about membranes and d

780

00:27:31,269 --> 00:27:29,190

yeah go ahead he's part he's probably

781

00:27:34,390 --> 00:27:31,279

correct it's partly some physical

782

00:27:35,909 --> 00:27:34,400

manipulation but what i envy the most

783

00:27:38,630 --> 00:27:35,919

about your position is

784

00:27:40,470 --> 00:27:38,640

the understanding the comprehension from

785

00:27:42,470 --> 00:27:40,480

various angles

786

00:27:44,710 --> 00:27:42,480

from like you have to

787

00:27:46,470 --> 00:27:44,720

know these theories inside and out to be

788

00:27:48,149 --> 00:27:46,480

able to predict to make an experiment to

789

00:27:50,149 --> 00:27:48,159

know what could be wrong you have to be

790

00:27:52,070 --> 00:27:50,159

passionate i agree with you kurt 100 but

791

00:27:53,990 --> 00:27:52,080

you have to have the passion that that's

792

00:27:55,830 --> 00:27:54,000

curious and that's meaningful to you i

793

00:27:57,990 --> 00:27:55,840

have a lot of students kurt that are

794

00:27:59,750 --> 00:27:58,000

pretty naturally gifted at building

795

00:28:03,190 --> 00:27:59,760

things tinkering things i actually

796

00:28:04,549 --> 00:28:03,200

worked on an old 1970s rabbit volkswagen

797

00:28:06,149 --> 00:28:04,559

rabbit you know when i was in high

798

00:28:09,110 --> 00:28:06,159

school it's my first car it cost me you

799

00:28:10,710 --> 00:28:09,120

know less than my laptop cost me today

800

00:28:12,710 --> 00:28:10,720

and i love that thing and i love working

801
00:28:14,950 --> 00:28:12,720
on it and having a sense of satisfaction

802
00:28:16,870 --> 00:28:14,960
every day i could say oh i tuned up the

803
00:28:18,789 --> 00:28:16,880
brakes or i lifted a suspension you know

804
00:28:21,830 --> 00:28:18,799
i lifted it by a micron or whatever i

805
00:28:23,510 --> 00:28:21,840
was doing back then and and the point is

806
00:28:25,430 --> 00:28:23,520
that you but that was because i had

807
00:28:27,110 --> 00:28:25,440
passion for it some of my students don't

808
00:28:28,630 --> 00:28:27,120
have passion they don't they don't think

809
00:28:30,389 --> 00:28:28,640
about the big picture questions a lot

810
00:28:31,990 --> 00:28:30,399
most of them do some of them are just

811
00:28:33,669 --> 00:28:32,000
really good they can build in the clean

812
00:28:36,149 --> 00:28:33,679
room they can build new types of

813
00:28:38,149 --> 00:28:36,159

detectors they love the pure technology

814

00:28:39,750 --> 00:28:38,159

they are doing engineering there's tr

815

00:28:41,669 --> 00:28:39,760

look behind me in this picture you see

816

00:28:43,750 --> 00:28:41,679

these telescopes and it's hard to see

817

00:28:45,510 --> 00:28:43,760

you know over my shoulder but there's uh

818

00:28:47,110 --> 00:28:45,520

there are diesel generators i have

819

00:28:49,029 --> 00:28:47,120

students that are like fascinated with

820

00:28:51,029 --> 00:28:49,039

the way diesel generators work and if

821

00:28:52,549 --> 00:28:51,039

they didn't and they're physicists and

822

00:28:54,070 --> 00:28:52,559

they're doing logistics and what's

823

00:28:56,070 --> 00:28:54,080

called project management it's so

824

00:28:57,990 --> 00:28:56,080

crucial kurt but

825

00:29:00,149 --> 00:28:58,000

for me that's not what really turns me

826

00:29:02,149 --> 00:29:00,159

on about physics it's understanding the

827

00:29:03,909 --> 00:29:02,159

theory that i could understand the way a

828

00:29:06,149 --> 00:29:03,919

four-dimensional scalar field would

829

00:29:08,549 --> 00:29:06,159

operate over cosmic time and then say

830

00:29:10,070 --> 00:29:08,559

hmm to measure that not only do i want

831

00:29:11,669 --> 00:29:10,080

to measure that of course any you know

832

00:29:13,830 --> 00:29:11,679

red-blooded physicists would want to

833

00:29:15,510 --> 00:29:13,840

measure but i want to understand what

834

00:29:17,590 --> 00:29:15,520

are the impediments to measuring it

835

00:29:19,830 --> 00:29:17,600

first that's what makes so my friend

836

00:29:22,630 --> 00:29:19,840

sabine hassenfelder was on my podcast

837

00:29:24,070 --> 00:29:22,640

she has this book lost tomorrow oh great

838

00:29:25,269 --> 00:29:24,080

so she has her book lost in math you'll

839

00:29:27,029 --> 00:29:25,279

talk about it she'll go on her whole

840

00:29:28,950 --> 00:29:27,039

litany i've heard it before and i

841

00:29:30,230 --> 00:29:28,960

respect her but i said one of the first

842

00:29:32,950 --> 00:29:30,240

things i said in my interview with her

843

00:29:34,789 --> 00:29:32,960

is i said um no experiment is not

844

00:29:36,070 --> 00:29:34,799

beautiful like there's no such thing as

845

00:29:37,990 --> 00:29:36,080

even if you look at do you remember have

846

00:29:40,310 --> 00:29:38,000

you ever seen a picture curt of the very

847

00:29:42,070 --> 00:29:40,320

first transistor that uh you know

848

00:29:44,549 --> 00:29:42,080

shockley and barney have invented it's

849

00:29:46,230 --> 00:29:44,559

like a ch you know it's like some some

850

00:29:47,590 --> 00:29:46,240

silicon

851

00:29:49,669 --> 00:29:47,600

it looks like a s'more it's got like a

852

00:29:51,750 --> 00:29:49,679

coat hanger and and some and some

853

00:29:53,750 --> 00:29:51,760

marshmallow it literally looks like that

854

00:29:55,510 --> 00:29:53,760

that is beautiful nonetheless because

855

00:29:56,950 --> 00:29:55,520

they took the materials that they had

856

00:29:59,830 --> 00:29:56,960

and they made it work and they tested

857

00:30:02,230 --> 00:29:59,840

for these contaminations impurities

858

00:30:03,909 --> 00:30:02,240

systematic effects and it is beautiful

859

00:30:05,190 --> 00:30:03,919

also all experiments do what are called

860

00:30:07,269 --> 00:30:05,200

null tests you've probably heard of

861

00:30:09,350 --> 00:30:07,279

these jackknife tests where you take a

862

00:30:10,950 --> 00:30:09,360

set of data look i do the cosmic

863

00:30:14,070 --> 00:30:10,960

microwave background

864

00:30:16,230 --> 00:30:14,080

know that the data that i'm analyzing

865

00:30:18,070 --> 00:30:16,240

was taken on a tuesday it doesn't care

866

00:30:19,430 --> 00:30:18,080

about that so therefore if i take data

867

00:30:21,029 --> 00:30:19,440

on a tuesday compare it to data on a

868

00:30:24,549 --> 00:30:21,039

wednesday and subtract the two what

869

00:30:26,470 --> 00:30:24,559

should i get zero zero similarly if i

870

00:30:27,669 --> 00:30:26,480

scan back and forth i take all the data

871

00:30:29,269 --> 00:30:27,679

and i bin it when i was moving the

872

00:30:30,310 --> 00:30:29,279

telescope to the left versus moving it

873

00:30:32,389 --> 00:30:30,320

to the right

874

00:30:33,990 --> 00:30:32,399

and i subtract them what should i get

875

00:30:37,909 --> 00:30:34,000

well that depends on

876

00:30:39,350 --> 00:30:37,919

it depends on the spatial homogeneity

877

00:30:42,149 --> 00:30:39,360

and it can never pronounce that and then

878

00:30:43,750 --> 00:30:42,159

i saw i saw isotropy well but we know

879

00:30:46,470 --> 00:30:43,760

that the cosmic signals themselves are

880

00:30:47,909 --> 00:30:46,480

homogeneous and isotropic so any you're

881

00:30:49,590 --> 00:30:47,919

right there could be deviations from the

882

00:30:51,029 --> 00:30:49,600

ground from the telescope mirrors

883

00:30:52,950 --> 00:30:51,039

whatever i'm just being

884

00:30:54,630 --> 00:30:52,960

particular yeah so exactly what you're

885

00:30:56,310 --> 00:30:54,640

saying so there's symmetries and the

886

00:30:57,990 --> 00:30:56,320

symmetries are beautiful what sabine

887

00:31:00,710 --> 00:30:58,000

rails against is the reliance on

888

00:31:02,149 --> 00:31:00,720

symmetry to create new theories or to

889

00:31:04,149 --> 00:31:02,159

have guidance towards what we're doing

890

00:31:06,470 --> 00:31:04,159

in math so i take issue with the fact

891

00:31:08,950 --> 00:31:06,480

that categorically saying beauty and

892

00:31:11,750 --> 00:31:08,960

symmetry and naturalness are are

893

00:31:13,269 --> 00:31:11,760

anathema to to new physics so you you

894

00:31:14,789 --> 00:31:13,279

know i would you know i'm sure you'll

895

00:31:16,630 --> 00:31:14,799

hear that i'm sure you'll get into it

896

00:31:18,549 --> 00:31:16,640

but the basic philosophy that i have is

897

00:31:19,909 --> 00:31:18,559

that all experiments are beautiful

898

00:31:22,230 --> 00:31:19,919

and that her thing is that you should

899

00:31:25,350 --> 00:31:22,240

not be guided by beauty and theory so

900

00:31:27,510 --> 00:31:25,360

maybe we don't agree disagree that much

901
00:31:28,870 --> 00:31:27,520
are there books that are experimentalist

902
00:31:30,310 --> 00:31:28,880
books much like

903
00:31:34,389 --> 00:31:30,320
much like i was mentioning there's the

904
00:31:35,909 --> 00:31:34,399
same cars yeah quantum mechanics

905
00:31:37,909 --> 00:31:35,919
well you know i

906
00:31:41,029 --> 00:31:37,919
i didn't think that there were and so my

907
00:31:42,389 --> 00:31:41,039
my book is uh describes a lot about how

908
00:31:44,549 --> 00:31:42,399
a cosmic microwave background

909
00:31:46,710 --> 00:31:44,559
polarimeter works how you measure what

910
00:31:48,950 --> 00:31:46,720
polarization is using in the novel in

911
00:31:51,430 --> 00:31:48,960
the losing the nobel prize book yeah so

912
00:31:53,269 --> 00:31:51,440
it's about how a polarimeter works what

913
00:31:55,190 --> 00:31:53,279

is polarization it's the least well

914

00:31:57,350 --> 00:31:55,200

understood of all the three properties

915

00:31:58,549 --> 00:31:57,360

of light i describe how that works i

916

00:32:01,430 --> 00:31:58,559

describe how you can make your own

917

00:32:03,110 --> 00:32:01,440

polarimeter etc and so i give a lot of

918

00:32:04,870 --> 00:32:03,120

analogies i talk about classic

919

00:32:06,710 --> 00:32:04,880

experiments and i talk about in

920

00:32:09,190 --> 00:32:06,720

particular there was a man named edward

921

00:32:11,110 --> 00:32:09,200

ohm no relation to the ohm of resistance

922

00:32:13,269 --> 00:32:11,120

fame but he was working on the exact

923

00:32:15,590 --> 00:32:13,279

same telescope at bell labs that

924

00:32:18,549 --> 00:32:15,600

pensions and wilson were working on and

925

00:32:20,310 --> 00:32:18,559

he did error analysis incorrectly and

926

00:32:22,870 --> 00:32:20,320

because of that he found that he had

927

00:32:24,870 --> 00:32:22,880

this persistent three degree background

928

00:32:27,509 --> 00:32:24,880

that he could not get rid of and he

929

00:32:30,310 --> 00:32:27,519

assumed that that error was due to uh

930

00:32:32,549 --> 00:32:30,320

was due to this conspiracy of error bars

931

00:32:34,310 --> 00:32:32,559

co-adding together constructively

932

00:32:36,549 --> 00:32:34,320

literally doing a mistake that my

933

00:32:39,750 --> 00:32:36,559

freshman in physics would get failure

934

00:32:42,070 --> 00:32:39,760

marks for uh and uh and because of that

935

00:32:43,750 --> 00:32:42,080

he had the data that that pensions and

936

00:32:44,710 --> 00:32:43,760

wilson would later get four years

937

00:32:47,110 --> 00:32:44,720

earlier

938

00:32:48,630 --> 00:32:47,120

and so he is one of the nobel prize

939

00:32:50,310 --> 00:32:48,640

losers in the book

940

00:32:52,950 --> 00:32:50,320

so i described that what does that mean

941

00:32:54,710 --> 00:32:52,960

to do a systematic error how how do

942

00:32:56,630 --> 00:32:54,720

experimentalists build these things now

943

00:32:58,950 --> 00:32:56,640

there are good there are some books that

944

00:33:01,029 --> 00:32:58,960

talk about it um there's a book by john

945

00:33:02,630 --> 00:33:01,039

mather called the very first light that

946

00:33:04,389 --> 00:33:02,640

describes kobe

947

00:33:06,230 --> 00:33:04,399

um george smoot wrote a book called

948

00:33:08,950 --> 00:33:06,240

wrinkles in time also about kobe and

949

00:33:12,070 --> 00:33:08,960

they won the nobel prize in 2006.

950

00:33:14,470 --> 00:33:12,080

um but uh you know uh they're they're in

951
00:33:15,830 --> 00:33:14,480
that was one of the lacuna that i felt i

952
00:33:17,350 --> 00:33:15,840
could repair

953
00:33:19,430 --> 00:33:17,360
and make a contribution to with losing

954
00:33:21,269 --> 00:33:19,440
the nobel prize how about for these

955
00:33:23,110 --> 00:33:21,279
physicists who are second year they're

956
00:33:25,269 --> 00:33:23,120
smart upper they're going into the upper

957
00:33:27,430 --> 00:33:25,279
gear and they want to understand

958
00:33:30,470 --> 00:33:27,440
other theoretical physicists and they

959
00:33:33,029 --> 00:33:30,480
want a textbook like that takes you from

960
00:33:34,470 --> 00:33:33,039
from knowing virtually nothing to how do

961
00:33:36,470 --> 00:33:34,480
you

962
00:33:37,350 --> 00:33:36,480
yeah what are some experiments and how

963
00:33:41,909 --> 00:33:37,360

do you

964

00:33:44,630 --> 00:33:41,919

analysis so jim peebles who won the

965

00:33:46,230 --> 00:33:44,640

nobel prize last year at princeton uh

966

00:33:47,909 --> 00:33:46,240

was hopefully coming on my show pretty

967

00:33:50,710 --> 00:33:47,919

soon and he's written a book called

968

00:33:53,029 --> 00:33:50,720

cosmology century and it goes through he

969

00:33:55,190 --> 00:33:53,039

was part of the original uh penzias and

970

00:33:58,470 --> 00:33:55,200

wilson competitor team at princeton that

971

00:34:00,470 --> 00:33:58,480

lost the nobel prize back in 1960 and 78

972

00:34:02,389 --> 00:34:00,480

when penzias and wilson did win it but

973

00:34:04,549 --> 00:34:02,399

they were famously scooped

974

00:34:06,950 --> 00:34:04,559

by and this was my graduate students

975

00:34:08,149 --> 00:34:06,960

advisors graduate his advisor david

976

00:34:10,389 --> 00:34:08,159

wilkinson

977

00:34:12,149 --> 00:34:10,399

uh and team and peebles lost the nobel

978

00:34:14,950 --> 00:34:12,159

prize for the discovery missed out on

979

00:34:16,950 --> 00:34:14,960

discovering the cmb uh by only a little

980

00:34:18,950 --> 00:34:16,960

bit to this other team led by penzies

981

00:34:20,550 --> 00:34:18,960

and wilson anyway jim peebles has

982

00:34:22,310 --> 00:34:20,560

written a book called cosmology century

983

00:34:24,310 --> 00:34:22,320

and he goes through a lot of the classic

984

00:34:25,909 --> 00:34:24,320

experiments and how we came not just to

985

00:34:28,310 --> 00:34:25,919

know what we know about the cmb which is

986

00:34:31,750 --> 00:34:28,320

very important obviously but also galaxy

987

00:34:33,589 --> 00:34:31,760

surveys how did we start from 1900

988

00:34:35,750 --> 00:34:33,599

knowing almost nothing if the universe

989

00:34:38,629 --> 00:34:35,760

was static eternal infinite finite

990

00:34:41,589 --> 00:34:38,639

whatever uh to knowing so much about

991

00:34:44,069 --> 00:34:41,599

cosmology the age down to the you know

992

00:34:45,750 --> 00:34:44,079

tens of millions of years the density

993

00:34:47,990 --> 00:34:45,760

down to you know fractions of a percent

994

00:34:50,149 --> 00:34:48,000

the expansion rate uh depending on who

995

00:34:53,109 --> 00:34:50,159

you talk to to either you know sub

996

00:34:55,030 --> 00:34:53,119

percent or nine percent uh and et cetera

997

00:34:56,790 --> 00:34:55,040

so it's a fascinating book it's brand

998

00:34:57,910 --> 00:34:56,800

new and there's another book by a

999

00:34:59,829 --> 00:34:57,920

colleague of mine in the simon's

1000

00:35:02,470 --> 00:34:59,839

observatory also at princeton

1001
00:35:04,630 --> 00:35:02,480
uh named uh joe dunkley she wrote a book

1002
00:35:07,270 --> 00:35:04,640
called our universe and then another

1003
00:35:10,550 --> 00:35:07,280
princeton professor you see

1004
00:35:13,510 --> 00:35:10,560
joe dunkley joanne dunkley joanne okay a

1005
00:35:15,270 --> 00:35:13,520
book called uh cosm r universe and then

1006
00:35:18,230 --> 00:35:15,280
lyman page also at princeton wrote a

1007
00:35:19,829 --> 00:35:18,240
book just out now called the little book

1008
00:35:21,589 --> 00:35:19,839
of cosmology

1009
00:35:23,430 --> 00:35:21,599
and they're very accessible uh

1010
00:35:24,950 --> 00:35:23,440
especially to not the first one jim

1011
00:35:25,670 --> 00:35:24,960
people's book is more technical you'll

1012
00:35:30,390 --> 00:35:25,680
see

1013
00:35:32,470 --> 00:35:30,400

correlation functions uh but

1014

00:35:34,630 --> 00:35:32,480

but that's not my book yeah i think i

1015

00:35:35,750 --> 00:35:34,640

think you'll appreciate that book

1016

00:35:37,829 --> 00:35:35,760

so

1017

00:35:40,310 --> 00:35:37,839

as a experimental physicist what do you

1018

00:35:42,710 --> 00:35:40,320

think is missing is needed for

1019

00:35:43,910 --> 00:35:42,720

progress to be made on a new theory of

1020

00:35:46,230 --> 00:35:43,920

everything or current theories of

1021

00:35:47,910 --> 00:35:46,240

everything is it like i was asking you

1022

00:35:50,310 --> 00:35:47,920

in the notes is it something as simple

1023

00:35:52,230 --> 00:35:50,320

as a larger collider is it to build the

1024

00:35:53,910 --> 00:35:52,240

collider in space is it not even the

1025

00:35:55,910 --> 00:35:53,920

collider at all is it's just analyze the

1026
00:35:57,430 --> 00:35:55,920
cosmic background radiation with more

1027
00:36:00,230 --> 00:35:57,440
resolution

1028
00:36:02,870 --> 00:36:00,240
yes so obviously you know i have a bias

1029
00:36:05,270 --> 00:36:02,880
towards uh two things one things that i

1030
00:36:07,349 --> 00:36:05,280
can contribute to uh because that's

1031
00:36:09,270 --> 00:36:07,359
where i'm putting my limited amount of

1032
00:36:10,470 --> 00:36:09,280
of attention you know uh

1033
00:36:12,069 --> 00:36:10,480
you have a limited amount of time but

1034
00:36:14,230 --> 00:36:12,079
you even have less attention that you

1035
00:36:17,349 --> 00:36:14,240
can dedicate right to different things

1036
00:36:19,589 --> 00:36:17,359
um and so what i feel is worthy of my

1037
00:36:21,670 --> 00:36:19,599
attention and that of my you know six

1038
00:36:24,069 --> 00:36:21,680

graduate students and six

1039

00:36:26,710 --> 00:36:24,079

undergraduates and three postdocs uh

1040

00:36:28,630 --> 00:36:26,720

revolves around the cmb but not only for

1041

00:36:30,950 --> 00:36:28,640

studying the cosmic microwave background

1042

00:36:33,109 --> 00:36:30,960

for looking for this potential signature

1043

00:36:35,190 --> 00:36:33,119

of inflation uh which would be this

1044

00:36:37,190 --> 00:36:35,200

twisting curling pattern of microwaves

1045

00:36:40,470 --> 00:36:37,200

that were we claimed also as part of the

1046

00:36:42,390 --> 00:36:40,480

bicep two experiment back in 2014 we

1047

00:36:44,870 --> 00:36:42,400

declared we detected it turned out we

1048

00:36:47,190 --> 00:36:44,880

had to recant that claim

1049

00:36:49,270 --> 00:36:47,200

uh not that we made a blunder or made a

1050

00:36:51,510 --> 00:36:49,280

mistake but but we met we attributed the

1051
00:36:54,870 --> 00:36:51,520
source of the signal to an incorrect um

1052
00:36:57,109 --> 00:36:54,880
to an incorrect piece of evidence um

1053
00:36:59,750 --> 00:36:57,119
the uh the biggest picture things to me

1054
00:37:02,470 --> 00:36:59,760
are to understand whether or not time is

1055
00:37:04,710 --> 00:37:02,480
uh had a beginning and i think you know

1056
00:37:06,790 --> 00:37:04,720
that has just tremendous implications

1057
00:37:09,030 --> 00:37:06,800
for for not just me but everybody in

1058
00:37:10,870 --> 00:37:09,040
terms of philosophy metaphysics religion

1059
00:37:12,790 --> 00:37:10,880
if you believe smolin has a great book

1060
00:37:15,109 --> 00:37:12,800
on that i don't know if you've read it

1061
00:37:17,270 --> 00:37:15,119
yeah yeah so i'm in the i'm in the

1062
00:37:19,190 --> 00:37:17,280
middle of it um i was invited to a

1063
00:37:21,510 --> 00:37:19,200

conference at perimeter institute near

1064

00:37:24,390 --> 00:37:21,520

you uh three or four years ago where i

1065

00:37:26,550 --> 00:37:24,400

started to have conversations about him

1066

00:37:29,430 --> 00:37:26,560

that could use the cmb

1067

00:37:31,589 --> 00:37:29,440

to determine if there is a clock and a

1068

00:37:33,670 --> 00:37:31,599

certain universal clock and that

1069

00:37:35,510 --> 00:37:33,680

universal clock might be connected to

1070

00:37:38,230 --> 00:37:35,520

what we talk about in terms of cpt

1071

00:37:40,790 --> 00:37:38,240

violation cp violation and that's using

1072

00:37:44,710 --> 00:37:40,800

the properties of polarization as a sort

1073

00:37:45,670 --> 00:37:44,720

of uh detector of mirror symmetry so we

1074

00:37:47,190 --> 00:37:45,680

know that

1075

00:37:49,270 --> 00:37:47,200

something called cpt violation is

1076

00:37:51,750 --> 00:37:49,280

respected but we and and we know that cp

1077

00:37:53,430 --> 00:37:51,760

violation takes place um

1078

00:37:55,670 --> 00:37:53,440

but the kind of interface between the

1079

00:37:57,910 --> 00:37:55,680

two of them can best be tested across

1080

00:37:59,829 --> 00:37:57,920

cosmic scales because if there's a we

1081

00:38:01,910 --> 00:37:59,839

know that whatever effect there is that

1082

00:38:03,270 --> 00:38:01,920

breaks symmetry in the electromagnetism

1083

00:38:06,630 --> 00:38:03,280

world and the sector that we call

1084

00:38:09,510 --> 00:38:06,640

photons that has to be incredibly small

1085

00:38:12,390 --> 00:38:09,520

but over cosmic distances of billions of

1086

00:38:14,550 --> 00:38:12,400

light years of travel time you might see

1087

00:38:17,589 --> 00:38:14,560

the evidence for the rotation of

1088

00:38:19,990 --> 00:38:17,599

polarization of both photons and some

1089

00:38:22,310 --> 00:38:20,000

say even of gravitational waves so

1090

00:38:24,150 --> 00:38:22,320

there's a huge area of physics that's

1091

00:38:25,750 --> 00:38:24,160

left to be explored

1092

00:38:28,270 --> 00:38:25,760

and that i believe will tell us a lot

1093

00:38:30,230 --> 00:38:28,280

about the fundamental aspects of the of

1094

00:38:32,390 --> 00:38:30,240

electromagnetism and then if you do

1095

00:38:34,630 --> 00:38:32,400

believe that there is a grand unified

1096

00:38:36,230 --> 00:38:34,640

theory plus a gravity so a theory of

1097

00:38:39,190 --> 00:38:36,240

everything

1098

00:38:42,870 --> 00:38:39,200

then you would have to argue that

1099

00:38:45,670 --> 00:38:42,880

if uh if the weak force disobeys parity

1100

00:38:47,270 --> 00:38:45,680

symmetry then gravity must at very high

1101
00:38:48,390 --> 00:38:47,280
energies and so where's the best place

1102
00:38:51,270 --> 00:38:48,400
to look for

1103
00:38:54,630 --> 00:38:51,280
gravity's behavior at very high energies

1104
00:38:56,630 --> 00:38:54,640
the big bang or a bounce and that's

1105
00:38:58,390 --> 00:38:56,640
something proposed by my colleague paul

1106
00:38:59,829 --> 00:38:58,400
steinhardt at princeton that the

1107
00:39:02,150 --> 00:38:59,839
universe is actually cyclical that there

1108
00:39:04,710 --> 00:39:02,160
was no big bang that there is no single

1109
00:39:07,190 --> 00:39:04,720
origin of time that the universe

1110
00:39:11,030 --> 00:39:07,200
undergoes a perfectly classical physics

1111
00:39:12,790 --> 00:39:11,040
uh bounces and expansions over trillions

1112
00:39:13,910 --> 00:39:12,800
of years not just you know billions of

1113
00:39:16,470 --> 00:39:13,920

years

1114

00:39:18,470 --> 00:39:16,480

and uh and this is uh also related

1115

00:39:20,230 --> 00:39:18,480

there's related work by roger penrose

1116

00:39:22,710 --> 00:39:20,240

and you may know this conformal cyclic

1117

00:39:25,190 --> 00:39:22,720

cosmology so that's the biggest question

1118

00:39:27,670 --> 00:39:25,200

you could possibly answer is time unique

1119

00:39:30,390 --> 00:39:27,680

is it did it have a beginning uh is it a

1120

00:39:31,750 --> 00:39:30,400

singular origin as as you know as people

1121

00:39:34,470 --> 00:39:31,760

claim or

1122

00:39:36,550 --> 00:39:34,480

are there other you know aspects of of

1123

00:39:38,550 --> 00:39:36,560

the universe that we can only study

1124

00:39:41,990 --> 00:39:38,560

using the universe as our biggest

1125

00:39:43,910 --> 00:39:42,000

possible accessible particle accelerator

1126

00:39:46,230 --> 00:39:43,920

do you think there are imp in principle

1127

00:39:47,349 --> 00:39:46,240

limitations to experimental physics for

1128

00:39:48,790 --> 00:39:47,359

example

1129

00:39:50,310 --> 00:39:48,800

lee smullen said

1130

00:39:52,230 --> 00:39:50,320

that you can't

1131

00:39:53,670 --> 00:39:52,240

make theories about the universe from

1132

00:39:55,109 --> 00:39:53,680

within the universe i believe that's in

1133

00:39:57,190 --> 00:39:55,119

timerborne

1134

00:39:59,030 --> 00:39:57,200

i don't know if you understand if i'm

1135

00:39:59,910 --> 00:39:59,040

yeah um

1136

00:40:01,750 --> 00:39:59,920

you know

1137

00:40:03,750 --> 00:40:01,760

yeah so i've heard him speak about that

1138

00:40:05,430 --> 00:40:03,760

and i think that's related to this book

1139

00:40:06,790 --> 00:40:05,440

which i don't want to break our

1140

00:40:09,829 --> 00:40:06,800

conversation enough to go look up this

1141

00:40:11,990 --> 00:40:09,839

book but he has his doubts about the

1142

00:40:13,829 --> 00:40:12,000

existence even of the scientific method

1143

00:40:15,910 --> 00:40:13,839

so if the scientific method which relies

1144

00:40:18,550 --> 00:40:15,920

on hypothesis kind of you know some kind

1145

00:40:20,870 --> 00:40:18,560

of conjecture some some crisp test some

1146

00:40:23,270 --> 00:40:20,880

ability to be proven wrong in the case

1147

00:40:25,829 --> 00:40:23,280

of popper etc um

1148

00:40:28,310 --> 00:40:25,839

then yeah you might you might think that

1149

00:40:30,230 --> 00:40:28,320

if that isn't maintained in other words

1150

00:40:33,109 --> 00:40:30,240

if you don't believe that that's the

1151
00:40:34,150 --> 00:40:33,119
cinequan none of physics of science

1152
00:40:36,630 --> 00:40:34,160
itself

1153
00:40:39,510 --> 00:40:36,640
then you know then trying to rely on

1154
00:40:41,990 --> 00:40:39,520
experiment to reveal something new is

1155
00:40:43,430 --> 00:40:42,000
plagued and fraught with the very bias

1156
00:40:45,829 --> 00:40:43,440
that you're trying to

1157
00:40:47,349 --> 00:40:45,839
solipsistically uh you know eliminate

1158
00:40:48,550 --> 00:40:47,359
which is that you can learn something

1159
00:40:51,589 --> 00:40:48,560
about the universe from within the

1160
00:40:53,349 --> 00:40:51,599
universe um and and you know i think

1161
00:40:55,270 --> 00:40:53,359
it's a fascinating question and lee is

1162
00:40:57,270 --> 00:40:55,280
one of the most original thinkers i know

1163
00:40:58,390 --> 00:40:57,280

so it's not possible for me to ignore

1164

00:41:00,390 --> 00:40:58,400

what he says

1165

00:41:02,470 --> 00:41:00,400

on a day-to-day basis do i think that

1166

00:41:04,150 --> 00:41:02,480

it's not possible to for to learn about

1167

00:41:06,470 --> 00:41:04,160

the universe of course not no i do i

1168

00:41:08,069 --> 00:41:06,480

believe we can learn tremendously about

1169

00:41:15,510 --> 00:41:08,079

the

1170

00:41:17,829 --> 00:41:15,520

level and so to be honest i don't really

1171

00:41:19,510 --> 00:41:17,839

concern myself so much of like these

1172

00:41:22,069 --> 00:41:19,520

questions the ultimate question like do

1173

00:41:23,510 --> 00:41:22,079

i exist you know do i have free will i

1174

00:41:24,790 --> 00:41:23,520

actually don't personally find those

1175

00:41:26,950 --> 00:41:24,800

interesting i know you're interested in

1176

00:41:29,030 --> 00:41:26,960

it yeah do you forget about if you find

1177

00:41:31,270 --> 00:41:29,040

it interesting do you happen to believe

1178

00:41:33,430 --> 00:41:31,280

that you have free will i do yeah in

1179

00:41:35,430 --> 00:41:33,440

general i do and how does that comport

1180

00:41:36,150 --> 00:41:35,440

with your experimentalist reductionism i

1181

00:41:37,670 --> 00:41:36,160

don't know if you believe in

1182

00:41:39,510 --> 00:41:37,680

reductionism but i don't i don't

1183

00:41:42,309 --> 00:41:39,520

necessarily believe in reductionism i i

1184

00:41:44,790 --> 00:41:42,319

find all these things kind of again um

1185

00:41:46,870 --> 00:41:44,800

so i participated with stuart hoffman

1186

00:41:50,230 --> 00:41:46,880

who is a good friend not stuart hoffman

1187

00:41:51,990 --> 00:41:50,240

um uh stuart hammeroff at university of

1188

00:41:55,030 --> 00:41:52,000

arizona who runs this science of

1189

00:41:57,589 --> 00:41:55,040

consciousness seminar every other year

1190

00:41:59,589 --> 00:41:57,599

alongside roger penrose and others and

1191

00:42:01,349 --> 00:41:59,599

actually noam chomsky spoke with me a

1192

00:42:04,870 --> 00:42:01,359

few years ago here in san diego when i

1193

00:42:06,790 --> 00:42:04,880

was here and uh you know i became very

1194

00:42:08,150 --> 00:42:06,800

frustrated and disillusioned a little

1195

00:42:10,630 --> 00:42:08,160

bit because

1196

00:42:13,030 --> 00:42:10,640

they couldn't even like say for sure

1197

00:42:14,710 --> 00:42:13,040

what consciousness was and yet they said

1198

00:42:15,990 --> 00:42:14,720

they have a science of consciousness or

1199

00:42:17,990 --> 00:42:16,000

they're working towards the science of

1200

00:42:20,950 --> 00:42:18,000

con i know sam harris is the hard

1201
00:42:23,030 --> 00:42:20,960
problem until you understand so it's not

1202
00:42:24,710 --> 00:42:23,040
so much that i feel if i can prove it or

1203
00:42:26,309 --> 00:42:24,720
i feel like i'm a hypocrite because i

1204
00:42:28,150 --> 00:42:26,319
believe in free will even though i am an

1205
00:42:30,790 --> 00:42:28,160
experimentalist no it's more that i

1206
00:42:33,109 --> 00:42:30,800
think the burden is on other people uh

1207
00:42:34,710 --> 00:42:33,119
who believe that there isn't free will

1208
00:42:36,630 --> 00:42:34,720
and there isn't you know there there is

1209
00:42:38,790 --> 00:42:36,640
super determinism and and i know people

1210
00:42:40,470 --> 00:42:38,800
will just throw it around like the block

1211
00:42:42,390 --> 00:42:40,480
universe and it's just but there's no

1212
00:42:44,309 --> 00:42:42,400
evidence for it so i i guess the

1213
00:42:45,750 --> 00:42:44,319

question is i'll give you yeah go ahead

1214

00:42:46,950 --> 00:42:45,760

i'll play devil's ad

1215

00:42:48,309 --> 00:42:46,960

sure

1216

00:42:49,750 --> 00:42:48,319

let's say

1217

00:42:51,349 --> 00:42:49,760

you have free will

1218

00:42:53,510 --> 00:42:51,359

okay well so that means you made a

1219

00:42:55,349 --> 00:42:53,520

decision of your own choosing well what

1220

00:42:57,510 --> 00:42:55,359

caused you to choose in that particular

1221

00:42:59,589 --> 00:42:57,520

direction and then if you say well i had

1222

00:43:01,910 --> 00:42:59,599

some play in that well then i asked what

1223

00:43:03,829 --> 00:43:01,920

caused that it's just what caused until

1224

00:43:05,270 --> 00:43:03,839

you get to something that is outside of

1225

00:43:07,349 --> 00:43:05,280

you so for example the initial

1226

00:43:08,630 --> 00:43:07,359

conditions of the big bang maybe or your

1227

00:43:10,710 --> 00:43:08,640

mother giving birth to you which you

1228

00:43:13,109 --> 00:43:10,720

didn't choose

1229

00:43:14,390 --> 00:43:13,119

how is it that you have free will

1230

00:43:15,829 --> 00:43:14,400

i guess i would ask kind of like the

1231

00:43:17,990 --> 00:43:15,839

turing like how would you tell the

1232

00:43:18,790 --> 00:43:18,000

difference like if i did have free will

1233

00:43:23,589 --> 00:43:18,800

you know

1234

00:43:25,670 --> 00:43:23,599

believe in free will i have no choice

1235

00:43:26,710 --> 00:43:25,680

but but the question of you know i would

1236

00:43:29,030 --> 00:43:26,720

say

1237

00:43:31,190 --> 00:43:29,040

isn't that is that the super you know

1238

00:43:33,349 --> 00:43:31,200

the super set of all events that have

1239

00:43:35,109 --> 00:43:33,359

taken place since the big bang if you

1240

00:43:36,390 --> 00:43:35,119

want to say that that's deterministic

1241

00:43:38,710 --> 00:43:36,400

when we know that there's certain

1242

00:43:41,430 --> 00:43:38,720

quantum d coherent effects that cannot

1243

00:43:44,150 --> 00:43:41,440

be modeled as as intrinsically being

1244

00:43:46,950 --> 00:43:44,160

deterministic or could possibly allow

1245

00:43:49,190 --> 00:43:46,960

for um for violations of certain bells

1246

00:43:50,950 --> 00:43:49,200

inequalities uh if you look at it that

1247

00:43:53,109 --> 00:43:50,960

way i guess it's just that then it

1248

00:43:56,069 --> 00:43:53,119

becomes very very too much too

1249

00:43:58,069 --> 00:43:56,079

all-encompassing so like i recount to

1250

00:43:59,349 --> 00:43:58,079

somebody a couple days ago like when i

1251
00:44:01,190 --> 00:43:59,359
was dating my wife we went to an

1252
00:44:02,950 --> 00:44:01,200
astrologer and she knew i didn't believe

1253
00:44:04,950 --> 00:44:02,960
in astrology and she wanted to have fun

1254
00:44:05,990 --> 00:44:04,960
so she said go tell her tell her about

1255
00:44:08,550 --> 00:44:06,000
yourself and she'll predict your

1256
00:44:09,990 --> 00:44:08,560
horoscope and so i said yeah i'm pisces

1257
00:44:11,190 --> 00:44:10,000
i do this this and this oh it's

1258
00:44:13,670 --> 00:44:11,200
going to be good you guys are going to

1259
00:44:15,349 --> 00:44:13,680
do this and and the bubble and i said is

1260
00:44:17,829 --> 00:44:15,359
it is it really true that pisces are

1261
00:44:19,670 --> 00:44:17,839
born in september i i forgot oh no

1262
00:44:21,589 --> 00:44:19,680
you're born yeah i'm born oh you're a

1263
00:44:23,030 --> 00:44:21,599

virgo but don't worry this everything i

1264

00:44:24,550 --> 00:44:23,040

said is still going to happen anyway so

1265

00:44:26,150 --> 00:44:24,560

it's like what was the what is the

1266

00:44:27,589 --> 00:44:26,160

difference like if everything is also

1267

00:44:29,829 --> 00:44:27,599

all-encompassing then i guess that i'm a

1268

00:44:32,069 --> 00:44:29,839

virgo by the way oh you are okay well

1269

00:44:33,430 --> 00:44:32,079

virgos are the ones in their right minds

1270

00:44:35,270 --> 00:44:33,440

or i don't know

1271

00:44:37,910 --> 00:44:35,280

i i think you know i think you're right

1272

00:44:39,750 --> 00:44:37,920

i think you're right well i also happen

1273

00:44:41,190 --> 00:44:39,760

i wouldn't say i believe in free will

1274

00:44:42,870 --> 00:44:41,200

but i don't find the arguments against

1275

00:44:44,630 --> 00:44:42,880

free will is particularly convincing i

1276

00:44:45,750 --> 00:44:44,640

just want to know what your opinion was

1277

00:44:48,309 --> 00:44:45,760

so is it

1278

00:44:49,750 --> 00:44:48,319

your counter argument is that

1279

00:44:51,349 --> 00:44:49,760

is the turing test how would you tell

1280

00:44:53,829 --> 00:44:51,359

one way or the other it's an experiment

1281

00:44:56,069 --> 00:44:53,839

in this question exactly and and and

1282

00:44:57,990 --> 00:44:56,079

isn't it i'm i'm a pragmatist kurt you

1283

00:45:00,150 --> 00:44:58,000

know at the end of the day

1284

00:45:02,790 --> 00:45:00,160

uh you know what i'm concerned about are

1285

00:45:03,510 --> 00:45:02,800

are things that i can get a crisp answer

1286

00:45:05,190 --> 00:45:03,520

to

1287

00:45:06,550 --> 00:45:05,200

so i don't believe i'll ever get a crisp

1288

00:45:08,470 --> 00:45:06,560

answer to that nor do i and you could

1289

00:45:10,630 --> 00:45:08,480

ask me about god and i don't think i'm

1290

00:45:12,710 --> 00:45:10,640

gonna have like some answer about god or

1291

00:45:14,390 --> 00:45:12,720

the existence of god but i think you

1292

00:45:15,750 --> 00:45:14,400

know i think a place for a physicist

1293

00:45:18,230 --> 00:45:15,760

especially an experimentalist is to be

1294

00:45:20,230 --> 00:45:18,240

agnostic but actually agnostic which

1295

00:45:21,829 --> 00:45:20,240

means like if you just don't go to

1296

00:45:24,390 --> 00:45:21,839

church or you don't go to synagogue in

1297

00:45:27,430 --> 00:45:24,400

my case um you go to the same you know

1298

00:45:30,390 --> 00:45:27,440

you you have the same religious

1299

00:45:32,309 --> 00:45:30,400

performance as as richard dawkins like

1300

00:45:33,910 --> 00:45:32,319

there's no functional delineation

1301

00:45:35,109 --> 00:45:33,920

between you and richard dawkin i

1302

00:45:37,349 --> 00:45:35,119

actually had this conversation with

1303

00:45:38,790 --> 00:45:37,359

freeman dyson before he passed away you

1304

00:45:40,150 --> 00:45:38,800

know because he said he's an agnostic

1305

00:45:41,990 --> 00:45:40,160

and i said well what church do you go to

1306

00:45:43,190 --> 00:45:42,000

i don't really go to church i said so

1307

00:45:45,349 --> 00:45:43,200

you go to the same church as richard

1308

00:45:47,750 --> 00:45:45,359

dawkins and he's like cognitive

1309

00:45:50,470 --> 00:45:47,760

dissonance a little bit so um

1310

00:45:52,630 --> 00:45:50,480

what i look at is uh behaviorism so how

1311

00:45:55,190 --> 00:45:52,640

do i behave and if i knew that

1312

00:45:57,270 --> 00:45:55,200

everything was controlled uh by you know

1313

00:45:59,990 --> 00:45:57,280

the initial condition state if there was

1314

00:46:01,510 --> 00:46:00,000

a big bang which we don't so i i guess i

1315

00:46:02,870 --> 00:46:01,520

think about it in terms of what is the

1316

00:46:05,510 --> 00:46:02,880

pragmatic

1317

00:46:07,910 --> 00:46:05,520

day-to-day implication of this does it

1318

00:46:10,390 --> 00:46:07,920

does it have any bearing on me uh

1319

00:46:11,750 --> 00:46:10,400

individually so in the case of free will

1320

00:46:13,990 --> 00:46:11,760

i don't think it does i don't think i'll

1321

00:46:15,510 --> 00:46:14,000

behave differently and treat my kids you

1322

00:46:17,190 --> 00:46:15,520

know my one kid hits another one i said

1323

00:46:18,550 --> 00:46:17,200

oh you didn't really have free will so

1324

00:46:20,550 --> 00:46:18,560

i'm not going to be no of course i'm

1325

00:46:22,069 --> 00:46:20,560

going to punish them um or make them

1326
00:46:23,750 --> 00:46:22,079
understand and apologize i'm not going

1327
00:46:25,190 --> 00:46:23,760
to lay it off as some people like

1328
00:46:27,349 --> 00:46:25,200
michael shermer i've had this

1329
00:46:29,109 --> 00:46:27,359
conversation you know he basically is

1330
00:46:31,589 --> 00:46:29,119
much more libertine about this on the

1331
00:46:33,589 --> 00:46:31,599
other hand if god exists that's a much

1332
00:46:35,030 --> 00:46:33,599
bigger question right as and i'm not

1333
00:46:37,670 --> 00:46:35,040
saying i'm not i'm not saying if i

1334
00:46:40,710 --> 00:46:37,680
believe or i don't as i said i'm a fully

1335
00:46:43,430 --> 00:46:40,720
practicing devout agnostic meaning i go

1336
00:46:45,670 --> 00:46:43,440
to services i i

1337
00:46:47,430 --> 00:46:45,680
read and i learn i taught myself aramaic

1338
00:46:49,030 --> 00:46:47,440

so i could understand the arguments of

1339

00:46:51,190 --> 00:46:49,040

the second holiest book in judaism

1340

00:46:52,870 --> 00:46:51,200

called the talmud i learned that at age

1341

00:46:54,390 --> 00:46:52,880

30 it wasn't easy

1342

00:46:55,589 --> 00:46:54,400

and i study it on a regular basis

1343

00:46:58,390 --> 00:46:55,599

because i want to take it seriously

1344

00:47:00,069 --> 00:46:58,400

because if god exists that would have if

1345

00:47:01,510 --> 00:47:00,079

you knew for i don't know your religious

1346

00:47:03,510 --> 00:47:01,520

beliefs and it almost doesn't matter to

1347

00:47:06,069 --> 00:47:03,520

me but if you knew like i asked sean

1348

00:47:07,589 --> 00:47:06,079

carroll this question i said you once

1349

00:47:10,390 --> 00:47:07,599

you know what is the probability the

1350

00:47:11,510 --> 00:47:10,400

multiverse is true i said 50

1351

00:47:14,470 --> 00:47:11,520

and i said what's the probability that

1352

00:47:16,069 --> 00:47:14,480

god exists he said less than less than

1353

00:47:18,550 --> 00:47:16,079

uh five percent right right right he

1354

00:47:20,710 --> 00:47:18,560

didn't say zero so yeah imagine now that

1355

00:47:22,470 --> 00:47:20,720

means he's open he is a brilliant man so

1356

00:47:24,309 --> 00:47:22,480

i could tell him i could let's say i

1357

00:47:25,910 --> 00:47:24,319

provide evidence whatever some miracle

1358

00:47:28,069 --> 00:47:25,920

that he can't dismiss and then he

1359

00:47:30,069 --> 00:47:28,079

believes it so he would change his life

1360

00:47:31,349 --> 00:47:30,079

i know that he would even though i don't

1361

00:47:33,349 --> 00:47:31,359

i don't think he thinks the probability

1362

00:47:34,790 --> 00:47:33,359

is even that high by the way uh but but

1363

00:47:36,069 --> 00:47:34,800

it was a good sound bite we had a good

1364

00:47:38,550 --> 00:47:36,079

conversation about it but you know what

1365

00:47:40,550 --> 00:47:38,560

i'm saying kurt the bottom line is i am

1366

00:47:43,190 --> 00:47:40,560

concerned with things that will impact

1367

00:47:45,670 --> 00:47:43,200

my life as a behaviorist how will it

1368

00:47:48,230 --> 00:47:45,680

change my behavior how will i change my

1369

00:47:50,470 --> 00:47:48,240

treatment of the poor the sick

1370

00:47:52,550 --> 00:47:50,480

my wife my kids you

1371

00:47:54,870 --> 00:47:52,560

how will i change my behavior

1372

00:47:55,990 --> 00:47:54,880

is much more influenced to the good i

1373

00:47:57,109 --> 00:47:56,000

would say

1374

00:47:58,790 --> 00:47:57,119

by wrestling with the question of

1375

00:48:00,870 --> 00:47:58,800

whether or not god exists whether or not

1376

00:48:02,550 --> 00:48:00,880

it does exist is an important question

1377

00:48:04,630 --> 00:48:02,560

for that reason because if the answer is

1378

00:48:06,230 --> 00:48:04,640

yes it would have huge implications and

1379

00:48:07,589 --> 00:48:06,240

even dawkins has said like he doesn't

1380

00:48:09,829 --> 00:48:07,599

rule it out so

1381

00:48:11,349 --> 00:48:09,839

um so but free will

1382

00:48:12,950 --> 00:48:11,359

if you told me that you know everything

1383

00:48:14,550 --> 00:48:12,960

is super deterministic

1384

00:48:16,870 --> 00:48:14,560

it wouldn't change how i operate on a

1385

00:48:18,230 --> 00:48:16,880

daily basis

1386

00:48:22,710 --> 00:48:18,240

you mentioned

1387

00:48:25,109 --> 00:48:22,720

now you also said earlier that we have

1388

00:48:28,069 --> 00:48:25,119

evidence and i think it was jim people's

1389

00:48:30,069 --> 00:48:28,079

book that goes over how you how we even

1390

00:48:33,430 --> 00:48:30,079

know about what an instantaneous amount

1391

00:48:35,349 --> 00:48:33,440

of time after the infinite infinitesimal

1392

00:48:37,349 --> 00:48:35,359

amount of time after the big bang okay

1393

00:48:39,670 --> 00:48:37,359

well but that's after the big bang

1394

00:48:42,230 --> 00:48:39,680

that's free supposing the big bang so

1395

00:48:44,710 --> 00:48:42,240

yes not necessarily

1396

00:48:45,990 --> 00:48:44,720

yeah so i always say if i could ask god

1397

00:48:48,470 --> 00:48:46,000

if god exists

1398

00:48:49,750 --> 00:48:48,480

uh you know what what happened uh one

1399

00:48:51,750 --> 00:48:49,760

question i'd say what happened on the

1400

00:48:53,030 --> 00:48:51,760

tuesday before the big bang in other

1401
00:48:54,790 --> 00:48:53,040
words you know hawking used to say it

1402
00:48:56,390 --> 00:48:54,800
doesn't make sense to ask what predated

1403
00:48:58,549 --> 00:48:56,400
the big bang right um i don't think

1404
00:49:02,390 --> 00:48:58,559
that's actually correct uh because you

1405
00:49:04,549 --> 00:49:02,400
can have many many legitimate scenarios

1406
00:49:07,030 --> 00:49:04,559
in which time is cyclical it's just

1407
00:49:08,470 --> 00:49:07,040
there's possibility for that and if that

1408
00:49:10,549 --> 00:49:08,480
happens there's a perfectly great

1409
00:49:12,710 --> 00:49:10,559
explanation for what happened on the

1410
00:49:15,270 --> 00:49:12,720
tuesday before the big bang it was a

1411
00:49:17,670 --> 00:49:15,280
fiery hellscape of collapsing you know

1412
00:49:19,190 --> 00:49:17,680
all the material energy and and and

1413
00:49:21,829 --> 00:49:19,200

properties of the early of the universe

1414

00:49:23,030 --> 00:49:21,839

that pre-existed again i'm not stating i

1415

00:49:25,510 --> 00:49:23,040

believe it i'm just saying it is a

1416

00:49:27,270 --> 00:49:25,520

well-posed question now can a theorist

1417

00:49:28,950 --> 00:49:27,280

and an experimentalist work together as

1418

00:49:30,630 --> 00:49:28,960

paul steinhardt

1419

00:49:32,390 --> 00:49:30,640

and and his collaborators are working

1420

00:49:36,150 --> 00:49:32,400

and in part the mission of the simon's

1421

00:49:38,390 --> 00:49:36,160

observatory is to falsify his hypothesis

1422

00:49:40,950 --> 00:49:38,400

so you cannot falsify the big bang

1423

00:49:43,430 --> 00:49:40,960

hypothesis as such in other words the

1424

00:49:45,109 --> 00:49:43,440

big bang would be an aspect of a

1425

00:49:46,630 --> 00:49:45,119

collapsing universe scenario called the

1426

00:49:49,270 --> 00:49:46,640

cyclic universe there'd be the

1427

00:49:50,790 --> 00:49:49,280

equivalent of a hot dense uh and again

1428

00:49:51,670 --> 00:49:50,800

another you know shout out to sean

1429

00:49:53,670 --> 00:49:51,680

carroll

1430

00:49:55,829 --> 00:49:53,680

he says a good thing which is that

1431

00:49:57,510 --> 00:49:55,839

debate when you say the big bang you're

1432

00:49:59,589 --> 00:49:57,520

really talking about a period about a

1433

00:50:01,349 --> 00:49:59,599

minute or two

1434

00:50:03,750 --> 00:50:01,359

from the from time

1435

00:50:06,150 --> 00:50:03,760

backwards to a minute before

1436

00:50:07,589 --> 00:50:06,160

this event when our extrapolations of

1437

00:50:10,309 --> 00:50:07,599

classical physics would imply a

1438

00:50:12,150 --> 00:50:10,319

singularity it's basically the end of

1439

00:50:14,230 --> 00:50:12,160

our of our knowledge or the beginning of

1440

00:50:16,069 --> 00:50:14,240

our ignorance he calls it so the big

1441

00:50:18,390 --> 00:50:16,079

bang is really a shibboleth it's a it's

1442

00:50:20,630 --> 00:50:18,400

a shortcut it's it's a code word for

1443

00:50:22,230 --> 00:50:20,640

where does our ignorance stop and our

1444

00:50:24,069 --> 00:50:22,240

ignorance stops about a minute

1445

00:50:25,430 --> 00:50:24,079

afterwards when we start making uh we

1446

00:50:26,549 --> 00:50:25,440

start synthesizing the very first

1447

00:50:28,470 --> 00:50:26,559

elements

1448

00:50:31,670 --> 00:50:28,480

you know i'm i happen to think that our

1449

00:50:32,870 --> 00:50:31,680

ignorance is is is so far greater and i

1450

00:50:34,710 --> 00:50:32,880

do this thought experiment where it's

1451
00:50:36,630 --> 00:50:34,720
like imagine you're a few billion years

1452
00:50:38,390 --> 00:50:36,640
from now maybe maybe 90 billion or

1453
00:50:42,309 --> 00:50:38,400
whatever

1454
00:50:43,910 --> 00:50:42,319
we're on earth and we have our sun but

1455
00:50:45,589 --> 00:50:43,920
we look out and we and the galaxies are

1456
00:50:46,470 --> 00:50:45,599
moving so far away that we see almost

1457
00:50:48,230 --> 00:50:46,480
nothing

1458
00:50:50,069 --> 00:50:48,240
but we wouldn't we wouldn't know that

1459
00:50:51,510 --> 00:50:50,079
anything else existed

1460
00:50:53,430 --> 00:50:51,520
that's right okay so that's just a few

1461
00:50:54,790 --> 00:50:53,440
billion years from now given presuming

1462
00:50:56,870 --> 00:50:54,800
our current theories of general

1463
00:50:58,069 --> 00:50:56,880

relativity and cosmological expansion

1464

00:50:59,750 --> 00:50:58,079

are correct

1465

00:51:01,109 --> 00:50:59,760

okay well what about now why do we think

1466

00:51:03,910 --> 00:51:01,119

that we're in such a privileged position

1467

00:51:05,270 --> 00:51:03,920

that we have so much

1468

00:51:07,349 --> 00:51:05,280

knowledge to even

1469

00:51:08,870 --> 00:51:07,359

think we're on the we're one percent of

1470

00:51:10,309 --> 00:51:08,880

the way there to a theory of everything

1471

00:51:12,630 --> 00:51:10,319

for example by the way what do you think

1472

00:51:14,470 --> 00:51:12,640

of eric weinstein's theory of everything

1473

00:51:16,710 --> 00:51:14,480

so he and i are very close uh

1474

00:51:19,750 --> 00:51:16,720

collaborators friends and and we talk

1475

00:51:22,870 --> 00:51:19,760

about this a lot i've encouraged him um

1476
00:51:23,990 --> 00:51:22,880
to to really start thinking about ways

1477
00:51:25,109 --> 00:51:24,000
that we could

1478
00:51:28,710 --> 00:51:25,119
revive

1479
00:51:31,990 --> 00:51:28,720
both the um both the kind of excitement

1480
00:51:35,270 --> 00:51:32,000
and the sociological milieu that

1481
00:51:36,790 --> 00:51:35,280
happened before 1974 in physics and

1482
00:51:38,710 --> 00:51:36,800
that's the period of time that sabine

1483
00:51:40,309 --> 00:51:38,720
and eric and others have claimed it was

1484
00:51:41,990 --> 00:51:40,319
like basically the end of physics like

1485
00:51:44,069 --> 00:51:42,000
there haven't been new discoveries or

1486
00:51:45,589 --> 00:51:44,079
predictions which i argue with both of

1487
00:51:46,950 --> 00:51:45,599
them on my podcast

1488
00:51:49,430 --> 00:51:46,960

um

1489

00:51:51,829 --> 00:51:49,440

but uh but but essentially they want he

1490

00:51:54,069 --> 00:51:51,839

wants to recreate the urgency of the

1491

00:51:56,549 --> 00:51:54,079

manhattan project of the mit radar

1492

00:51:58,309 --> 00:51:56,559

laboratory uh of the world war ii

1493

00:52:00,710 --> 00:51:58,319

generation of the shelter island

1494

00:52:02,549 --> 00:52:00,720

generation post world war ii when

1495

00:52:05,190 --> 00:52:02,559

physicists were chauffeured around by

1496

00:52:07,670 --> 00:52:05,200

secret service agents um because they

1497

00:52:09,910 --> 00:52:07,680

they contain within them uh national

1498

00:52:12,710 --> 00:52:09,920

secrets and national treasures he wants

1499

00:52:15,190 --> 00:52:12,720

to recreate that and uh and i'm hoping

1500

00:52:17,030 --> 00:52:15,200

to you know engage with him as an

1501
00:52:18,790 --> 00:52:17,040
experimentalist i'm not a mathematician

1502
00:52:21,990 --> 00:52:18,800
i do understand some of the math that

1503
00:52:23,990 --> 00:52:22,000
goes into it uh you must know that he is

1504
00:52:26,950 --> 00:52:24,000
you know universally looked upon in the

1505
00:52:28,950 --> 00:52:26,960
physics community with both with both uh

1506
00:52:31,430 --> 00:52:28,960
skepticism because he hasn't published

1507
00:52:32,950 --> 00:52:31,440
anything although if you join my if you

1508
00:52:35,510 --> 00:52:32,960
go to my uh

1509
00:52:37,030 --> 00:52:35,520
uh my youtube interviews with him i've

1510
00:52:39,190 --> 00:52:37,040
done two now

1511
00:52:41,270 --> 00:52:39,200
and in the second one i

1512
00:52:43,990 --> 00:52:41,280
have actually downloaded his slides from

1513
00:52:46,470 --> 00:52:44,000

his oxford talk in 2013 one of my

1514

00:52:47,750 --> 00:52:46,480

undergraduates digitized them and so if

1515

00:52:49,829 --> 00:52:47,760

you sign up for my mailing list at

1516

00:52:52,470 --> 00:52:49,839

bryankeating.com i'll send you a copy of

1517

00:52:54,470 --> 00:52:52,480

his lecture notes from that lecture in

1518

00:52:55,750 --> 00:52:54,480

2013. that's about as close as we get

1519

00:52:58,790 --> 00:52:55,760

right now

1520

00:53:00,150 --> 00:52:58,800

because he's in that making hay phase

1521

00:53:02,150 --> 00:53:00,160

kurt which i'm sure you've been in the

1522

00:53:03,910 --> 00:53:02,160

state of flow where you're actually

1523

00:53:06,230 --> 00:53:03,920

incur you're just producing great

1524

00:53:08,150 --> 00:53:06,240

content for your film for your uh for

1525

00:53:09,990 --> 00:53:08,160

your research for all the other projects

1526
00:53:11,750 --> 00:53:10,000
for this youtube channel and you're just

1527
00:53:13,109 --> 00:53:11,760
singularly focused on this thing and it

1528
00:53:15,030 --> 00:53:13,119
obsesses you

1529
00:53:16,870 --> 00:53:15,040
and you want to learn more about it

1530
00:53:20,069 --> 00:53:16,880
before you then take these tentative

1531
00:53:21,670 --> 00:53:20,079
furtive steps to publication so i would

1532
00:53:24,470 --> 00:53:21,680
say i said he's looked upon

1533
00:53:26,630 --> 00:53:24,480
simultaneously with skepticism

1534
00:53:28,790 --> 00:53:26,640
but also dismay because he's a great

1535
00:53:31,430 --> 00:53:28,800
communicator of science and he believes

1536
00:53:33,670 --> 00:53:31,440
as he said in my podcast interview that

1537
00:53:35,670 --> 00:53:33,680
physicists are the worst at pr

1538
00:53:37,510 --> 00:53:35,680

uh that have ever existed because we

1539

00:53:39,270 --> 00:53:37,520

have the greatest material

1540

00:53:41,430 --> 00:53:39,280

and instead we just keep regurgitating

1541

00:53:43,670 --> 00:53:41,440

the same double slit experiment the

1542

00:53:45,990 --> 00:53:43,680

wormholes multiverse you know when we

1543

00:53:48,710 --> 00:53:46,000

have the hop vibration i'm not saying if

1544

00:53:51,349 --> 00:53:48,720

i i 100 agree with eric weinstein on

1545

00:53:52,309 --> 00:53:51,359

that it's it's incredibly incredibly

1546

00:53:54,069 --> 00:53:52,319

boring

1547

00:53:56,309 --> 00:53:54,079

yeah oh yeah it can be up and down at

1548

00:53:58,549 --> 00:53:56,319

the same time

1549

00:54:00,710 --> 00:53:58,559

exactly so there's a limit to that so i

1550

00:54:02,630 --> 00:54:00,720

but but then he'll go on

1551
00:54:03,510 --> 00:54:02,640
referring to superposition today

1552
00:54:05,430 --> 00:54:03,520
yeah

1553
00:54:07,670 --> 00:54:05,440
and uh he'll go on joe rogan show and

1554
00:54:09,430 --> 00:54:07,680
six million people will watch it and you

1555
00:54:11,589 --> 00:54:09,440
know that's six million people that will

1556
00:54:13,670 --> 00:54:11,599
be potentially there's some kid out

1557
00:54:16,390 --> 00:54:13,680
there who like me at age 12 they didn't

1558
00:54:17,829 --> 00:54:16,400
have podcasts back then uh but uh but

1559
00:54:19,589 --> 00:54:17,839
we'll think well that's really cool i

1560
00:54:21,829 --> 00:54:19,599
want to learn about i used to read isaac

1561
00:54:23,589 --> 00:54:21,839
asimov not his science fiction books he

1562
00:54:25,109 --> 00:54:23,599
wrote a tremendous amount of non-fiction

1563
00:54:27,990 --> 00:54:25,119

in science chemistry the history of

1564

00:54:29,670 --> 00:54:28,000

chemistry i devoured it at age 12.

1565

00:54:31,990 --> 00:54:29,680

flatland the book flatland have you ever

1566

00:54:33,270 --> 00:54:32,000

read that book kurt no oh you got it

1567

00:54:34,069 --> 00:54:33,280

i've heard of it i've heard it you will

1568

00:54:36,309 --> 00:54:34,079

love it

1569

00:54:37,750 --> 00:54:36,319

it has it's uh it's by ed

1570

00:54:40,549 --> 00:54:37,760

edward abbey

1571

00:54:42,150 --> 00:54:40,559

in the late 1800s victorian england and

1572

00:54:44,549 --> 00:54:42,160

it's actually like a commentary on

1573

00:54:46,309 --> 00:54:44,559

racism which is really fascinating but

1574

00:54:48,069 --> 00:54:46,319

but it also talks about what it's like

1575

00:54:50,630 --> 00:54:48,079

for a two-dimensional creature to

1576

00:54:53,030 --> 00:54:50,640

visualize the third dimensions and in so

1577

00:54:54,710 --> 00:54:53,040

doing it helps you visualize what the

1578

00:54:57,030 --> 00:54:54,720

fourth dimension might look like to a

1579

00:54:58,790 --> 00:54:57,040

three-dimensional creature um you have

1580

00:55:00,549 --> 00:54:58,800

to read that so that was an ins that was

1581

00:55:01,910 --> 00:55:00,559

a foundational book in my education you

1582

00:55:03,190 --> 00:55:01,920

asked me about books earlier but that's

1583

00:55:05,270 --> 00:55:03,200

one of them because i started thinking

1584

00:55:06,950 --> 00:55:05,280

geometrically and there's always the

1585

00:55:08,390 --> 00:55:06,960

siren song of thinking geometrically

1586

00:55:10,710 --> 00:55:08,400

that leads you to beauty and symmetry

1587

00:55:12,710 --> 00:55:10,720

and everything else but in my case it

1588

00:55:15,589 --> 00:55:12,720

actually led me to like well let me

1589

00:55:17,670 --> 00:55:15,599

think about things that i can't access

1590

00:55:19,030 --> 00:55:17,680

with experiments so the most important

1591

00:55:21,109 --> 00:55:19,040

experiments are called gdenkan

1592

00:55:22,710 --> 00:55:21,119

experiments thought experiments einstein

1593

00:55:24,549 --> 00:55:22,720

was the greatest experimentalist of all

1594

00:55:27,270 --> 00:55:24,559

time in that sense because that's what

1595

00:55:29,670 --> 00:55:27,280

led him to create theories of relativity

1596

00:55:31,750 --> 00:55:29,680

in both both theory general and special

1597

00:55:33,990 --> 00:55:31,760

so i hope that kids out there will take

1598

00:55:35,750 --> 00:55:34,000

what eric's doing seriously i am trying

1599

00:55:37,349 --> 00:55:35,760

to encourage him to actually i've

1600

00:55:39,430 --> 00:55:37,359

actually invited him i'm on record

1601
00:55:41,510 --> 00:55:39,440
multiple times i'm the only physicist in

1602
00:55:43,270 --> 00:55:41,520
the world apparently which is sad to me

1603
00:55:46,069 --> 00:55:43,280
that's invited him to be a scholar in

1604
00:55:46,870 --> 00:55:46,079
residence here in san diego and and work

1605
00:55:51,270 --> 00:55:46,880
on

1606
00:55:53,349 --> 00:55:51,280
tests for geometric unity which is what

1607
00:55:54,789 --> 00:55:53,359
he calls this theory of everything i've

1608
00:55:56,789 --> 00:55:54,799
also had on stephen wolfram on my

1609
00:55:58,950 --> 00:55:56,799
podcast i've also encouraged him to look

1610
00:56:00,789 --> 00:55:58,960
for you know ways that we can

1611
00:56:02,870 --> 00:56:00,799
collaborate together to think of ways we

1612
00:56:05,589 --> 00:56:02,880
could test it as an experimentalist

1613
00:56:07,190 --> 00:56:05,599

because again i am obsessed with time

1614

00:56:09,510 --> 00:56:07,200

tick tock tick tock

1615

00:56:12,069 --> 00:56:09,520

and i'm obsessed with the brevity of

1616

00:56:14,390 --> 00:56:12,079

life and how short a period of attention

1617

00:56:16,710 --> 00:56:14,400

span we have to make discoveries and so

1618

00:56:18,870 --> 00:56:16,720

i don't waste my time but if there are

1619

00:56:20,630 --> 00:56:18,880

potential avenues like eric could be

1620

00:56:22,150 --> 00:56:20,640

correct could be wrong paul steinhardt

1621

00:56:24,230 --> 00:56:22,160

could be correct could be wrong with

1622

00:56:26,230 --> 00:56:24,240

regard to the bouncing models that he's

1623

00:56:27,670 --> 00:56:26,240

proposed uh steven wolfram could be

1624

00:56:29,270 --> 00:56:27,680

right could be wrong so i'm actually

1625

00:56:31,589 --> 00:56:29,280

talking later today about ways we can

1626
00:56:33,510 --> 00:56:31,599
get the whole physics community together

1627
00:56:36,309 --> 00:56:33,520
and a kind of like a shelter island or

1628
00:56:39,589 --> 00:56:36,319
revival of of the theory of everything

1629
00:56:41,430 --> 00:56:39,599
uh studies maybe through uh zoom maybe

1630
00:56:43,829 --> 00:56:41,440
through a webinar something like that

1631
00:56:45,910 --> 00:56:43,839
and thinking really big to attract the

1632
00:56:47,990 --> 00:56:45,920
greatest minds to attack this problem

1633
00:56:49,750 --> 00:56:48,000
and rejuvenate as eric says this

1634
00:56:52,950 --> 00:56:49,760
rockstar status that physicists used to

1635
00:56:54,069 --> 00:56:52,960
have in the in the 20th century

1636
00:56:55,750 --> 00:56:54,079
okay

1637
00:56:57,910 --> 00:56:55,760
is there much movement on that this

1638
00:56:59,349 --> 00:56:57,920

manhattan physics project or is it right

1639

00:57:01,430 --> 00:56:59,359

now it's just conversations between you

1640

00:57:03,990 --> 00:57:01,440

and eric and maybe two other people and

1641

00:57:06,390 --> 00:57:04,000

it's over yeah i'm sort of inspired by

1642

00:57:07,349 --> 00:57:06,400

in part by by david kaiser my friend at

1643

00:57:09,190 --> 00:57:07,359

mit

1644

00:57:11,270 --> 00:57:09,200

uh who who wrote a book recently called

1645

00:57:13,349 --> 00:57:11,280

quantum legacies about the the

1646

00:57:15,589 --> 00:57:13,359

aftershocks of the world war two

1647

00:57:16,870 --> 00:57:15,599

projects and when physicists were

1648

00:57:20,069 --> 00:57:16,880

chauffeured around with you know

1649

00:57:21,750 --> 00:57:20,079

bodyguards and uh and also by eric so

1650

00:57:23,349 --> 00:57:21,760

now we're thinking about it we we have

1651
00:57:26,309 --> 00:57:23,359
kicked around some ideas for an hour or

1652
00:57:27,910 --> 00:57:26,319
two yesterday um i'll i'll let you know

1653
00:57:29,270 --> 00:57:27,920
when if if we can actually put together

1654
00:57:30,549 --> 00:57:29,280
that would be the dream like the salve

1655
00:57:33,030 --> 00:57:30,559
conference you ever seen that picture of

1656
00:57:35,030 --> 00:57:33,040
like marie curie and niels bohr and

1657
00:57:36,470 --> 00:57:35,040
einstein yeah i would i would be taking

1658
00:57:38,230 --> 00:57:36,480
the picture and putting it on instagram

1659
00:57:40,309 --> 00:57:38,240
i wouldn't be actually in the picture uh

1660
00:57:42,950 --> 00:57:40,319
but the point is let's get let's get the

1661
00:57:45,510 --> 00:57:42,960
most creative people together uh but we

1662
00:57:47,109 --> 00:57:45,520
can't ignore funding we cannot ignore

1663
00:57:48,549 --> 00:57:47,119

basic research funding and that's what's

1664

00:57:51,510 --> 00:57:48,559

so exciting about partnering with the

1665

00:57:53,990 --> 00:57:51,520

simons foundation they really primarily

1666

00:57:56,069 --> 00:57:54,000

support non-application-driven science

1667

00:57:59,030 --> 00:57:56,079

mainly math computer science

1668

00:58:00,870 --> 00:57:59,040

computational biology astrophysics and

1669

00:58:03,190 --> 00:58:00,880

now the simon's observatory pictured

1670

00:58:05,430 --> 00:58:03,200

behind me to look at potential

1671

00:58:08,309 --> 00:58:05,440

resolutions and answers to you know the

1672

00:58:09,670 --> 00:58:08,319

greatest questions of the human mind

1673

00:58:12,870 --> 00:58:09,680

tell the audience where they can find

1674

00:58:14,950 --> 00:58:12,880

out more about you and what you're up to

1675

00:58:16,630 --> 00:58:14,960

so i'm doing a lot you asked me in the

1676
00:58:17,670 --> 00:58:16,640
notes we didn't you know fully or in the

1677
00:58:19,430 --> 00:58:17,680
beginning

1678
00:58:21,430 --> 00:58:19,440
my mission is really to communicate you

1679
00:58:23,030 --> 00:58:21,440
know what i want to be and maybe i have

1680
00:58:25,109 --> 00:58:23,040
a kindred spirit with you it's kind of

1681
00:58:27,510 --> 00:58:25,119
like the joe rogan of science like i

1682
00:58:29,270 --> 00:58:27,520
want to do stuff uh uh and it doesn't

1683
00:58:30,789 --> 00:58:29,280
have to be restricted to science uh

1684
00:58:34,470 --> 00:58:30,799
there are people like we mentioned dave

1685
00:58:36,069 --> 00:58:34,480
rubin uh zoobees is gonna appear soon

1686
00:58:37,270 --> 00:58:36,079
michael shermer they're not scientists

1687
00:58:39,270 --> 00:58:37,280
per se

1688
00:58:41,109 --> 00:58:39,280

but but but basically they're of an

1689

00:58:43,589 --> 00:58:41,119

affinity either for science fiction

1690

00:58:44,950 --> 00:58:43,599

which i claim allows you to do thought

1691

00:58:47,030 --> 00:58:44,960

experiments

1692

00:58:49,349 --> 00:58:47,040

and so we talk about uh things that

1693

00:58:50,870 --> 00:58:49,359

revolve around academic freedom

1694

00:58:52,789 --> 00:58:50,880

in the case of my podcast which you can

1695

00:58:54,630 --> 00:58:52,799

find on youtube at dr brian keating dr

1696

00:58:56,789 --> 00:58:54,640

brian keating

1697

00:58:59,109 --> 00:58:56,799

and you can find me on twitter and my

1698

00:59:01,670 --> 00:58:59,119

goal is to really have incredible

1699

00:59:04,150 --> 00:59:01,680

conversations that stimulate me

1700

00:59:05,589 --> 00:59:04,160

to think about the future legacy that i

1701
00:59:07,750 --> 00:59:05,599
want to leave

1702
00:59:08,549 --> 00:59:07,760
on earth which is uh which is to have

1703
00:59:11,349 --> 00:59:08,559
this

1704
00:59:14,470 --> 00:59:11,359
impact on gleaning wisdom and

1705
00:59:17,670 --> 00:59:14,480
communicating a vision for

1706
00:59:19,589 --> 00:59:17,680
curiosity for wonder for imagination and

1707
00:59:22,069 --> 00:59:19,599
and that's part of uh you know this

1708
00:59:24,870 --> 00:59:22,079
tripartite vision that i have

1709
00:59:26,710 --> 00:59:24,880
for my life so yes long story short find

1710
00:59:29,109 --> 00:59:26,720
my podcast on dr brian keating on

1711
00:59:30,950 --> 00:59:29,119
youtube um hopefully you can link to it

1712
00:59:33,270 --> 00:59:30,960
and i'll link back

1713
00:59:35,510 --> 00:59:33,280

and uh and then i'm on twitter dr brian

1714

00:59:37,270 --> 00:59:35,520

keating instagram same thing

1715

00:59:40,309 --> 00:59:37,280

and i have a mailing list where i send

1716

00:59:42,069 --> 00:59:40,319

out things like uh personal notes and