

SOMEWHERE IN THE SKIES



EXTRATERRESTRIAL

FEATURING AVI LOEB

1
00:00:10,070 --> 00:00:09,589
[Music]

2
00:00:14,910 --> 00:00:10,080
this

3
00:00:31,429 --> 00:00:16,900
sprague

4
00:00:35,030 --> 00:00:33,110
welcome everyone to somewhere in the

5
00:00:38,229 --> 00:00:35,040
skies and uh today we are

6
00:00:40,869 --> 00:00:38,239
joined by professor avi loeb avi

7
00:00:42,229 --> 00:00:40,879
received a phd in plasma physics at age

8
00:00:44,549 --> 00:00:42,239
24

9
00:00:46,470 --> 00:00:44,559
from the hebrew university of jerusalem

10
00:00:48,709 --> 00:00:46,480
and was subsequently a long-term member

11
00:00:49,830 --> 00:00:48,719
of the institute for advanced study at

12
00:00:51,950 --> 00:00:49,840
princeton

13
00:00:53,350 --> 00:00:51,960

where he started to work in theoretical

14

00:00:56,310 --> 00:00:53,360

astrophysics

15

00:00:58,310 --> 00:00:56,320

in 93 he moved to harvard university as

16

00:01:01,110 --> 00:00:58,320

an assistant professor in the department

17

00:01:02,229 --> 00:01:01,120

of astronomy where he was tenured three

18

00:01:04,229 --> 00:01:02,239

years later

19

00:01:06,469 --> 00:01:04,239

he was also a visiting professorship at

20

00:01:08,789 --> 00:01:06,479

the weizmann institute of science

21

00:01:09,510 --> 00:01:08,799

and a sackler senior professorship by

22

00:01:11,830 --> 00:01:09,520

special

23

00:01:12,870 --> 00:01:11,840

appointment in the school of physics and

24

00:01:16,469 --> 00:01:12,880

astronomy

25

00:01:18,789 --> 00:01:16,479

at tel aviv university he is the father

26
00:01:20,310 --> 00:01:18,799
of the black hole institute a member of

27
00:01:23,429 --> 00:01:20,320
many other organizations

28
00:01:25,830 --> 00:01:23,439
has authored over 700

29
00:01:26,550 --> 00:01:25,840
research articles and has written five

30
00:01:28,950 --> 00:01:26,560
books

31
00:01:30,230 --> 00:01:28,960
uh the newest of which is the focus of

32
00:01:32,789 --> 00:01:30,240
our discussion

33
00:01:33,670 --> 00:01:32,799
today the book is extraterrestrial the

34
00:01:36,149 --> 00:01:33,680
first sign

35
00:01:37,109 --> 00:01:36,159
of intelligent life beyond earth and the

36
00:01:39,429 --> 00:01:37,119
author

37
00:01:40,550 --> 00:01:39,439
is avi logan he is here with us today

38
00:01:42,149 --> 00:01:40,560

avi thank you

39

00:01:44,550 --> 00:01:42,159

so much for joining me today on summer

40

00:01:46,149 --> 00:01:44,560

in the skies thank you for having me

41

00:01:47,590 --> 00:01:46,159

the fact that i have you here with me

42

00:01:49,990 --> 00:01:47,600

today avi uh

43

00:01:52,310 --> 00:01:50,000

is a huge honor and pleasure so i really

44

00:01:55,749 --> 00:01:52,320

had to roll out your resume there to uh

45

00:01:57,190 --> 00:01:55,759

to show uh my audience the

46

00:01:59,429 --> 00:01:57,200

depths we're going to go into in

47

00:02:01,749 --> 00:01:59,439

tonight's discussion i should say that

48

00:02:04,789 --> 00:02:01,759

all these labels mean

49

00:02:07,910 --> 00:02:04,799

does do not mean much for me because

50

00:02:09,350 --> 00:02:07,920

you know what really matters to me is

51
00:02:12,150 --> 00:02:09,360
you know

52
00:02:14,309 --> 00:02:12,160
in science is curiosity and just like

53
00:02:16,390 --> 00:02:14,319
kids you know they don't have labels

54
00:02:17,990 --> 00:02:16,400
uh they just try to learn about the

55
00:02:21,190 --> 00:02:18,000
world and that's what we are

56
00:02:23,110 --> 00:02:21,200
all doing you know and there was a a

57
00:02:24,710 --> 00:02:23,120
an article in the gazette the harvard

58
00:02:26,470 --> 00:02:24,720
gazette that i wrote where

59
00:02:28,790 --> 00:02:26,480
i was asked what is the one thing you

60
00:02:32,150 --> 00:02:28,800
would like to change about the world

61
00:02:33,190 --> 00:02:32,160
and i said i i just want my colleagues

62
00:02:36,869 --> 00:02:33,200
to behave more like

63
00:02:39,270 --> 00:02:36,879

kids that's that's all i wanted

64

00:02:40,309 --> 00:02:39,280

i i completely agree with you there i

65

00:02:43,350 --> 00:02:40,319

think you know

66

00:02:46,790 --> 00:02:43,360

as we as we age we lose that

67

00:02:48,229 --> 00:02:46,800

inhibition you know that or we have that

68

00:02:51,190 --> 00:02:48,239

inhibition i should say

69

00:02:51,750 --> 00:02:51,200

and curiosity kind of takes a back seat

70

00:02:53,830 --> 00:02:51,760

so

71

00:02:55,190 --> 00:02:53,840

it's good to see people like yourself

72

00:02:57,750 --> 00:02:55,200

out there uh

73

00:02:58,550 --> 00:02:57,760

challenging the mainstream challenging

74

00:03:00,550 --> 00:02:58,560

the norm

75

00:03:02,630 --> 00:03:00,560

and theorizing which is such an

76

00:03:05,750 --> 00:03:02,640

important part of science to begin with

77

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

well it's the unfortunate aspect of

78

00:03:10,390 --> 00:03:08,080

people uh changing the pattern of their

79

00:03:12,869 --> 00:03:10,400

behavior from being kids to

80

00:03:15,430 --> 00:03:12,879

being adults is that is that they are

81

00:03:17,670 --> 00:03:15,440

starting to care more about themselves

82

00:03:19,270 --> 00:03:17,680

you know and about their ego and in

83

00:03:21,350 --> 00:03:19,280

academia you see that a lot

84

00:03:23,990 --> 00:03:21,360

uh you know professors once they get

85

00:03:28,070 --> 00:03:24,000

tenure they have students and postdocs

86

00:03:29,110 --> 00:03:28,080

that are behave as if they're in an echo

87

00:03:32,149 --> 00:03:29,120

chamber they

88

00:03:36,070 --> 00:03:32,159

echo whatever the senior person says and

89

00:03:39,750 --> 00:03:36,080

that amplifies the message but

90

00:03:40,550 --> 00:03:39,760

this is you know chasing uh awards and

91

00:03:43,110 --> 00:03:40,560

honors

92

00:03:43,670 --> 00:03:43,120

is really not what science is about it's

93

00:03:46,390 --> 00:03:43,680

not about

94

00:03:47,270 --> 00:03:46,400

us it's about understanding the world

95

00:03:51,190 --> 00:03:47,280

nature

96

00:03:54,630 --> 00:03:51,200

and that's what we do as kids

97

00:03:55,670 --> 00:03:54,640

and i just refuse to change that

98

00:03:57,670 --> 00:03:55,680

attitude and

99

00:03:58,949 --> 00:03:57,680

i don't really care about how many likes

100

00:04:02,149 --> 00:03:58,959

i have on twitter

101
00:04:05,190 --> 00:04:02,159
and whether i get prizes and whether uh

102
00:04:05,910 --> 00:04:05,200
you know the community around me uh a

103
00:04:08,390 --> 00:04:05,920
plow

104
00:04:10,309 --> 00:04:08,400
you know or not it doesn't really matter

105
00:04:13,350 --> 00:04:10,319
because what we are after is

106
00:04:15,030 --> 00:04:13,360
figuring out how the world works and

107
00:04:16,390 --> 00:04:15,040
you know if you look at the history you

108
00:04:19,590 --> 00:04:16,400
see situations like

109
00:04:20,629 --> 00:04:19,600
with galileo galilei who is a hero of

110
00:04:23,030 --> 00:04:20,639
science you know

111
00:04:24,469 --> 00:04:23,040
he argued that the earth is moving

112
00:04:28,230 --> 00:04:24,479
around the sun

113
00:04:30,870 --> 00:04:28,240

and the philosophers at the time said

114

00:04:31,909 --> 00:04:30,880

no we know the truth the sun moves

115

00:04:33,590 --> 00:04:31,919

around the earth and

116

00:04:35,030 --> 00:04:33,600

you know that's consistent with our

117

00:04:38,469 --> 00:04:35,040

religion and everything

118

00:04:40,950 --> 00:04:38,479

and then they put him in house arrest

119

00:04:41,670 --> 00:04:40,960

as a result but that didn't change the

120

00:04:44,070 --> 00:04:41,680

fact that

121

00:04:45,030 --> 00:04:44,080

the earth moves around the sun it only

122

00:04:48,310 --> 00:04:45,040

maintained their

123

00:04:51,749 --> 00:04:48,320

ignorance so you know my view is that

124

00:04:53,909 --> 00:04:51,759

reality stays the same

125

00:04:56,950 --> 00:04:53,919

irrespective of whether you ignore it or

126

00:05:00,790 --> 00:04:56,960

not it's the one thing that persists

127

00:05:01,350 --> 00:05:00,800

and if we uh ignore reality just because

128

00:05:03,830 --> 00:05:01,360

we are

129

00:05:05,189 --> 00:05:03,840

chasing our egos and you know trying to

130

00:05:07,110 --> 00:05:05,199

get honors and awards

131

00:05:09,430 --> 00:05:07,120

that's the wrong approach for finding

132

00:05:11,189 --> 00:05:09,440

the truth you know

133

00:05:12,550 --> 00:05:11,199

that's such a good point the truth does

134

00:05:14,629 --> 00:05:12,560

not care about

135

00:05:16,550 --> 00:05:14,639

our feelings right i think it's a good

136

00:05:18,469 --> 00:05:16,560

way to say it um well

137

00:05:20,070 --> 00:05:18,479

let's let's rewind just a little bit

138

00:05:22,390 --> 00:05:20,080

obvi if you don't mind um

139

00:05:23,110 --> 00:05:22,400

could you tell us a little about how you

140

00:05:26,710 --> 00:05:23,120

first

141

00:05:27,670 --> 00:05:26,720

got involved and interested in astronomy

142

00:05:30,629 --> 00:05:27,680

cosmology

143

00:05:31,909 --> 00:05:30,639

what led you to where you are today that

144

00:05:34,469 --> 00:05:31,919

burning curiosity

145

00:05:34,950 --> 00:05:34,479

when did that all start for you well it

146

00:05:37,270 --> 00:05:34,960

was

147

00:05:37,990 --> 00:05:37,280

purely by chance or circumstances i

148

00:05:41,189 --> 00:05:38,000

should say because

149

00:05:43,670 --> 00:05:41,199

i was born on a farm and then i used to

150

00:05:44,790 --> 00:05:43,680

collect eggs every afternoon and drive a

151
00:05:46,310 --> 00:05:44,800
tractor

152
00:05:48,710 --> 00:05:46,320
and i was mostly interested in

153
00:05:50,710 --> 00:05:48,720
philosophy because it addresses the most

154
00:05:52,550 --> 00:05:50,720
fundamental questions that we have

155
00:05:54,469 --> 00:05:52,560
unfortunately doesn't answer those

156
00:05:56,550 --> 00:05:54,479
questions and then

157
00:05:58,629 --> 00:05:56,560
i grew up in israel and you have to

158
00:06:02,950 --> 00:05:58,639
serve in the military at age 18

159
00:06:05,830 --> 00:06:02,960
it's obligatory and i prefer to do

160
00:06:06,950 --> 00:06:05,840
intellectual work the the thing that is

161
00:06:10,070 --> 00:06:06,960
closest to

162
00:06:11,909 --> 00:06:10,080
pursuing philosophy and so i was good in

163
00:06:14,309 --> 00:06:11,919

physics and they recruited me to an

164

00:06:17,430 --> 00:06:14,319

elite program that

165

00:06:18,790 --> 00:06:17,440

uses physics for the defense of the

166

00:06:21,510 --> 00:06:18,800

country and

167

00:06:23,110 --> 00:06:21,520

i finished my phd at age 24 the first

168

00:06:24,790 --> 00:06:23,120

one in this program

169

00:06:26,309 --> 00:06:24,800

and actually the project that i

170

00:06:28,629 --> 00:06:26,319

developed was

171

00:06:30,790 --> 00:06:28,639

the first international project funded

172

00:06:32,150 --> 00:06:30,800

by the strategic defense initiative of

173

00:06:35,430 --> 00:06:32,160

ronald reagan

174

00:06:38,230 --> 00:06:35,440

back in the nineteen and uh

175

00:06:39,909 --> 00:06:38,240

as a result i came to the us for visits

176

00:06:41,029 --> 00:06:39,919

because we were funded by the us

177

00:06:43,350 --> 00:06:41,039

government

178

00:06:45,270 --> 00:06:43,360

and the in one of those visits i visited

179

00:06:48,950 --> 00:06:45,280

the institute for advanced study

180

00:06:51,749 --> 00:06:48,960

where albert einstein was a professor uh

181

00:06:53,589 --> 00:06:51,759

decades earlier because someone told me

182

00:06:54,469 --> 00:06:53,599

that it's a very interesting place to

183

00:06:57,430 --> 00:06:54,479

visit

184

00:06:58,309 --> 00:06:57,440

uh and i met a person named john bakal

185

00:07:00,950 --> 00:06:58,319

that then

186

00:07:01,990 --> 00:07:00,960

gambled on me offered me a five-year

187

00:07:03,749 --> 00:07:02,000

fellowship

188

00:07:05,029 --> 00:07:03,759

under the condition that i'll switch to

189

00:07:07,350 --> 00:07:05,039

astrophysics

190

00:07:08,230 --> 00:07:07,360

so even though philosophy was my true

191

00:07:09,510 --> 00:07:08,240

love i said

192

00:07:11,990 --> 00:07:09,520

well you know that's an unusual

193

00:07:14,309 --> 00:07:12,000

opportunity i should not give up on it

194

00:07:16,070 --> 00:07:14,319

so i went into astrophysics i had to

195

00:07:16,629 --> 00:07:16,080

learn all the vocabulary i didn't know

196

00:07:18,309 --> 00:07:16,639

much

197

00:07:19,749 --> 00:07:18,319

i didn't know how the sun shines let's

198

00:07:22,870 --> 00:07:19,759

put it this way

199

00:07:24,469 --> 00:07:22,880

uh and so i learned it uh and then

200

00:07:26,309 --> 00:07:24,479

harvard university offered me an

201
00:07:28,309 --> 00:07:26,319
assistant professorship

202
00:07:30,309 --> 00:07:28,319
uh nobody else wanted that position

203
00:07:32,550 --> 00:07:30,319
because the chance of getting tenured

204
00:07:33,990 --> 00:07:32,560
was very small and so

205
00:07:35,909 --> 00:07:34,000
actually they chose someone else's

206
00:07:37,749 --> 00:07:35,919
number one and that someone said no i

207
00:07:40,629 --> 00:07:37,759
don't want that job because

208
00:07:41,589 --> 00:07:40,639
i will not be promoted um so they gave

209
00:07:43,270 --> 00:07:41,599
it to me and

210
00:07:45,350 --> 00:07:43,280
and then i was promoted three years

211
00:07:47,990 --> 00:07:45,360
later and after that

212
00:07:49,110 --> 00:07:48,000
about a decade and a half later i became

213
00:07:51,670 --> 00:07:49,120

the chair of that

214

00:07:52,230 --> 00:07:51,680

department the longest serving chair i

215

00:07:55,670 --> 00:07:52,240

should say

216

00:07:58,950 --> 00:07:55,680

since 2011 until 2020

217

00:08:01,990 --> 00:07:58,960

last year and

218

00:08:04,390 --> 00:08:02,000

at that point i realized you know that

219

00:08:05,350 --> 00:08:04,400

in fact even though i had an arranged

220

00:08:08,469 --> 00:08:05,360

marriage

221

00:08:11,990 --> 00:08:08,479

uh into astrophysics

222

00:08:14,550 --> 00:08:12,000

uh the the person that i'm married

223

00:08:16,550 --> 00:08:14,560

to is actually my true love because in

224

00:08:18,790 --> 00:08:16,560

astrophysics you have very fundamental

225

00:08:20,710 --> 00:08:18,800

questions philosophical questions

226

00:08:22,710 --> 00:08:20,720

that we can address with scientific

227

00:08:24,710 --> 00:08:22,720

tools such as

228

00:08:28,469 --> 00:08:24,720

you know what is our origins how did the

229

00:08:33,990 --> 00:08:32,310

and are we alone is there life out there

230

00:08:36,469 --> 00:08:34,000

you know these are really fundamental

231

00:08:38,550 --> 00:08:36,479

questions that you can find

232

00:08:40,550 --> 00:08:38,560

a discussion about in almost all

233

00:08:42,949 --> 00:08:40,560

religions uh if you look at the old

234

00:08:44,710 --> 00:08:42,959

testament the bible the first chapter

235

00:08:46,389 --> 00:08:44,720

discusses these questions now we can

236

00:08:49,509 --> 00:08:46,399

address those questions

237

00:08:50,790 --> 00:08:49,519

with scientific tools so i'm i'm really

238

00:08:52,710 --> 00:08:50,800

happy to pursue

239

00:08:56,710 --> 00:08:52,720

astrophysics even though i was forced

240

00:09:00,230 --> 00:08:59,190

such as life i completely understand

241

00:09:02,710 --> 00:09:00,240

that well i mean

242

00:09:04,070 --> 00:09:02,720

and you've come such a long way since

243

00:09:06,550 --> 00:09:04,080

then uh you even

244

00:09:08,070 --> 00:09:06,560

started your own institute which i'd

245

00:09:08,630 --> 00:09:08,080

love to talk to you about before we get

246

00:09:11,990 --> 00:09:08,640

to

247

00:09:15,190 --> 00:09:12,000

you know the the elephant slash

248

00:09:15,990 --> 00:09:15,200

object in the room omua but before that

249

00:09:18,630 --> 00:09:16,000

avi

250

00:09:20,870 --> 00:09:18,640

um the black hole institute could you

251
00:09:23,750 --> 00:09:20,880
tell us a little about what this is

252
00:09:25,990 --> 00:09:23,760
and uh why you decided to to found this

253
00:09:29,590 --> 00:09:26,000
institute this is fascinating to me

254
00:09:34,310 --> 00:09:29,600
yeah so this uh black hole initiative

255
00:09:34,790 --> 00:09:34,320
uh started it was inaugurated in 2016

256
00:09:38,550 --> 00:09:34,800
and

257
00:09:40,550 --> 00:09:38,560
the idea was to establish a center

258
00:09:41,910 --> 00:09:40,560
that brings together physicists

259
00:09:45,110 --> 00:09:41,920
mathematicians

260
00:09:46,230 --> 00:09:45,120
astronomers and philosophers that are

261
00:09:49,190 --> 00:09:46,240
all interested

262
00:09:50,790 --> 00:09:49,200
in black holes black holes are these

263
00:09:53,910 --> 00:09:50,800

extreme

264

00:09:55,910 --> 00:09:53,920

structures of space and time that they

265

00:09:59,750 --> 00:09:55,920

represent the ultimate prison

266

00:10:03,269 --> 00:09:59,760

even light cannot escape from them and

267

00:10:06,630 --> 00:10:03,279

einstein wrote his theory of gravity

268

00:10:09,350 --> 00:10:06,640

in november 1915

269

00:10:10,870 --> 00:10:09,360

published it and then a few months later

270

00:10:12,630 --> 00:10:10,880

carl schwarzschild

271

00:10:14,310 --> 00:10:12,640

was the first to derive an analytic

272

00:10:15,590 --> 00:10:14,320

solution a simple solution to those

273

00:10:20,310 --> 00:10:15,600

equations

274

00:10:26,069 --> 00:10:23,750

a hundred years later the first direct

275

00:10:29,590 --> 00:10:26,079

evidence for a black hole came

276

00:10:31,829 --> 00:10:29,600

in the form of gravitational waves when

277

00:10:33,350 --> 00:10:31,839

two black holes collided at the edge of

278

00:10:36,710 --> 00:10:33,360

the universe and

279

00:10:40,550 --> 00:10:36,720

sent the ripples in space and time that

280

00:10:42,949 --> 00:10:40,560

our ligo observatory detected discovered

281

00:10:44,389 --> 00:10:42,959

for which the nobel prize was awarded a

282

00:10:47,509 --> 00:10:44,399

couple of years later

283

00:10:49,750 --> 00:10:47,519

in physics so it's quite remarkable that

284

00:10:51,190 --> 00:10:49,760

only it took only a century between the

285

00:10:54,949 --> 00:10:51,200

idea of a black hole

286

00:10:57,269 --> 00:10:54,959

to when it was discovered and that was

287

00:10:58,790 --> 00:10:57,279

just around the time when we established

288

00:11:00,550 --> 00:10:58,800

the black hole initiative

289

00:11:02,710 --> 00:11:00,560

we didn't know about the ligo result

290

00:11:03,670 --> 00:11:02,720

when we decided to establish it but then

291

00:11:06,230 --> 00:11:03,680

it came along

292

00:11:07,030 --> 00:11:06,240

it was publicized around the same time

293

00:11:09,430 --> 00:11:07,040

and

294

00:11:11,590 --> 00:11:09,440

since then i should say this year the

295

00:11:14,310 --> 00:11:11,600

nobel prize was given again

296

00:11:14,790 --> 00:11:14,320

to the study of black holes so we should

297

00:11:19,110 --> 00:11:14,800

in

298

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

also the year

299

00:11:22,310 --> 00:11:21,519

uh when the nobel prize was avoided

300

00:11:25,030 --> 00:11:22,320

again

301
00:11:27,509 --> 00:11:25,040
for black holes we actually forecasted

302
00:11:29,990 --> 00:11:27,519
that it will become a major frontier

303
00:11:31,829 --> 00:11:30,000
in the study of the of the universe and

304
00:11:32,790 --> 00:11:31,839
i should say that einstein himself

305
00:11:36,150 --> 00:11:32,800
doubted

306
00:11:37,590 --> 00:11:36,160
that black holes exist in nature in 1939

307
00:11:39,190 --> 00:11:37,600
he wrote a paper saying

308
00:11:41,030 --> 00:11:39,200
black holes are just mathematical

309
00:11:42,150 --> 00:11:41,040
constructs they don't really exist in

310
00:11:44,949 --> 00:11:42,160
nature

311
00:11:46,949 --> 00:11:44,959
and he was wrong on that but this just

312
00:11:49,030 --> 00:11:46,959
illustrates that you know science is a

313
00:11:50,470 --> 00:11:49,040

learning experience even einstein was

314

00:11:54,069 --> 00:11:50,480

wrong

315

00:11:55,910 --> 00:11:54,079

actually three times late in his career

316

00:11:57,110 --> 00:11:55,920

and it's a learning experience when you

317

00:11:58,790 --> 00:11:57,120

work on the frontier

318

00:12:01,269 --> 00:11:58,800

sometimes you make mistakes you have to

319

00:12:03,269 --> 00:12:01,279

take risks and as i said before it's

320

00:12:05,670 --> 00:12:03,279

just like kids you know you stumble

321

00:12:07,030 --> 00:12:05,680

uh and but through that process you

322

00:12:10,069 --> 00:12:07,040

learn something new

323

00:12:12,150 --> 00:12:10,079

and you know all these fossa's all these

324

00:12:14,069 --> 00:12:12,160

people in academia that try to pretend

325

00:12:16,310 --> 00:12:14,079

as if they know everything

326

00:12:19,750 --> 00:12:16,320

or they want to protect their image by

327

00:12:21,829 --> 00:12:19,760

never being wrong by never taking a risk

328

00:12:23,190 --> 00:12:21,839

they are betraying the promise of

329

00:12:25,910 --> 00:12:23,200

science because

330

00:12:28,629 --> 00:12:25,920

they are not considering possibilities

331

00:12:30,710 --> 00:12:28,639

that might be true and revolutionary

332

00:12:32,389 --> 00:12:30,720

and for example the detection of

333

00:12:33,350 --> 00:12:32,399

gravitational waves from black hole

334

00:12:36,629 --> 00:12:33,360

collisions

335

00:12:39,190 --> 00:12:36,639

that was a revolutionary concept and

336

00:12:41,110 --> 00:12:39,200

a lot of people in the mainstream

337

00:12:44,470 --> 00:12:41,120

doubted that it's possible

338

00:12:46,069 --> 00:12:44,480

uh but now we use it so

339

00:12:48,069 --> 00:12:46,079

that's why i don't care about the number

340

00:12:50,389 --> 00:12:48,079

of likes i get on twitter

341

00:12:51,750 --> 00:12:50,399

because you know many of the people that

342

00:12:54,949 --> 00:12:51,760

pioneered things

343

00:12:55,670 --> 00:12:54,959

in science uh were not particularly

344

00:13:00,870 --> 00:12:55,680

liked

345

00:13:05,269 --> 00:13:03,750

absolutely and um we're gonna get into

346

00:13:07,829 --> 00:13:05,279

sort of that uh

347

00:13:08,389 --> 00:13:07,839

rebellious nature that i highly respect

348

00:13:11,030 --> 00:13:08,399

about

349

00:13:12,470 --> 00:13:11,040

the work you've done and and many other

350

00:13:15,030 --> 00:13:12,480

you know scientists in

351
00:13:16,230 --> 00:13:15,040
all different fields as well um who

352
00:13:18,550 --> 00:13:16,240
aren't afraid

353
00:13:20,949 --> 00:13:18,560
to throw the darts at the wall and see

354
00:13:21,350 --> 00:13:20,959
what sticks you know i should say one

355
00:13:23,590 --> 00:13:21,360
thing

356
00:13:25,269 --> 00:13:23,600
though uh that just before we

357
00:13:26,310 --> 00:13:25,279
inaugurated the black hole initiative

358
00:13:29,190 --> 00:13:26,320
about the

359
00:13:31,509 --> 00:13:29,200
four months before that uh actually half

360
00:13:33,190 --> 00:13:31,519
a year before that i i met the stephen

361
00:13:37,030 --> 00:13:33,200
hawking in london

362
00:13:38,629 --> 00:13:37,040
at some event and his caretaker said

363
00:13:40,470 --> 00:13:38,639

would you mind saying something to

364

00:13:41,910 --> 00:13:40,480

stephen he's bored would you mind

365

00:13:44,710 --> 00:13:41,920

speaking to him

366

00:13:46,230 --> 00:13:44,720

and i went to stephen and said because

367

00:13:48,150 --> 00:13:46,240

everyone around was not really a

368

00:13:49,990 --> 00:13:48,160

scientist and so i went to him and said

369

00:13:51,910 --> 00:13:50,000

look we're about to inaugurate

370

00:13:54,069 --> 00:13:51,920

the black hole initiative black holes

371

00:13:56,310 --> 00:13:54,079

were the focus of his career

372

00:13:57,910 --> 00:13:56,320

and i said that we would love it if you

373

00:14:01,110 --> 00:13:57,920

were to come and visit us

374

00:14:01,750 --> 00:14:01,120

for the inauguration and then i left

375

00:14:03,670 --> 00:14:01,760

because

376

00:14:05,509 --> 00:14:03,680

it took him a long time to respond and i

377

00:14:07,509 --> 00:14:05,519

was not patient enough to wait like 10

378

00:14:09,670 --> 00:14:07,519

minutes for his response

379

00:14:10,629 --> 00:14:09,680

so i thought well nothing will happen as

380

00:14:14,310 --> 00:14:10,639

a result but then

381

00:14:16,389 --> 00:14:14,320

a few months later he asked his doctor

382

00:14:18,230 --> 00:14:16,399

to travel across the atlantic for the

383

00:14:19,430 --> 00:14:18,240

first time in four years and come to the

384

00:14:21,750 --> 00:14:19,440

inauguration

385

00:14:22,550 --> 00:14:21,760

the only problem was that this journey

386

00:14:25,509 --> 00:14:22,560

would cost

387

00:14:28,069 --> 00:14:25,519

half a million dollars but i found a way

388

00:14:31,189 --> 00:14:28,079

there was a way to get that funding

389

00:14:31,750 --> 00:14:31,199

and he came and he actually visited my

390

00:14:34,389 --> 00:14:31,760

house

391

00:14:35,110 --> 00:14:34,399

uh for passover he's not jewish but he

392

00:14:37,910 --> 00:14:35,120

came for that

393

00:14:39,350 --> 00:14:37,920

and it was quite remarkable uh to have

394

00:14:42,629 --> 00:14:39,360

him to host him

395

00:14:44,949 --> 00:14:42,639

at our home wow

396

00:14:45,750 --> 00:14:44,959

what a story that you'll always have to

397

00:14:47,509 --> 00:14:45,760

treasure

398

00:14:49,189 --> 00:14:47,519

i mean having stephen hawking in your

399

00:14:50,389 --> 00:14:49,199

home i i can't even imagine

400

00:14:52,629 --> 00:14:50,399

i can't even imagine what that would be

401
00:14:57,670 --> 00:14:52,639
like oh my gosh um

402
00:15:00,550 --> 00:14:57,680
well okay so let's move to 2017

403
00:15:02,310 --> 00:15:00,560
and this is when news broke of this

404
00:15:05,430 --> 00:15:02,320
object

405
00:15:07,350 --> 00:15:05,440
um and the whole world

406
00:15:08,870 --> 00:15:07,360
was talking about this whether it was in

407
00:15:11,110 --> 00:15:08,880
the world of science or

408
00:15:12,069 --> 00:15:11,120
or religion or um us in the

409
00:15:15,189 --> 00:15:12,079
quote-unquote

410
00:15:18,550 --> 00:15:15,199
ufo world ufo community

411
00:15:21,509 --> 00:15:18,560
and the possibility that oh my gosh

412
00:15:23,509 --> 00:15:21,519
this could be the first object to come

413
00:15:26,150 --> 00:15:23,519

into our solar system so

414

00:15:27,509 --> 00:15:26,160

i guess would you mind kind of walking

415

00:15:30,550 --> 00:15:27,519

us through those

416

00:15:31,509 --> 00:15:30,560

first moments avi of when it was

417

00:15:34,310 --> 00:15:31,519

discovered

418

00:15:36,069 --> 00:15:34,320

um you know we we heard about it later

419

00:15:38,310 --> 00:15:36,079

than when it was actually

420

00:15:41,430 --> 00:15:38,320

uh first discovered so could you kind of

421

00:15:44,389 --> 00:15:41,440

walk through the entire

422

00:15:45,749 --> 00:15:44,399

origin story if you will yes so it was

423

00:15:49,269 --> 00:15:45,759

spotted

424

00:15:53,269 --> 00:15:49,279

on october 19th 2017

425

00:15:57,269 --> 00:15:53,279

and by a telescope in hawaii

426

00:15:59,110 --> 00:15:57,279

on mount haleakala called pan stars

427

00:16:00,550 --> 00:15:59,120

and because it was discovered in hawaii

428

00:16:03,110 --> 00:16:00,560

it was given

429

00:16:03,749 --> 00:16:03,120

a name from the hawaiian language that

430

00:16:07,670 --> 00:16:03,759

means

431

00:16:10,710 --> 00:16:07,680

scout a messenger from far away

432

00:16:13,350 --> 00:16:10,720

that's the origin of the name and it's

433

00:16:13,990 --> 00:16:13,360

because the object is the very first one

434

00:16:17,110 --> 00:16:14,000

that we

435

00:16:19,430 --> 00:16:17,120

spotted from outside the solar system

436

00:16:22,150 --> 00:16:19,440

it was moving too fast to be bound to

437

00:16:23,990 --> 00:16:22,160

the sun that was recognized immediately

438

00:16:26,069 --> 00:16:24,000

that it's an interstellar object an

439

00:16:29,030 --> 00:16:26,079

invader of the

440

00:16:29,910 --> 00:16:29,040

solar system it was spotted only when it

441

00:16:32,629 --> 00:16:29,920

was

442

00:16:34,629 --> 00:16:32,639

moving away from us if we would have

443

00:16:37,590 --> 00:16:34,639

detected it in july

444

00:16:38,310 --> 00:16:37,600

that year at that time it was moving

445

00:16:42,069 --> 00:16:38,320

towards us

446

00:16:45,910 --> 00:16:42,079

as it turns out i was visiting

447

00:16:47,829 --> 00:16:45,920

that mountain in hawaii in maui we were

448

00:16:48,710 --> 00:16:47,839

on vacation with my family and we went

449

00:16:57,990 --> 00:16:48,720

to

450

00:17:01,030 --> 00:16:58,000

at that time we would have spotted it

451
00:17:01,590 --> 00:17:01,040
then it would have been possible uh to

452
00:17:04,870 --> 00:17:01,600
send

453
00:17:05,510 --> 00:17:04,880
a camera on a cubesat that will meet it

454
00:17:08,630 --> 00:17:05,520
halfway

455
00:17:10,870 --> 00:17:08,640
and take a photograph of it but since it

456
00:17:13,909 --> 00:17:10,880
was discovered only when it started the

457
00:17:15,510 --> 00:17:13,919
moving away from us uh it was too late

458
00:17:16,390 --> 00:17:15,520
it's sort of like having a guest for

459
00:17:17,990 --> 00:17:16,400
dinner

460
00:17:20,150 --> 00:17:18,000
and by the time you realize that the

461
00:17:22,069 --> 00:17:20,160
guest is strange or weird or

462
00:17:24,309 --> 00:17:22,079
interesting it's already out of the

463
00:17:27,429 --> 00:17:24,319

front door into the dark street

464

00:17:28,470 --> 00:17:27,439

that was the experience now why was it

465

00:17:31,190 --> 00:17:28,480

strange

466

00:17:32,870 --> 00:17:31,200

um at first astronomers thought it's

467

00:17:34,710 --> 00:17:32,880

just like any other rock

468

00:17:37,990 --> 00:17:34,720

that we have seen before in the solar

469

00:17:40,070 --> 00:17:38,000

system so most likely it's a comet

470

00:17:42,230 --> 00:17:40,080

and then the problem was that there was

471

00:17:43,270 --> 00:17:42,240

no cometary tail there was no trail of

472

00:17:47,110 --> 00:17:43,280

gas

473

00:17:50,310 --> 00:17:47,120

behind it as a result of evaporation of

474

00:17:51,110 --> 00:17:50,320

ice on its surface um so then people

475

00:17:53,590 --> 00:17:51,120

said oh

476
00:17:54,230 --> 00:17:53,600
well okay so it's not a comet but maybe

477
00:17:56,950 --> 00:17:54,240
it's just

478
00:17:58,230 --> 00:17:56,960
rock just an asteroid the problem with

479
00:18:01,750 --> 00:17:58,240
that was that

480
00:18:04,630 --> 00:18:01,760
it showed an extra push

481
00:18:06,390 --> 00:18:04,640
um in addition to the force of gravity

482
00:18:09,909 --> 00:18:06,400
coming from the sun

483
00:18:12,630 --> 00:18:09,919
and such a push is given to comets

484
00:18:14,630 --> 00:18:12,640
from the rocket effect from gases

485
00:18:16,710 --> 00:18:14,640
pushing them forward this the gas

486
00:18:17,750 --> 00:18:16,720
goes backwards and just like in a jet

487
00:18:21,750 --> 00:18:17,760
plane

488
00:18:24,070 --> 00:18:21,760

um so there is this extra push but we

489

00:18:26,390 --> 00:18:24,080

don't see a cometary tail so how what

490

00:18:28,230 --> 00:18:26,400

gives it this extra push the other

491

00:18:31,350 --> 00:18:28,240

peculiar fact was that

492

00:18:33,909 --> 00:18:31,360

the object was tumbling the brightness

493

00:18:35,669 --> 00:18:33,919

that we received from it uh as a result

494

00:18:38,070 --> 00:18:35,679

of reflected sunlight

495

00:18:40,230 --> 00:18:38,080

changed by a factor of ten and that

496

00:18:41,190 --> 00:18:40,240

meant that the area of the object on the

497

00:18:43,909 --> 00:18:41,200

sky

498

00:18:46,070 --> 00:18:43,919

was changing as it was spinning around

499

00:18:49,110 --> 00:18:46,080

was changing by a factor of 10

500

00:18:51,990 --> 00:18:49,120

every 8 hours and

501
00:18:53,669 --> 00:18:52,000
that means that its geometry is very

502
00:18:56,870 --> 00:18:53,679
extreme because even if you take

503
00:18:59,110 --> 00:18:56,880
a razor thin piece of paper and you let

504
00:19:02,789 --> 00:18:59,120
it tumble in the wind

505
00:19:05,190 --> 00:19:02,799
you don't see it edge on

506
00:19:07,350 --> 00:19:05,200
most of the time and a factor of 10

507
00:19:08,710 --> 00:19:07,360
changing the area of this piece of paper

508
00:19:11,750 --> 00:19:08,720
means that it really is

509
00:19:14,549 --> 00:19:11,760
quite flat and long

510
00:19:16,070 --> 00:19:14,559
now the the best fit to the amount of

511
00:19:19,190 --> 00:19:16,080
light that we received

512
00:19:20,390 --> 00:19:19,200
as it was tumbling is that of a from a

513
00:19:22,710 --> 00:19:20,400

pancake shape

514

00:19:24,789 --> 00:19:22,720

from a flattened object not from a cigar

515

00:19:26,150 --> 00:19:24,799

shaped object as it was depicted in many

516

00:19:28,630 --> 00:19:26,160

cartoons

517

00:19:30,710 --> 00:19:28,640

so we know that most likely it's a it

518

00:19:32,950 --> 00:19:30,720

was a flat object

519

00:19:34,630 --> 00:19:32,960

that was pushed by some force and you

520

00:19:36,390 --> 00:19:34,640

know we suggested in a paper that we

521

00:19:38,710 --> 00:19:36,400

wrote in a scientific paper with

522

00:19:39,510 --> 00:19:38,720

my postdoc will be ali we suggest that

523

00:19:41,909 --> 00:19:39,520

maybe

524

00:19:43,110 --> 00:19:41,919

it's the reflection of sunlight that

525

00:19:44,630 --> 00:19:43,120

pushed it

526

00:19:47,909 --> 00:19:44,640

and for that you need the object to be

527

00:19:50,710 --> 00:19:47,919

extremely thin sort of like a sail

528

00:19:52,789 --> 00:19:50,720

uh on a sailboat uh that is pushed by

529

00:19:55,029 --> 00:19:52,799

wind except here it's being pushed by

530

00:19:58,150 --> 00:19:55,039

the reflection of sunlight

531

00:19:59,590 --> 00:19:58,160

and if that is the case then it must be

532

00:20:01,909 --> 00:19:59,600

artificially produced

533

00:20:03,510 --> 00:20:01,919

because you don't get such objects in

534

00:20:05,830 --> 00:20:03,520

nature

535

00:20:07,990 --> 00:20:05,840

and so the suggestion was that just like

536

00:20:11,590 --> 00:20:08,000

our civilization is developing

537

00:20:13,669 --> 00:20:11,600

light sails for space exploration

538

00:20:15,350 --> 00:20:13,679

these are sails that are pushed by light

539

00:20:16,310 --> 00:20:15,360

where you don't need to carry the fuel

540

00:20:19,350 --> 00:20:16,320

with you

541

00:20:23,110 --> 00:20:19,360

in order to move the spacecraft

542

00:20:25,750 --> 00:20:23,120

perhaps another civilization already

543

00:20:26,549 --> 00:20:25,760

mastered this technology and or maybe

544

00:20:29,750 --> 00:20:26,559

it's some

545

00:20:30,149 --> 00:20:29,760

you know uh surface layer of spacecraft

546

00:20:33,270 --> 00:20:30,159

that

547

00:20:36,390 --> 00:20:33,280

was torn apart and we it's just the

548

00:20:39,830 --> 00:20:36,400

you know very thin i should say

549

00:20:42,310 --> 00:20:39,840

in september this year i mean 2020

550

00:20:43,270 --> 00:20:42,320

there was another object discovered that

551
00:20:46,230 --> 00:20:43,280
looked a bit

552
00:20:47,110 --> 00:20:46,240
strange in the sense that it also showed

553
00:20:50,630 --> 00:20:47,120
a push

554
00:20:53,830 --> 00:20:50,640
uh by sunlight uh and

555
00:20:55,909 --> 00:20:53,840
except that it was bound to the sun

556
00:20:58,070 --> 00:20:55,919
moving roughly at the orbit of the earth

557
00:21:00,149 --> 00:20:58,080
and so when astronomers

558
00:21:01,990 --> 00:21:00,159
uh extrapolated back in time they found

559
00:21:06,230 --> 00:21:02,000
that in 1966

560
00:21:08,230 --> 00:21:06,240
it actually came from the earth and

561
00:21:09,430 --> 00:21:08,240
then of course they went to the history

562
00:21:12,310 --> 00:21:09,440
books and found

563
00:21:13,430 --> 00:21:12,320

there was actually a lunar lander called

564

00:21:15,350 --> 00:21:13,440

surveyor 2

565

00:21:17,590 --> 00:21:15,360

a mission that actually failed but the

566

00:21:19,430 --> 00:21:17,600

rocket booster from that mission

567

00:21:21,350 --> 00:21:19,440

was kicked into space and that is the

568

00:21:23,909 --> 00:21:21,360

object that was discovered

569

00:21:26,549 --> 00:21:23,919

and that was a hollow very thin object

570

00:21:28,390 --> 00:21:26,559

and that's why it exhibited this push so

571

00:21:29,590 --> 00:21:28,400

we can tell the difference between a

572

00:21:31,590 --> 00:21:29,600

rock

573

00:21:33,029 --> 00:21:31,600

uh that cannot be pushed by sunlight

574

00:21:36,310 --> 00:21:33,039

because it's uh

575

00:21:38,149 --> 00:21:36,320

it's full i mean the area of of its

576

00:21:40,870 --> 00:21:38,159

surface relative to its weight

577

00:21:41,510 --> 00:21:40,880

is not big enough uh only for a very

578

00:21:44,149 --> 00:21:41,520

thin

579

00:21:45,270 --> 00:21:44,159

object you can get a push we can

580

00:21:48,549 --> 00:21:45,280

distinguish a rock

581

00:21:51,830 --> 00:21:48,559

from a hollow or a thin

582

00:21:55,590 --> 00:21:51,840

artificial object in the case of

583

00:21:58,950 --> 00:21:55,600

this rocket booster it was made by us

584

00:22:01,990 --> 00:21:58,960

in the case of umuamua who knows and

585

00:22:04,070 --> 00:22:02,000

who knows what the purpose was so

586

00:22:05,110 --> 00:22:04,080

you know we just put this possibility on

587

00:22:07,350 --> 00:22:05,120

the table

588

00:22:09,430 --> 00:22:07,360

and to me the most surprising thing is

589

00:22:12,230 --> 00:22:09,440

we didn't arrange for any press

590

00:22:13,510 --> 00:22:12,240

release or going to the press and then

591

00:22:16,549 --> 00:22:13,520

there was a huge

592

00:22:17,669 --> 00:22:16,559

a viral response from the media and at

593

00:22:19,830 --> 00:22:17,679

the same time

594

00:22:22,149 --> 00:22:19,840

a big push back from the scientific

595

00:22:24,230 --> 00:22:22,159

community there is a taboo

596

00:22:26,310 --> 00:22:24,240

you're not supposed to discuss an

597

00:22:29,590 --> 00:22:26,320

interpretation that relates

598

00:22:31,190 --> 00:22:29,600

some anomalies that you see to uh

599

00:22:33,270 --> 00:22:31,200

intelligence extraterrestrial

600

00:22:34,710 --> 00:22:33,280

intelligence right and the question is

601
00:22:37,990 --> 00:22:34,720
why today

602
00:22:39,350 --> 00:22:38,000
this is really um unjustified and i can

603
00:22:42,230 --> 00:22:39,360
explain why

604
00:22:43,270 --> 00:22:42,240
uh yeah well let's let's discuss that

605
00:22:46,390 --> 00:22:43,280
now you mentioned

606
00:22:48,470 --> 00:22:46,400
artificial and interstellar so i think a

607
00:22:49,909 --> 00:22:48,480
lot of people's minds would naturally go

608
00:22:52,870 --> 00:22:49,919
to

609
00:22:55,029 --> 00:22:52,880
alien and of course this is what the

610
00:22:57,590 --> 00:22:55,039
media is going to latch on to

611
00:22:59,430 --> 00:22:57,600
uh this is what the i would assume

612
00:23:02,710 --> 00:22:59,440
mainstream scientific community

613
00:23:04,310 --> 00:23:02,720

would push against so i mean

614

00:23:05,990 --> 00:23:04,320

i guess before we get into the

615

00:23:08,789 --> 00:23:06,000

possibilities of why

616

00:23:09,909 --> 00:23:08,799

this could be from a extraterrestrial

617

00:23:11,909 --> 00:23:09,919

intelligence

618

00:23:13,510 --> 00:23:11,919

what was the reception when you first

619

00:23:15,990 --> 00:23:13,520

published this paper by

620

00:23:18,310 --> 00:23:16,000

your peers and uh you know your

621

00:23:20,470 --> 00:23:18,320

colleagues and overall how did they

622

00:23:21,750 --> 00:23:20,480

respond to these these theories that you

623

00:23:23,909 --> 00:23:21,760

were bringing forth

624

00:23:26,549 --> 00:23:23,919

well the strange thing is that the the

625

00:23:28,630 --> 00:23:26,559

mainstream scientists

626
00:23:30,549 --> 00:23:28,640
came together and most of them said

627
00:23:32,710 --> 00:23:30,559
business as usual forget about it they

628
00:23:34,630 --> 00:23:32,720
wrote a big paper saying

629
00:23:36,470 --> 00:23:34,640
you know there are all these anomalies

630
00:23:38,070 --> 00:23:36,480
but in principle

631
00:23:40,230 --> 00:23:38,080
there might be a natural process that

632
00:23:41,909 --> 00:23:40,240
explains them but then a few

633
00:23:43,750 --> 00:23:41,919
of the mainstream people tried to

634
00:23:45,909 --> 00:23:43,760
explain these anomalies

635
00:23:47,669 --> 00:23:45,919
and they came up with something that we

636
00:23:50,390 --> 00:23:47,679
have never seen before

637
00:23:50,710 --> 00:23:50,400
they said oh maybe it's a dust bunny you

638
00:23:53,269 --> 00:23:50,720

know

639

00:23:55,350 --> 00:23:53,279

a collection of dust particles a very

640

00:23:57,430 --> 00:23:55,360

porous object that is sort of like a

641

00:24:00,070 --> 00:23:57,440

cloud you know very porous

642

00:24:01,029 --> 00:24:00,080

a hundred times less dense than air a

643

00:24:03,029 --> 00:24:01,039

cloud

644

00:24:04,310 --> 00:24:03,039

that is being pushed by sunlight that

645

00:24:06,310 --> 00:24:04,320

was one proposal

646

00:24:08,149 --> 00:24:06,320

the problem with that is such an object

647

00:24:10,230 --> 00:24:08,159

would not survive the journey

648

00:24:11,269 --> 00:24:10,240

most likely there was another proposal

649

00:24:14,470 --> 00:24:11,279

maybe it's a

650

00:24:15,269 --> 00:24:14,480

hydrogen iceberg we've never seen such a

651
00:24:17,990 --> 00:24:15,279
thing

652
00:24:18,310 --> 00:24:18,000
and in a paper that i wrote subsequently

653
00:24:20,950 --> 00:24:18,320
with

654
00:24:22,070 --> 00:24:20,960
a colleague of mine tim juan we showed

655
00:24:24,230 --> 00:24:22,080
that

656
00:24:26,230 --> 00:24:24,240
such an iceberg would evaporate very

657
00:24:27,029 --> 00:24:26,240
quickly it will not survive the journey

658
00:24:29,190 --> 00:24:27,039
as well

659
00:24:30,870 --> 00:24:29,200
so you can you can tell the people that

660
00:24:31,669 --> 00:24:30,880
thought about the anomalies and tried to

661
00:24:34,950 --> 00:24:31,679
explain them

662
00:24:35,830 --> 00:24:34,960
as a natural product of some natural

663
00:24:38,710 --> 00:24:35,840

process

664

00:24:39,430 --> 00:24:38,720

had a very difficult time doing that and

665

00:24:41,350 --> 00:24:39,440

yet

666

00:24:43,430 --> 00:24:41,360

the majority of people that didn't

667

00:24:46,149 --> 00:24:43,440

really look at the details

668

00:24:48,070 --> 00:24:46,159

were dismissing it and we're ridiculing

669

00:24:50,710 --> 00:24:48,080

the actual possibility

670

00:24:52,070 --> 00:24:50,720

that it might be artificial and and that

671

00:24:54,230 --> 00:24:52,080

i find

672

00:24:56,070 --> 00:24:54,240

inappropriate and unhealthy and i'll

673

00:24:58,630 --> 00:24:56,080

explain why because

674

00:25:01,350 --> 00:24:58,640

to me the existence of another

675

00:25:03,669 --> 00:25:01,360

civilization is not a speculation

676
00:25:05,350 --> 00:25:03,679
we know that roughly half of the

677
00:25:08,390 --> 00:25:05,360
sun-like stars

678
00:25:10,549 --> 00:25:08,400
have a planet of the size of the earth

679
00:25:12,549 --> 00:25:10,559
roughly the distance of the earth from

680
00:25:13,750 --> 00:25:12,559
the sun so that it can have liquid water

681
00:25:15,830 --> 00:25:13,760
on the surface and the

682
00:25:17,029 --> 00:25:15,840
chemistry of life as we know it so there

683
00:25:19,830 --> 00:25:17,039
are billions of such

684
00:25:21,430 --> 00:25:19,840
earth sun systems in the milky way

685
00:25:23,909 --> 00:25:21,440
galaxy alone

686
00:25:25,029 --> 00:25:23,919
and what's you know if you arrange for

687
00:25:26,789 --> 00:25:25,039
the same

688
00:25:28,070 --> 00:25:26,799

circumstances what's the chance that you

689

00:25:30,549 --> 00:25:28,080

will not get the same

690

00:25:31,350 --> 00:25:30,559

outcome if you roll the dice billions of

691

00:25:34,149 --> 00:25:31,360

times

692

00:25:34,870 --> 00:25:34,159

you know you definitely should have a

693

00:25:37,350 --> 00:25:34,880

lot of

694

00:25:39,510 --> 00:25:37,360

results you know systems in which you

695

00:25:41,029 --> 00:25:39,520

have life as we know it

696

00:25:42,789 --> 00:25:41,039

i would find that to be the most

697

00:25:46,230 --> 00:25:42,799

conservative

698

00:25:48,950 --> 00:25:46,240

uh assumption to say we are not special

699

00:25:50,549 --> 00:25:48,960

we are very common you know when my

700

00:25:52,149 --> 00:25:50,559

daughters were young

701
00:25:54,149 --> 00:25:52,159
they thought that the world centers of

702
00:25:54,870 --> 00:25:54,159
them on them that they are very unique

703
00:25:56,470 --> 00:25:54,880
and special

704
00:25:58,310 --> 00:25:56,480
then they went to the street and saw

705
00:26:00,230 --> 00:25:58,320
other kids and

706
00:26:02,870 --> 00:26:00,240
then as a result of that they got a

707
00:26:04,310 --> 00:26:02,880
better perspective and matured

708
00:26:07,029 --> 00:26:04,320
many of my colleagues and our

709
00:26:09,430 --> 00:26:07,039
civilization is not mature yet

710
00:26:11,510 --> 00:26:09,440
many of the people think that we are

711
00:26:14,630 --> 00:26:11,520
unique and special

712
00:26:17,269 --> 00:26:14,640
and the only way to change that

713
00:26:17,830 --> 00:26:17,279

misconception is to find evidence for

714

00:26:21,430 --> 00:26:17,840

others

715

00:26:23,350 --> 00:26:21,440

out there and i i

716

00:26:25,510 --> 00:26:23,360

not only believe that that we are not

717

00:26:26,149 --> 00:26:25,520

alone but i don't think that we are the

718

00:26:28,310 --> 00:26:26,159

sharpest

719

00:26:29,510 --> 00:26:28,320

cookie in the jar that we are the

720

00:26:31,669 --> 00:26:29,520

smartest kid on the

721

00:26:33,669 --> 00:26:31,679

block you know that we are probably

722

00:26:34,070 --> 00:26:33,679

typical and there are things that are

723

00:26:36,950 --> 00:26:34,080

much

724

00:26:37,750 --> 00:26:36,960

smarter than we are because you know if

725

00:26:40,390 --> 00:26:37,760

you open the

726

00:26:41,029 --> 00:26:40,400

newspaper every morning you know humans

727

00:26:43,430 --> 00:26:41,039

may

728

00:26:44,630 --> 00:26:43,440

make a lot of mistakes we waste a lot of

729

00:26:47,190 --> 00:26:44,640

time and

730

00:26:48,789 --> 00:26:47,200

energy and money fighting each other

731

00:26:50,310 --> 00:26:48,799

doing things that are not necessarily

732

00:26:53,830 --> 00:26:50,320

for the better

733

00:26:55,029 --> 00:26:53,840

good of everyone uh so we we certainly

734

00:26:57,669 --> 00:26:55,039

do not behave as

735

00:26:58,870 --> 00:26:57,679

as the smartest you know kid on the

736

00:27:00,310 --> 00:26:58,880

block and

737

00:27:02,070 --> 00:27:00,320

and you know if you just think about it

738

00:27:04,470 --> 00:27:02,080

if you look at recipe books for

739

00:27:06,630 --> 00:27:04,480

for cakes and you can see that out of

740

00:27:08,230 --> 00:27:06,640

the same ingredients you can make

741

00:27:10,149 --> 00:27:08,240

very different cakes depending on how

742

00:27:12,070 --> 00:27:10,159

you mix them and

743

00:27:13,990 --> 00:27:12,080

under which condition and what order and

744

00:27:15,029 --> 00:27:14,000

so forth so what's the chance that if

745

00:27:17,830 --> 00:27:15,039

you take the

746

00:27:18,389 --> 00:27:17,840

soup of chemicals that was on earth that

747

00:27:23,269 --> 00:27:18,399

by

748

00:27:26,389 --> 00:27:23,279

chance that we are the

749

00:27:27,269 --> 00:27:26,399

the best cake that you can imagine very

750

00:27:29,830 --> 00:27:27,279

small

751
00:27:30,470 --> 00:27:29,840
so we are one of those typical cakes you

752
00:27:32,149 --> 00:27:30,480
know there are

753
00:27:33,669 --> 00:27:32,159
cakes that are much more intelligent

754
00:27:36,549 --> 00:27:33,679
much better than us

755
00:27:38,149 --> 00:27:36,559
in many respects i'm sure uh and we just

756
00:27:39,750 --> 00:27:38,159
need to find evidence for them now of

757
00:27:41,029 --> 00:27:39,760
course you can bury your head in the

758
00:27:43,190 --> 00:27:41,039
sand and say

759
00:27:44,230 --> 00:27:43,200
i don't want to talk about it i don't

760
00:27:46,870 --> 00:27:44,240
want to

761
00:27:49,110 --> 00:27:46,880
consider that possibility that will only

762
00:27:51,990 --> 00:27:49,120
maintain your ignorance

763
00:27:53,990 --> 00:27:52,000

but reality will not go away yeah

764

00:27:57,269 --> 00:27:54,000

absolutely and you know uh

765

00:28:00,870 --> 00:27:57,279

we're so young as a species as a planet

766

00:28:04,149 --> 00:28:00,880

and i i i tend to agree with you that

767

00:28:06,950 --> 00:28:04,159

we base everything obvious seems in

768

00:28:08,070 --> 00:28:06,960

uh the sort of mainstream perception of

769

00:28:10,549 --> 00:28:08,080

science on

770

00:28:11,750 --> 00:28:10,559

uh our limitations here on our planet

771

00:28:14,710 --> 00:28:11,760

our limitation

772

00:28:16,149 --> 00:28:14,720

of our own physics our own uh dynamics

773

00:28:19,190 --> 00:28:16,159

our own science

774

00:28:22,149 --> 00:28:19,200

where the possibilities are literally

775

00:28:22,950 --> 00:28:22,159

endless of what kind of life could be

776

00:28:25,430 --> 00:28:22,960

out there

777

00:28:26,389 --> 00:28:25,440

how it originated how it thrives and how

778

00:28:30,549 --> 00:28:26,399

it survives

779

00:28:31,269 --> 00:28:30,559

so right it may be very different than

780

00:28:33,269 --> 00:28:31,279

we are

781

00:28:35,350 --> 00:28:33,279

you know when you go on a blind date

782

00:28:37,269 --> 00:28:35,360

it's a fair assumption to assume that

783

00:28:39,510 --> 00:28:37,279

the person you would meet would not be

784

00:28:40,549 --> 00:28:39,520

very different from you because we share

785

00:28:43,669 --> 00:28:40,559

a common

786

00:28:46,710 --> 00:28:43,679

genetic heritage you know all humans

787

00:28:48,149 --> 00:28:46,720

but when you meet life from another

788

00:28:52,070 --> 00:28:48,159

place that had nothing

789

00:28:53,990 --> 00:28:52,080

in common with us you know it could be

790

00:28:56,789 --> 00:28:54,000

very different and the technologies

791

00:28:59,990 --> 00:28:56,799

could be much more advanced than ours

792

00:29:03,510 --> 00:29:00,000

that they would look like magic for us

793

00:29:05,750 --> 00:29:03,520

uh but the lesson from is

794

00:29:06,630 --> 00:29:05,760

similar to what i experienced when i go

795

00:29:08,789 --> 00:29:06,640

on vacation

796

00:29:11,029 --> 00:29:08,799

on a beach you know most of the time i

797

00:29:12,870 --> 00:29:11,039

see seashells that

798

00:29:14,310 --> 00:29:12,880

were swept ashore and each of them looks

799

00:29:15,269 --> 00:29:14,320

different and they were naturally

800

00:29:17,590 --> 00:29:15,279

produced

801
00:29:19,110 --> 00:29:17,600
but every now and then i stumble across

802
00:29:20,870 --> 00:29:19,120
a plastic bottle

803
00:29:23,110 --> 00:29:20,880
that implies that there is a

804
00:29:26,389 --> 00:29:23,120
civilization out there that produced it

805
00:29:29,190 --> 00:29:26,399
it's an artificially made object and

806
00:29:31,110 --> 00:29:29,200
my point is rather than just looking for

807
00:29:34,549 --> 00:29:31,120
radio signals from space

808
00:29:36,789 --> 00:29:34,559
we might check objects that come to us

809
00:29:38,630 --> 00:29:36,799
from outside the solar system

810
00:29:40,470 --> 00:29:38,640
and perhaps we'll find a message in a

811
00:29:45,110 --> 00:29:40,480
bottle so

812
00:29:48,070 --> 00:29:45,120
the search for um other civilizations

813
00:29:49,029 --> 00:29:48,080

could go in many different directions

814

00:29:53,269 --> 00:29:49,039

it's possible

815

00:29:57,269 --> 00:29:53,279

that many of those civilizations that

816

00:29:58,470 --> 00:29:57,279

existed are not around anymore that they

817

00:29:59,909 --> 00:29:58,480

are dead by now

818

00:30:03,350 --> 00:29:59,919

but that doesn't mean that we cannot

819

00:30:05,830 --> 00:30:03,360

find evidence for their existence

820

00:30:07,029 --> 00:30:05,840

we could search just as we do

821

00:30:09,190 --> 00:30:07,039

archaeology

822

00:30:10,789 --> 00:30:09,200

where we dig into the ground and find

823

00:30:12,310 --> 00:30:10,799

evidence for

824

00:30:14,549 --> 00:30:12,320

civilizations that are not around

825

00:30:16,870 --> 00:30:14,559

anymore uh we can do

826

00:30:17,830 --> 00:30:16,880

the same thing in space uh you know

827

00:30:21,350 --> 00:30:17,840

finding

828

00:30:23,190 --> 00:30:21,360

planets with burnt up surfaces that

829

00:30:25,269 --> 00:30:23,200

where the civilization did not take good

830

00:30:28,549 --> 00:30:25,279

care of of its climate or

831

00:30:30,710 --> 00:30:28,559

or went into a nuclear war or so we can

832

00:30:32,070 --> 00:30:30,720

find artifacts that are left behind

833

00:30:34,070 --> 00:30:32,080

we can find evidence for dead

834

00:30:35,830 --> 00:30:34,080

civilizations as well and

835

00:30:37,830 --> 00:30:35,840

and that would teach us an important

836

00:30:40,549 --> 00:30:37,840

lesson to behave better

837

00:30:41,830 --> 00:30:40,559

so that we will not share the same fate

838

00:30:44,710 --> 00:30:41,840

all together i think

839

00:30:46,310 --> 00:30:44,720

we can learn from the sky okay if we see

840

00:30:48,549 --> 00:30:46,320

evidence for other

841

00:30:49,750 --> 00:30:48,559

civilizations out there we can learn

842

00:30:51,590 --> 00:30:49,760

from them uh

843

00:30:53,510 --> 00:30:51,600

if we see a technology that we can

844

00:30:56,549 --> 00:30:53,520

import to earth

845

00:30:59,509 --> 00:30:56,559

it it would be huge you know and

846

00:31:01,190 --> 00:30:59,519

it could be very uh profitable you know

847

00:31:02,789 --> 00:31:01,200

instead of going to wall street or the

848

00:31:04,710 --> 00:31:02,799

silicon valley if you learn something

849

00:31:06,789 --> 00:31:04,720

from the sky looking at the sky

850

00:31:08,389 --> 00:31:06,799

you can make a lot of money out of that

851
00:31:12,470 --> 00:31:08,399
right and i think you know

852
00:31:15,669 --> 00:31:12,480
the technology that we see displayed by

853
00:31:19,350 --> 00:31:15,679
uh i'm talking about those who

854
00:31:21,350 --> 00:31:19,360
who claim to have seen unidentified

855
00:31:23,990 --> 00:31:21,360
aerial phenomena here on earth

856
00:31:25,590 --> 00:31:24,000
the technology being displayed by these

857
00:31:28,230 --> 00:31:25,600
craft or these

858
00:31:30,389 --> 00:31:28,240
anomalies or phenomena if we could

859
00:31:32,710 --> 00:31:30,399
harness that technology like you said i

860
00:31:34,789 --> 00:31:32,720
can only imagine how it could benefit

861
00:31:35,909 --> 00:31:34,799
humanity instead of being weaponized

862
00:31:39,750 --> 00:31:35,919
instead of being

863
00:31:41,190 --> 00:31:39,760

uh you know used for for bad or for

864

00:31:43,590 --> 00:31:41,200

destruction like you said

865

00:31:45,190 --> 00:31:43,600

a fake that we might have someday that

866

00:31:48,470 --> 00:31:45,200

another civilization had

867

00:31:54,789 --> 00:31:50,950

yes i should add to what you just said

868

00:31:57,110 --> 00:31:54,799

um i i participated in a debate about

869

00:31:57,990 --> 00:31:57,120

uh just a month and a half ago about the

870

00:32:00,710 --> 00:31:58,000

question of

871

00:32:02,070 --> 00:32:00,720

whether the space race between the us

872

00:32:05,430 --> 00:32:02,080

and china

873

00:32:08,630 --> 00:32:05,440

is uh good for humanity and

874

00:32:10,149 --> 00:32:08,640

all of the debaters uh were focusing on

875

00:32:12,070 --> 00:32:10,159

the military threat

876

00:32:13,590 --> 00:32:12,080

from space so if there is this race

877

00:32:15,750 --> 00:32:13,600

between china and the us

878

00:32:17,190 --> 00:32:15,760

you know it brings the risk to national

879

00:32:18,630 --> 00:32:17,200

security and so forth

880

00:32:20,710 --> 00:32:18,640

and i just couldn't understand it

881

00:32:22,310 --> 00:32:20,720

because space is all about going away

882

00:32:22,710 --> 00:32:22,320

from earth in the third dimension you

883

00:32:25,029 --> 00:32:22,720

know

884

00:32:26,789 --> 00:32:25,039

uh you don't just hover above the

885

00:32:28,789 --> 00:32:26,799

surface of the earth that's not

886

00:32:30,389 --> 00:32:28,799

where most of the space is it's very far

887

00:32:32,630 --> 00:32:30,399

away it's going to mars

888

00:32:33,750 --> 00:32:32,640

it's going to another star and there is

889

00:32:36,389 --> 00:32:33,760

no military risk

890

00:32:37,990 --> 00:32:36,399

from that if you go very far from earth

891

00:32:38,710 --> 00:32:38,000

you're not risking what's going on on

892

00:32:42,070 --> 00:32:38,720

earth

893

00:32:44,230 --> 00:32:42,080

and then to me it was very narrow minded

894

00:32:45,509 --> 00:32:44,240

the view to think about space as a

895

00:32:47,269 --> 00:32:45,519

military threat

896

00:32:49,190 --> 00:32:47,279

you know it's actually it's the one

897

00:32:51,590 --> 00:32:49,200

thing that can unify

898

00:32:52,789 --> 00:32:51,600

us you know we can have an ambition

899

00:32:56,549 --> 00:32:52,799

going to space

900

00:32:59,350 --> 00:32:56,559

um that will benefit the global economy

901
00:33:01,990 --> 00:32:59,360
so rather than fighting among each other

902
00:33:04,950 --> 00:33:02,000
space i think could be a unifier

903
00:33:06,710 --> 00:33:04,960
right and that kind of connects to uh my

904
00:33:10,470 --> 00:33:06,720
last question here in terms

905
00:33:15,590 --> 00:33:13,509
and what these are possible artificial

906
00:33:16,710 --> 00:33:15,600
objects could be coming into our solar

907
00:33:19,350 --> 00:33:16,720
system is

908
00:33:21,029 --> 00:33:19,360
techno signatures avi i know you've um

909
00:33:21,909 --> 00:33:21,039
you've done heavy research on this in

910
00:33:25,029 --> 00:33:21,919
the past

911
00:33:27,350 --> 00:33:25,039
as well um we covered this on a website

912
00:33:29,190 --> 00:33:27,360
i worked for called the debrief recently

913
00:33:31,750 --> 00:33:29,200

as well uh scientists

914

00:33:32,230 --> 00:33:31,760

members of seti now working in this

915

00:33:35,029 --> 00:33:32,240

field

916

00:33:36,870 --> 00:33:35,039

of techno signatures so for any of our

917

00:33:37,350 --> 00:33:36,880

audience who might not be familiar with

918

00:33:39,269 --> 00:33:37,360

what this

919

00:33:40,789 --> 00:33:39,279

is could you maybe give us kind of the

920

00:33:43,750 --> 00:33:40,799

clip notes version of

921

00:33:45,750 --> 00:33:43,760

what techno signatures is and uh i guess

922

00:33:48,470 --> 00:33:45,760

how it could benefit our search for

923

00:33:49,750 --> 00:33:48,480

extraterrestrial intelligence yeah so

924

00:33:51,909 --> 00:33:49,760

let me

925

00:33:52,870 --> 00:33:51,919

give you an example that will illustrate

926
00:33:56,149 --> 00:33:52,880
the point

927
00:33:58,149 --> 00:33:56,159
uh astronomers are willing to

928
00:34:00,230 --> 00:33:58,159
invest hundreds of millions of dollars

929
00:34:04,310 --> 00:34:00,240
or even billions of dollars

930
00:34:08,149 --> 00:34:04,320
in the next generation of telescopes

931
00:34:10,950 --> 00:34:08,159
that would search for oxygen

932
00:34:12,389 --> 00:34:10,960
in the atmospheres of planets around

933
00:34:17,270 --> 00:34:12,399
other stars

934
00:34:20,950 --> 00:34:19,589
produces oxygen that's a signature of

935
00:34:24,230 --> 00:34:20,960
life

936
00:34:27,190 --> 00:34:24,240
the problem with that argument is that

937
00:34:27,990 --> 00:34:27,200
in the first two billion years of earth

938
00:34:30,950 --> 00:34:28,000

roughly

939

00:34:33,669 --> 00:34:30,960

half of its half of the life of of the

940

00:34:37,750 --> 00:34:36,550

was spent with the atmosphere having

941

00:34:39,349 --> 00:34:37,760

very little oxygen

942

00:34:41,750 --> 00:34:39,359

in it even though there was life on

943

00:34:43,430 --> 00:34:41,760

earth in the first two billion years

944

00:34:45,990 --> 00:34:43,440

the level of oxygen in the atmosphere

945

00:34:47,349 --> 00:34:46,000

was very low so you can have live

946

00:34:49,589 --> 00:34:47,359

microbial life

947

00:34:50,389 --> 00:34:49,599

on a planet without oxygen in the

948

00:34:53,270 --> 00:34:50,399

atmosphere

949

00:34:53,990 --> 00:34:53,280

we know it from earth another point is

950

00:34:56,710 --> 00:34:54,000

that you can make

951
00:34:57,589 --> 00:34:56,720
oxygen by natural processes you can

952
00:35:00,790 --> 00:34:57,599
break

953
00:35:01,589 --> 00:35:00,800
water molecules and make oxygen so it

954
00:35:04,470 --> 00:35:01,599
wouldn't be

955
00:35:06,150 --> 00:35:04,480
really conclusive but does the

956
00:35:07,430 --> 00:35:06,160
mainstream of astronomy is willing to

957
00:35:10,550 --> 00:35:07,440
invest a huge

958
00:35:14,470 --> 00:35:10,560
sum of money pursuing that signature

959
00:35:16,550 --> 00:35:14,480
my point is simple there is actually

960
00:35:18,470 --> 00:35:16,560
the same instruments can actually detect

961
00:35:19,349 --> 00:35:18,480
something that will tell you beyond any

962
00:35:22,790 --> 00:35:19,359
doubt

963
00:35:25,750 --> 00:35:22,800

that there is life if they detect

964

00:35:27,270 --> 00:35:25,760

cfcs these are molecules that indicate

965

00:35:29,190 --> 00:35:27,280

industrial pollution

966

00:35:30,470 --> 00:35:29,200

that we for example produce here on

967

00:35:33,710 --> 00:35:30,480

earth

968

00:35:38,230 --> 00:35:33,720

these cfcs are molecules produced by

969

00:35:42,310 --> 00:35:38,240

refrigerating systems by industries

970

00:35:44,550 --> 00:35:42,320

that deplete the ozone layer on earth

971

00:35:47,349 --> 00:35:44,560

this industrial pollution can be looked

972

00:35:49,190 --> 00:35:47,359

for by the same telescopes

973

00:35:51,349 --> 00:35:49,200

yet the mainstream of the astronomy

974

00:35:53,589 --> 00:35:51,359

community is not discussing them at

975

00:35:55,109 --> 00:35:53,599

all so i wrote a paper about five years

976
00:35:57,829 --> 00:35:55,119
ago talking about

977
00:35:58,630 --> 00:35:57,839
searching for industrial pollution what

978
00:36:00,550 --> 00:35:58,640
is the pro i mean

979
00:36:02,550 --> 00:36:00,560
we are using the same instruments we

980
00:36:05,109 --> 00:36:02,560
just have to open our mind

981
00:36:05,750 --> 00:36:05,119
to the possibility that industrial

982
00:36:08,870 --> 00:36:05,760
pollution

983
00:36:11,589 --> 00:36:08,880
exists on exoplanets and

984
00:36:13,030 --> 00:36:11,599
once we do that if we detect it that

985
00:36:15,510 --> 00:36:13,040
would be

986
00:36:16,230 --> 00:36:15,520
beyond any doubt an indication for life

987
00:36:18,950 --> 00:36:16,240
because

988
00:36:21,670 --> 00:36:18,960

such molecules are so complex that they

989

00:36:23,589 --> 00:36:21,680

cannot be produced by natural processes

990

00:36:25,670 --> 00:36:23,599

so here is an example of a techno

991

00:36:29,109 --> 00:36:25,680

signature a signature that is

992

00:36:30,069 --> 00:36:29,119

a marker of technology that would

993

00:36:32,630 --> 00:36:30,079

indicate

994

00:36:34,069 --> 00:36:32,640

that an industrial civilization exists

995

00:36:36,870 --> 00:36:34,079

on a planet

996

00:36:37,589 --> 00:36:36,880

that's one example you can think of for

997

00:36:40,870 --> 00:36:37,599

example

998

00:36:44,150 --> 00:36:40,880

uh seeing evidence for photovoltaic

999

00:36:46,790 --> 00:36:44,160

cells on the surface of a planet or

1000

00:36:47,750 --> 00:36:46,800

artificial illumination of the surface

1001
00:36:51,430 --> 00:36:47,760
of a planet

1002
00:36:52,230 --> 00:36:51,440
both subjects on which i i wrote the

1003
00:36:54,470 --> 00:36:52,240
papers

1004
00:36:55,750 --> 00:36:54,480
uh you can think of megastructures

1005
00:36:58,550 --> 00:36:55,760
things that are big

1006
00:36:59,430 --> 00:36:58,560
that do not look like planets you can

1007
00:37:02,790 --> 00:36:59,440
think about the

1008
00:37:05,030 --> 00:37:02,800
satellites orbiting a planet uh

1009
00:37:06,470 --> 00:37:05,040
you know for example spacex is planning

1010
00:37:08,390 --> 00:37:06,480
to launch

1011
00:37:09,670 --> 00:37:08,400
tens of thousands of communication

1012
00:37:12,470 --> 00:37:09,680
satellites

1013
00:37:13,349 --> 00:37:12,480

in the next few years and uh you can

1014

00:37:15,109 --> 00:37:13,359

imagine that

1015

00:37:16,630 --> 00:37:15,119

in the distant future there would be

1016

00:37:18,550 --> 00:37:16,640

even more and

1017

00:37:21,349 --> 00:37:18,560

the question is can we detect evidence

1018

00:37:22,710 --> 00:37:21,359

for so many a swarm of satellites around

1019

00:37:25,109 --> 00:37:22,720

the planet

1020

00:37:26,230 --> 00:37:25,119

so all of these are technological

1021

00:37:28,550 --> 00:37:26,240

signatures that

1022

00:37:30,230 --> 00:37:28,560

you know we can search for if we only

1023

00:37:32,390 --> 00:37:30,240

open our mind

1024

00:37:33,750 --> 00:37:32,400

and the problem is really when you're

1025

00:37:36,390 --> 00:37:33,760

not open-minded

1026
00:37:38,470 --> 00:37:36,400
to find wonderful things things that you

1027
00:37:41,670 --> 00:37:38,480
don't expect necessarily

1028
00:37:42,870 --> 00:37:41,680
you will never discover them so it's a

1029
00:37:44,630 --> 00:37:42,880
catch

1030
00:37:45,910 --> 00:37:44,640
if the mainstream of the astronomy

1031
00:37:48,630 --> 00:37:45,920
community

1032
00:37:51,109 --> 00:37:48,640
is bullying and dismissing even a

1033
00:37:53,430 --> 00:37:51,119
discussion on the possibility that um

1034
00:37:54,950 --> 00:37:53,440
was artificial or that there are these

1035
00:37:57,589 --> 00:37:54,960
civilizations out there

1036
00:37:59,190 --> 00:37:57,599
if they say it's never aliens like the

1037
00:38:01,109 --> 00:37:59,200
if you go to twitter you'll find it a

1038
00:38:04,230 --> 00:38:01,119

lot of times being said

1039

00:38:06,390 --> 00:38:04,240

it's never don't talk about it and they

1040

00:38:07,910 --> 00:38:06,400

you know a lot of people ridicule anyone

1041

00:38:09,829 --> 00:38:07,920

that discusses this

1042

00:38:11,510 --> 00:38:09,839

then of course young people will worry

1043

00:38:13,190 --> 00:38:11,520

about their job prospects they will

1044

00:38:16,230 --> 00:38:13,200

never enter this field

1045

00:38:19,510 --> 00:38:16,240

you will never have fresh talent

1046

00:38:21,109 --> 00:38:19,520

working on these subjects and it will

1047

00:38:24,390 --> 00:38:21,119

never be funded

1048

00:38:27,430 --> 00:38:24,400

so it's a self-fulfilling prophecy you

1049

00:38:29,030 --> 00:38:27,440

you know all these no sayers they will

1050

00:38:30,630 --> 00:38:29,040

look at it and say oh look there is

1051
00:38:32,470 --> 00:38:30,640
nothing being found of course there is

1052
00:38:34,470 --> 00:38:32,480
nothing being found if you don't fund

1053
00:38:36,230 --> 00:38:34,480
the search and if you don't allow young

1054
00:38:39,750 --> 00:38:36,240
people to get into it because

1055
00:38:40,630 --> 00:38:39,760
of the uh intellectual climate that

1056
00:38:43,589 --> 00:38:40,640
suppresses

1057
00:38:45,349 --> 00:38:43,599
it then there will never be progress

1058
00:38:46,230 --> 00:38:45,359
it's just like burying your head in the

1059
00:38:48,390 --> 00:38:46,240
sand

1060
00:38:50,470 --> 00:38:48,400
and my point is that the public is

1061
00:38:53,430 --> 00:38:50,480
extremely interested in this question

1062
00:38:54,870 --> 00:38:53,440
the public is funding science how dare

1063
00:38:56,790 --> 00:38:54,880

the scientists say

1064

00:38:59,030 --> 00:38:56,800

we have the technology to search for

1065

00:39:02,310 --> 00:38:59,040

such things but we don't want to discuss

1066

00:39:04,950 --> 00:39:02,320

it i think it's completely inappropriate

1067

00:39:06,550 --> 00:39:04,960

if the public is interested and the

1068

00:39:07,829 --> 00:39:06,560

science community can address this

1069

00:39:10,870 --> 00:39:07,839

subject

1070

00:39:14,550 --> 00:39:10,880

it should be mainstream and then when

1071

00:39:17,829 --> 00:39:14,560

you look at the theoretical physics

1072

00:39:19,990 --> 00:39:17,839

right now a huge community of very

1073

00:39:23,270 --> 00:39:20,000

talented young people

1074

00:39:25,589 --> 00:39:23,280

work on concepts that have no

1075

00:39:26,630 --> 00:39:25,599

connection to reality no experimental

1076

00:39:29,670 --> 00:39:26,640

verification

1077

00:39:31,589 --> 00:39:29,680

they work on extra dimensions they work

1078

00:39:33,670 --> 00:39:31,599

on string theory

1079

00:39:35,349 --> 00:39:33,680

and you know many popularizers of

1080

00:39:37,190 --> 00:39:35,359

science talk about

1081

00:39:39,109 --> 00:39:37,200

you know the frontier of physics is

1082

00:39:40,630 --> 00:39:39,119

extra dimensions the frontier of physics

1083

00:39:42,390 --> 00:39:40,640

is string theory

1084

00:39:45,190 --> 00:39:42,400

but these are concepts for which there

1085

00:39:47,670 --> 00:39:45,200

is no experimental evidence

1086

00:39:49,510 --> 00:39:47,680

and they have been working on these for

1087

00:39:51,349 --> 00:39:49,520

several decades

1088

00:39:52,790 --> 00:39:51,359

and my point is if that is the

1089

00:39:54,870 --> 00:39:52,800

mainstream for which

1090

00:39:56,310 --> 00:39:54,880

awards are given for which you can get a

1091

00:39:58,230 --> 00:39:56,320

job

1092

00:39:59,349 --> 00:39:58,240

then something is distorted in the cut

1093

00:40:02,230 --> 00:39:59,359

scientific culture

1094

00:40:02,710 --> 00:40:02,240

because there is a significant component

1095

00:40:04,550 --> 00:40:02,720

of

1096

00:40:05,910 --> 00:40:04,560

the theoretical physics community

1097

00:40:07,270 --> 00:40:05,920

working on things

1098

00:40:09,750 --> 00:40:07,280

that the public doesn't really

1099

00:40:13,510 --> 00:40:09,760

understand that have no connection to

1100

00:40:16,550 --> 00:40:13,520

reality because they were never tested

1101

00:40:18,870 --> 00:40:16,560

whereas the same mainstream community is

1102

00:40:19,829 --> 00:40:18,880

dismissing a subject that is of interest

1103

00:40:22,790 --> 00:40:19,839

to the public

1104

00:40:23,829 --> 00:40:22,800

and on which we can get data so how can

1105

00:40:25,750 --> 00:40:23,839

you have both things

1106

00:40:27,750 --> 00:40:25,760

at the same time that makes no sense

1107

00:40:31,030 --> 00:40:27,760

something is unhealthy

1108

00:40:31,670 --> 00:40:31,040

in the current culture of theoretical

1109

00:40:35,109 --> 00:40:31,680

physics

1110

00:40:38,150 --> 00:40:35,119

and you know i am just

1111

00:40:38,950 --> 00:40:38,160

straightforward in that i'm saying these

1112

00:40:43,030 --> 00:40:38,960

things

1113

00:40:45,030 --> 00:40:43,040

based on what i see and

1114

00:40:46,630 --> 00:40:45,040

of course that will not be a popular

1115

00:40:48,470 --> 00:40:46,640

view because all these people that work

1116

00:40:51,589 --> 00:40:48,480

on these things will

1117

00:40:53,829 --> 00:40:51,599

you know push back

1118

00:40:54,950 --> 00:40:53,839

but but that's the truth if you ask

1119

00:40:56,710 --> 00:40:54,960

people practitioners

1120

00:40:58,309 --> 00:40:56,720

they will tell you that's the reality of

1121

00:40:59,990 --> 00:40:58,319

the of the situation and

1122

00:41:01,430 --> 00:41:00,000

and this is unfortunate especially for

1123

00:41:03,510 --> 00:41:01,440

young people because

1124

00:41:05,190 --> 00:41:03,520

you want young people to be independent

1125

00:41:06,150 --> 00:41:05,200

to think about things for which you can

1126

00:41:08,550 --> 00:41:06,160

get data

1127

00:41:09,910 --> 00:41:08,560

and to be excited about it so that we

1128

00:41:12,550 --> 00:41:09,920

can make progress you know

1129

00:41:13,510 --> 00:41:12,560

quantum mechanics and a central pillar

1130

00:41:16,069 --> 00:41:13,520

of physics

1131

00:41:17,589 --> 00:41:16,079

was never imagined until experiments

1132

00:41:20,710 --> 00:41:17,599

told us that it exists

1133

00:41:21,589 --> 00:41:20,720

so what how can we think that we will

1134

00:41:25,030 --> 00:41:21,599

come up with

1135

00:41:26,870 --> 00:41:25,040

the correct notion of nature just by

1136

00:41:28,390 --> 00:41:26,880

you know sitting in our offices without

1137

00:41:30,309 --> 00:41:28,400

any experimental feedback

1138

00:41:32,230 --> 00:41:30,319

you know physics is a dialogue with

1139

00:41:33,430 --> 00:41:32,240

nature you have to listen to nature you

1140

00:41:35,270 --> 00:41:33,440

have to see

1141

00:41:37,510 --> 00:41:35,280

what nature tells you it's a learning

1142

00:41:39,430 --> 00:41:37,520

experience many times you're wrong

1143

00:41:41,510 --> 00:41:39,440

so without this feedback if you make it

1144

00:41:41,990 --> 00:41:41,520

a monologue where you say what you think

1145

00:41:44,069 --> 00:41:42,000

nature

1146

00:41:46,230 --> 00:41:44,079

is then it's not different from the

1147

00:41:47,910 --> 00:41:46,240

philosophers that told galileo

1148

00:41:49,349 --> 00:41:47,920

we know that the sun moves around the

1149

00:41:52,150 --> 00:41:49,359

earth

1150

00:41:54,550 --> 00:41:52,160

exactly yeah well i mean i can hear the

1151
00:41:57,109 --> 00:41:54,560
excitement in your voice alvi which is

1152
00:41:57,750 --> 00:41:57,119
inspiring i know there are several uh

1153
00:42:00,069 --> 00:41:57,760
aspiring

1154
00:42:01,990 --> 00:42:00,079
astronomers that listen to the show and

1155
00:42:02,790 --> 00:42:02,000
were really excited that i was having

1156
00:42:05,750 --> 00:42:02,800
you on

1157
00:42:06,710 --> 00:42:05,760
because i think they share that same uh

1158
00:42:09,030 --> 00:42:06,720
wonder

1159
00:42:09,750 --> 00:42:09,040
as you do of why you got involved with

1160
00:42:11,750 --> 00:42:09,760
this

1161
00:42:13,030 --> 00:42:11,760
and the endless questions that can be

1162
00:42:15,589 --> 00:42:13,040
asked of

1163
00:42:17,349 --> 00:42:15,599

the universe yeah i should tell you in

1164

00:42:19,270 --> 00:42:17,359

this in this context

1165

00:42:20,630 --> 00:42:19,280

that what i do in the context of the

1166

00:42:23,670 --> 00:42:20,640

search for life

1167

00:42:26,550 --> 00:42:23,680

i is no different than what i than the

1168

00:42:27,829 --> 00:42:26,560

approach that i took in the context of

1169

00:42:30,069 --> 00:42:27,839

studying the universe

1170

00:42:31,990 --> 00:42:30,079

for example most of the matter in the

1171

00:42:34,069 --> 00:42:32,000

universe is not known it's called dark

1172

00:42:36,870 --> 00:42:34,079

matter because we don't know what it is

1173

00:42:37,829 --> 00:42:36,880

it's dark there is no interaction with

1174

00:42:39,589 --> 00:42:37,839

light

1175

00:42:41,109 --> 00:42:39,599

and you know there are various

1176

00:42:42,950 --> 00:42:41,119

possibilities for what

1177

00:42:44,950 --> 00:42:42,960

you know the the composition of the dark

1178

00:42:45,589 --> 00:42:44,960

matter is and over the years over the

1179

00:42:47,670 --> 00:42:45,599

decades

1180

00:42:49,030 --> 00:42:47,680

people suggested all kinds of

1181

00:42:51,910 --> 00:42:49,040

possibilities

1182

00:42:53,910 --> 00:42:51,920

and many of them were tested like weakly

1183

00:42:55,670 --> 00:42:53,920

interacting massive particles you know

1184

00:42:56,950 --> 00:42:55,680

there are very tight constraints on the

1185

00:42:59,270 --> 00:42:56,960

properties of these

1186

00:43:00,390 --> 00:42:59,280

particles by now so hundreds of millions

1187

00:43:02,630 --> 00:43:00,400

of dollars were

1188

00:43:04,230 --> 00:43:02,640

spent on experiments that proved that

1189

00:43:05,589 --> 00:43:04,240

the original notion of weakly

1190

00:43:09,190 --> 00:43:05,599

interacting massive particles

1191

00:43:09,829 --> 00:43:09,200

is not correct nobody blames those

1192

00:43:11,430 --> 00:43:09,839

people

1193

00:43:13,270 --> 00:43:11,440

that suggested it because it's part of

1194

00:43:13,910 --> 00:43:13,280

science as i said science is a learning

1195

00:43:15,750 --> 00:43:13,920

experience

1196

00:43:18,230 --> 00:43:15,760

it should be completely natural to

1197

00:43:20,309 --> 00:43:18,240

sometimes have the wrong idea

1198

00:43:22,630 --> 00:43:20,319

test it experimentally and show that

1199

00:43:25,910 --> 00:43:22,640

it's wrong that is part of science

1200

00:43:26,870 --> 00:43:25,920

it's a learning experience but the point

1201
00:43:28,950 --> 00:43:26,880
is that

1202
00:43:30,550 --> 00:43:28,960
moving from that you know and i wrote

1203
00:43:32,470 --> 00:43:30,560
like two years ago a paper

1204
00:43:34,230 --> 00:43:32,480
talking about the dark matter perhaps

1205
00:43:35,270 --> 00:43:34,240
being made of particles that have a

1206
00:43:39,430 --> 00:43:35,280
small electric

1207
00:43:41,589 --> 00:43:39,440
charge i found that a speculative idea

1208
00:43:43,910 --> 00:43:41,599
but there was no complaint about it then

1209
00:43:44,550 --> 00:43:43,920
when i see anomalies of an object in the

1210
00:43:46,069 --> 00:43:44,560
sky

1211
00:43:47,910 --> 00:43:46,079
and i write a paper about these

1212
00:43:48,470 --> 00:43:47,920
anomalies and try to explain them with

1213
00:43:50,630 --> 00:43:48,480

one

1214

00:43:52,069 --> 00:43:50,640

possible explanation i don't see that

1215

00:43:53,589 --> 00:43:52,079

any different than saying the dark

1216

00:43:55,349 --> 00:43:53,599

matter is made of

1217

00:43:57,589 --> 00:43:55,359

particles that are electrically charged

1218

00:43:59,430 --> 00:43:57,599

you know it's just a hypothesis that you

1219

00:44:02,069 --> 00:43:59,440

can test with getting more evidence

1220

00:44:05,030 --> 00:44:02,079

what's the problem then i get a backlash

1221

00:44:06,950 --> 00:44:05,040

of people saying how dare you discuss it

1222

00:44:09,589 --> 00:44:06,960

now the only reason that i appear in the

1223

00:44:10,230 --> 00:44:09,599

media it's unusual you know i get a lot

1224

00:44:13,910 --> 00:44:10,240

of

1225

00:44:14,710 --> 00:44:13,920

media attention you know it's because my

1226

00:44:17,670 --> 00:44:14,720

colleagues

1227

00:44:19,589 --> 00:44:17,680

are not sharing my behavior you know if

1228

00:44:23,190 --> 00:44:19,599

everyone was open-minded

1229

00:44:25,829 --> 00:44:23,200

and if we were to discuss an artificial

1230

00:44:27,829 --> 00:44:25,839

explanation for um naturally just you

1231

00:44:28,390 --> 00:44:27,839

know one of the possibilities no problem

1232

00:44:29,910 --> 00:44:28,400

what

1233

00:44:31,990 --> 00:44:29,920

you know then it would be just like

1234

00:44:33,270 --> 00:44:32,000

discussing various possibilities for the

1235

00:44:35,030 --> 00:44:33,280

dark matter

1236

00:44:36,150 --> 00:44:35,040

so that the media would not pay too much

1237

00:44:38,069 --> 00:44:36,160

attention you know there is this

1238

00:44:40,069 --> 00:44:38,079

possibility another possibility fine

1239

00:44:41,349 --> 00:44:40,079

it's part of science we rule out we get

1240

00:44:43,109 --> 00:44:41,359

more evidence on other

1241

00:44:45,109 --> 00:44:43,119

you know we will collect more data on

1242

00:44:48,390 --> 00:44:45,119

other objects like um

1243

00:44:50,309 --> 00:44:48,400

we move on but the fact that there is

1244

00:44:53,270 --> 00:44:50,319

this pushback makes me

1245

00:44:54,309 --> 00:44:53,280

unique and that's why i appear on your

1246

00:44:57,349 --> 00:44:54,319

show

1247

00:44:59,750 --> 00:44:57,359

and frankly i don't understand why i

1248

00:45:01,270 --> 00:44:59,760

should be unique but the way i view it

1249

00:45:02,550 --> 00:45:01,280

you know as i mentioned i i was in the

1250

00:45:05,589 --> 00:45:02,560

military

1251

00:45:07,270 --> 00:45:05,599

uh early on and you know when you go

1252

00:45:09,589 --> 00:45:07,280

into combat

1253

00:45:10,710 --> 00:45:09,599

they often say that you know one soldier

1254

00:45:13,990 --> 00:45:10,720

has to put

1255

00:45:15,510 --> 00:45:14,000

his body on the barbed wire so that

1256

00:45:18,790 --> 00:45:15,520

other soldiers can

1257

00:45:20,150 --> 00:45:18,800

go across that and then you know even

1258

00:45:22,630 --> 00:45:20,160

though it's painful for me

1259

00:45:23,990 --> 00:45:22,640

to see the reaction of some people and

1260

00:45:24,309 --> 00:45:24,000

by the way most of these people that

1261

00:45:27,270 --> 00:45:24,319

make

1262

00:45:29,109 --> 00:45:27,280

nasty remarks are not particularly good

1263

00:45:31,750 --> 00:45:29,119

scientists

1264

00:45:33,190 --> 00:45:31,760

and i'm not really offended by those

1265

00:45:34,630 --> 00:45:33,200

because i know that they are not really

1266

00:45:36,069 --> 00:45:34,640

good scientists and that's why they make

1267

00:45:36,790 --> 00:45:36,079

the remark because they don't really

1268

00:45:39,349 --> 00:45:36,800

understand

1269

00:45:40,230 --> 00:45:39,359

the subtlety of the of the anomalies you

1270

00:45:41,829 --> 00:45:40,240

know

1271

00:45:44,230 --> 00:45:41,839

any event it's a painful experience

1272

00:45:45,349 --> 00:45:44,240

sometimes and i just feel you know i'm

1273

00:45:47,270 --> 00:45:45,359

putting my body

1274

00:45:48,790 --> 00:45:47,280

on the barbed wire so that the younger

1275

00:45:50,710 --> 00:45:48,800

generation of tomorrow

1276

00:45:53,109 --> 00:45:50,720

will be able to explore this subject

1277

00:45:55,589 --> 00:45:53,119

freely that that's my thinking

1278

00:45:57,190 --> 00:45:55,599

i love that a trial blazer through and

1279

00:45:58,069 --> 00:45:57,200

through man i mean that that makes

1280

00:46:00,069 --> 00:45:58,079

perfect sense

1281

00:46:01,589 --> 00:46:00,079

and like i said there are young people

1282

00:46:04,150 --> 00:46:01,599

that are going to watch this

1283

00:46:06,150 --> 00:46:04,160

and listen who i think appreciate and

1284

00:46:09,270 --> 00:46:06,160

respect that work that you're doing

1285

00:46:10,870 --> 00:46:09,280

uh to build off of that as they progress

1286

00:46:13,270 --> 00:46:10,880

in their own understanding

1287

00:46:14,550 --> 00:46:13,280

of the universe and fighting back

1288

00:46:16,870 --> 00:46:14,560

against the norm

1289

00:46:17,589 --> 00:46:16,880

when it comes to mainstream science but

1290

00:46:20,150 --> 00:46:17,599

um

1291

00:46:21,750 --> 00:46:20,160

i would love just to say that's the

1292

00:46:25,510 --> 00:46:21,760

second message of my book

1293

00:46:27,670 --> 00:46:25,520

the first message has to do with um

1294

00:46:29,430 --> 00:46:27,680

in potential potentially artificial but

1295

00:46:31,190 --> 00:46:29,440

but the second is what i learned in that

1296

00:46:33,430 --> 00:46:31,200

process of exploring it

1297

00:46:36,550 --> 00:46:33,440

about the scientific community which is

1298

00:46:40,390 --> 00:46:36,560

a rather unhealthy situation right now

1299

00:46:42,950 --> 00:46:40,400

and i very much hope we will change

1300

00:46:44,390 --> 00:46:42,960

me too it's become very stigmatic and i

1301

00:46:47,270 --> 00:46:44,400

think dogmatic

1302

00:46:48,470 --> 00:46:47,280

as well and again i think that's why you

1303

00:46:50,790 --> 00:46:48,480

shaking things up

1304

00:46:53,109 --> 00:46:50,800

is so refreshing not just for people who

1305

00:46:55,670 --> 00:46:53,119

believe in ufos that's a whole

1306

00:46:56,150 --> 00:46:55,680

different conversation to be had but for

1307

00:46:59,430 --> 00:46:56,160

people

1308

00:47:02,790 --> 00:46:59,440

who want that

1309

00:47:04,790 --> 00:47:02,800

wonder and that uh amazing

1310

00:47:05,910 --> 00:47:04,800

possibility of there being something

1311

00:47:08,870 --> 00:47:05,920

else out there

1312

00:47:09,750 --> 00:47:08,880

either we are completely alone in the

1313

00:47:12,790 --> 00:47:09,760

universe

1314

00:47:15,510 --> 00:47:12,800

or or were not and uh both

1315

00:47:17,109 --> 00:47:15,520

answers are equally as terrifying if you

1316

00:47:19,750 --> 00:47:17,119

if you really look at it so i

1317

00:47:21,430 --> 00:47:19,760

i do i do hope and i hold out that hope

1318

00:47:24,150 --> 00:47:21,440

with people like you

1319

00:47:25,670 --> 00:47:24,160

blazing those trails and um i do have a

1320

00:47:27,910 --> 00:47:25,680

few listener questions here

1321

00:47:29,589 --> 00:47:27,920

oh if you're willing to stick around i'd

1322

00:47:30,390 --> 00:47:29,599

love to ask you some of these yeah go

1323

00:47:32,549 --> 00:47:30,400

ahead

1324

00:47:33,829 --> 00:47:32,559

any question you want absolutely thank

1325

00:47:37,270 --> 00:47:33,839

you thank you um

1326

00:47:38,470 --> 00:47:37,280

let's see you mentioned the the pancake

1327

00:47:41,270 --> 00:47:38,480

shape of a

1328

00:47:42,230 --> 00:47:41,280

lua now this question comes from ian and

1329

00:47:45,430 --> 00:47:42,240

um

1330

00:47:47,910 --> 00:47:45,440

he wants to know uh how did

1331

00:47:49,349 --> 00:47:47,920

scientists make this analysis and i

1332

00:47:50,549 --> 00:47:49,359

guess kind of building off of that

1333

00:47:53,750 --> 00:47:50,559

question

1334

00:47:54,470 --> 00:47:53,760

why didn't we have any images taken from

1335

00:47:57,589 --> 00:47:54,480

this whether

1336

00:47:58,790 --> 00:47:57,599

through wavelengths uh radio frequencies

1337

00:48:00,390 --> 00:47:58,800

infrared um

1338

00:48:01,829 --> 00:48:00,400

yeah can you maybe clarify some of the

1339

00:48:03,670 --> 00:48:01,839

misconceptions so the

1340

00:48:06,309 --> 00:48:03,680

answer to the second question is is

1341

00:48:08,630 --> 00:48:06,319

easier let me start with that um

1342

00:48:10,710 --> 00:48:08,640

basically the size of the object can be

1343

00:48:12,870 --> 00:48:10,720

inferred based on the amount of sunlight

1344

00:48:14,710 --> 00:48:12,880

that it reflects if you assume something

1345

00:48:18,710 --> 00:48:14,720

about their reflectance

1346

00:48:21,430 --> 00:48:18,720

um and so the sizes of order

1347

00:48:21,910 --> 00:48:21,440

the size of a football field it's 100

1348

00:48:25,190 --> 00:48:21,920

meters

1349

00:48:25,829 --> 00:48:25,200

a few hundred feet and then given that

1350

00:48:28,950 --> 00:48:25,839

size

1351
00:48:31,190 --> 00:48:28,960
and distance you know the distance is

1352
00:48:32,470 --> 00:48:31,200
uh roughly the earth sun separation at

1353
00:48:35,990 --> 00:48:32,480
the time that it was

1354
00:48:37,829 --> 00:48:36,000
detected at that distance the object

1355
00:48:40,950 --> 00:48:37,839
occupies a very small

1356
00:48:44,230 --> 00:48:40,960
angle on the sky that we cannot resolve

1357
00:48:46,710 --> 00:48:44,240
with existing telescopes on earth so

1358
00:48:48,230 --> 00:48:46,720
it's just it looks like a point of light

1359
00:48:51,030 --> 00:48:48,240
you can't really resolve it

1360
00:48:52,390 --> 00:48:51,040
however if we were to discover it on its

1361
00:48:54,390 --> 00:48:52,400
way towards us

1362
00:48:56,309 --> 00:48:54,400
we could have sent a spacecraft that

1363
00:48:58,309 --> 00:48:56,319

would meet it halfway

1364

00:49:00,630 --> 00:48:58,319

and come very close to it so that it's

1365

00:49:01,750 --> 00:49:00,640

big enough in terms of the angle that it

1366

00:49:04,390 --> 00:49:01,760

occupies

1367

00:49:05,030 --> 00:49:04,400

for a camera to take a photograph of it

1368

00:49:06,790 --> 00:49:05,040

so

1369

00:49:08,549 --> 00:49:06,800

you basically need to come close enough

1370

00:49:10,950 --> 00:49:08,559

to the object so that

1371

00:49:12,390 --> 00:49:10,960

it's big enough for the camera to

1372

00:49:15,030 --> 00:49:12,400

resolve it

1373

00:49:17,430 --> 00:49:15,040

but we didn't have that luxury in this

1374

00:49:19,270 --> 00:49:17,440

case so we don't have a photograph

1375

00:49:21,510 --> 00:49:19,280

of it and of course a photograph would

1376

00:49:24,549 --> 00:49:21,520

convince us beyond any doubt

1377

00:49:26,230 --> 00:49:24,559

what the nature of the object is and i

1378

00:49:27,990 --> 00:49:26,240

very much hope that in the future you

1379

00:49:29,030 --> 00:49:28,000

know when we see more objects of this

1380

00:49:31,670 --> 00:49:29,040

type that look

1381

00:49:33,430 --> 00:49:31,680

very peculiar we'll be able to send a

1382

00:49:34,549 --> 00:49:33,440

mission that will take a photograph from

1383

00:49:35,990 --> 00:49:34,559

up close

1384

00:49:37,910 --> 00:49:36,000

so that's the answer to the second

1385

00:49:39,829 --> 00:49:37,920

question the first question

1386

00:49:42,309 --> 00:49:39,839

how do we know that it's pancake shaped

1387

00:49:44,710 --> 00:49:42,319

and not cigar shape

1388

00:49:46,870 --> 00:49:44,720

that's based on a model for the

1389

00:49:50,230 --> 00:49:46,880

reflected light so

1390

00:49:52,230 --> 00:49:50,240

as it was tumbling around uh

1391

00:49:53,349 --> 00:49:52,240

the amount of light that it reflected

1392

00:49:56,470 --> 00:49:53,359

from the sun

1393

00:49:59,030 --> 00:49:56,480

changed and if you try to obtain

1394

00:50:01,030 --> 00:49:59,040

a fit to the change the variation in the

1395

00:50:04,150 --> 00:50:01,040

amount of light that we see

1396

00:50:07,589 --> 00:50:04,160

as a function of time the best fit

1397

00:50:10,069 --> 00:50:07,599

model was what one that had a flat

1398

00:50:12,069 --> 00:50:10,079

shape a pancake like shape if you were

1399

00:50:13,990 --> 00:50:12,079

to take a cigar like shape

1400

00:50:15,750 --> 00:50:14,000

it would not give you as good of a fit

1401

00:50:18,549 --> 00:50:15,760

and the confidence

1402

00:50:20,390 --> 00:50:18,559

that was inferred is 90 so at the 90

1403

00:50:22,230 --> 00:50:20,400

confidence level it was flat

1404

00:50:24,630 --> 00:50:22,240

there was another argument that was

1405

00:50:27,990 --> 00:50:24,640

actually in the original discovery paper

1406

00:50:31,910 --> 00:50:28,000

which had to do with the fact that

1407

00:50:34,630 --> 00:50:31,920

a flat object would be more likely to be

1408

00:50:35,510 --> 00:50:34,640

associated with this with the light

1409

00:50:38,710 --> 00:50:35,520

curve because

1410

00:50:41,190 --> 00:50:38,720

it would represent the largest amount of

1411

00:50:42,790 --> 00:50:41,200

energy that the object gets as it moves

1412

00:50:44,870 --> 00:50:42,800

through interstellar space so if

1413

00:50:46,470 --> 00:50:44,880

there is a tumultuous journey where it

1414

00:50:49,270 --> 00:50:46,480

gets kicked around

1415

00:50:51,270 --> 00:50:49,280

then based on the way that it tumbled

1416

00:50:53,670 --> 00:50:51,280

you can say that it should be

1417

00:50:55,750 --> 00:50:53,680

pancake shape because that represents

1418

00:50:58,309 --> 00:50:55,760

the most likely state

1419

00:50:58,790 --> 00:50:58,319

uh that it would be in given the light

1420

00:51:01,829 --> 00:50:58,800

curve

1421

00:51:04,390 --> 00:51:01,839

that we saw um and if it was cigar

1422

00:51:06,150 --> 00:51:04,400

shaped it would be the minimum energy so

1423

00:51:08,069 --> 00:51:06,160

if it was cigar shape that the light

1424

00:51:10,309 --> 00:51:08,079

curve that we saw would represent

1425

00:51:11,349 --> 00:51:10,319

an object that was barely kicked around

1426

00:51:13,990 --> 00:51:11,359

you know

1427

00:51:14,630 --> 00:51:14,000

so that's a separate argument uh so at

1428

00:51:17,990 --> 00:51:14,640

any event

1429

00:51:19,109 --> 00:51:18,000

we don't know for sure but most likely

1430

00:51:21,829 --> 00:51:19,119

it was not

1431

00:51:23,670 --> 00:51:21,839

the way depicted in those cartoons a

1432

00:51:24,870 --> 00:51:23,680

cigar-shaped object but more like a

1433

00:51:26,710 --> 00:51:24,880

pancake and

1434

00:51:27,910 --> 00:51:26,720

that is more consistent with the light

1435

00:51:30,390 --> 00:51:27,920

sale idea

1436

00:51:31,430 --> 00:51:30,400

so in fact when we wrote our first paper

1437

00:51:34,630 --> 00:51:31,440

with my postdoc

1438

00:51:36,069 --> 00:51:34,640

shmuel bialy the referee of the paper

1439

00:51:37,829 --> 00:51:36,079

and by the way the paper was accepted

1440

00:51:40,870 --> 00:51:37,839

for publication within a few days

1441

00:51:42,870 --> 00:51:40,880

which is the record for me um the

1442

00:51:43,990 --> 00:51:42,880

referee of that paper said and by the

1443

00:51:47,670 --> 00:51:44,000

way

1444

00:51:51,270 --> 00:51:47,680

it seems like a pancake shape is indeed

1445

00:51:55,270 --> 00:51:51,280

more likely based on the light curve so

1446

00:51:56,790 --> 00:51:55,280

so that's another interesting point that

1447

00:51:58,630 --> 00:51:56,800

goes in the direction of the object

1448

00:52:01,109 --> 00:51:58,640

being unusual because

1449

00:52:01,910 --> 00:52:01,119

most of the rocks that we see are not

1450

00:52:06,150 --> 00:52:01,920

really

1451
00:52:08,069 --> 00:52:06,160
flat that see and i'm glad you clarified

1452
00:52:10,630 --> 00:52:08,079
both those for us because i think

1453
00:52:11,510 --> 00:52:10,640
the number one question i got is why why

1454
00:52:14,069 --> 00:52:11,520
didn't we get

1455
00:52:15,109 --> 00:52:14,079
images of this thing and i mean you

1456
00:52:17,270 --> 00:52:15,119
explained it

1457
00:52:18,150 --> 00:52:17,280
plain as day we didn't make it in time

1458
00:52:20,150 --> 00:52:18,160
we didn't have

1459
00:52:21,430 --> 00:52:20,160
enough advanced knowledge and i mean i

1460
00:52:23,349 --> 00:52:21,440
know there's

1461
00:52:24,549 --> 00:52:23,359
even companies out there i believe it's

1462
00:52:26,950 --> 00:52:24,559
riga

1463
00:52:28,230 --> 00:52:26,960

university that i recently researched

1464

00:52:31,349 --> 00:52:28,240

who are

1465

00:52:34,309 --> 00:52:31,359

inventing technology to uh

1466

00:52:35,430 --> 00:52:34,319

to try to deflect asteroids before they

1467

00:52:37,430 --> 00:52:35,440

possibly

1468

00:52:39,190 --> 00:52:37,440

could cause catastrophic events on our

1469

00:52:41,829 --> 00:52:39,200

planet so if we're able to

1470

00:52:42,790 --> 00:52:41,839

know that enough ahead of time and have

1471

00:52:52,069 --> 00:52:42,800

the

1472

00:52:55,030 --> 00:52:52,079

that discovered

1473

00:52:55,990 --> 00:52:55,040

its main purpose is to find these killer

1474

00:53:01,349 --> 00:52:56,000

asteroids

1475

00:53:04,710 --> 00:53:01,359

earth that have a size

1476

00:53:07,270 --> 00:53:04,720

larger than the size of umuah uh

1477

00:53:09,589 --> 00:53:07,280

that if they happen to intercept the

1478

00:53:13,670 --> 00:53:09,599

earth could cause a lot of damage

1479

00:53:15,430 --> 00:53:13,680

and congress about 16 years ago decided

1480

00:53:17,750 --> 00:53:15,440

that astronomers should search for all

1481

00:53:20,710 --> 00:53:17,760

of these dangerous

1482

00:53:23,030 --> 00:53:20,720

rocks that can fly and you know we know

1483

00:53:25,829 --> 00:53:23,040

that the dinosaurs died as a result of a

1484

00:53:29,190 --> 00:53:25,839

giant rock that was much bigger you know

1485

00:53:30,950 --> 00:53:29,200

tens of kilometers in size

1486

00:53:32,950 --> 00:53:30,960

and of course the dinosaurs didn't have

1487

00:53:34,950 --> 00:53:32,960

astronomers to warn them

1488

00:53:36,790 --> 00:53:34,960

they didn't have science so they just

1489

00:53:39,990 --> 00:53:36,800

saw this giant rock

1490

00:53:44,870 --> 00:53:40,000

approaching them and boom you know

1491

00:53:47,910 --> 00:53:46,390

it must have been an amazing experience

1492

00:53:49,750 --> 00:53:47,920

to see this rock getting bigger and

1493

00:53:50,230 --> 00:53:49,760

bigger and eventually hitting the earth

1494

00:53:52,630 --> 00:53:50,240

you know

1495

00:53:53,910 --> 00:53:52,640

but they died as a result and we came in

1496

00:53:57,430 --> 00:53:53,920

their place

1497

00:53:59,670 --> 00:53:57,440

um and we have science to warn us

1498

00:54:00,710 --> 00:53:59,680

in advance with these telescopes like

1499

00:54:02,630 --> 00:54:00,720

pan stars

1500

00:54:04,390 --> 00:54:02,640

surveying the sky and in three years

1501
00:54:05,430 --> 00:54:04,400
there would be a much better telescope

1502
00:54:07,430 --> 00:54:05,440
doing that

1503
00:54:09,510 --> 00:54:07,440
uh called the vera rubin observatory

1504
00:54:09,990 --> 00:54:09,520
that will have a survey of the sky

1505
00:54:13,349 --> 00:54:10,000
called

1506
00:54:15,990 --> 00:54:13,359
lsst aimed at finding things that

1507
00:54:16,950 --> 00:54:16,000
survey could find on more more like

1508
00:54:20,309 --> 00:54:16,960
objects

1509
00:54:21,510 --> 00:54:20,319
every month so my point is in a few

1510
00:54:24,470 --> 00:54:21,520
years

1511
00:54:26,470 --> 00:54:24,480
we could have many of those discovered

1512
00:54:28,870 --> 00:54:26,480
and then study them in detail

1513
00:54:30,630 --> 00:54:28,880

we don't need to wait very long we just

1514

00:54:32,470 --> 00:54:30,640

need to collect the evidence

1515

00:54:34,790 --> 00:54:32,480

and let you know unless we decide to

1516

00:54:36,309 --> 00:54:34,800

bury our head in the sand again and say

1517

00:54:38,390 --> 00:54:36,319

we don't care about these objects

1518

00:54:41,430 --> 00:54:38,400

because we know what they are you know

1519

00:54:44,150 --> 00:54:41,440

so um all together i see

1520

00:54:45,510 --> 00:54:44,160

a lot of prospects for making progress

1521

00:54:47,190 --> 00:54:45,520

in this context and

1522

00:54:49,829 --> 00:54:47,200

it's just a new way of searching for

1523

00:54:53,270 --> 00:54:49,839

civilizations that was never

1524

00:54:53,990 --> 00:54:53,280

used before not based on radio signals

1525

00:54:57,349 --> 00:54:54,000

or

1526
00:54:58,870 --> 00:54:57,359
looking with telescopes at other stars

1527
00:55:00,870 --> 00:54:58,880
you know just

1528
00:55:02,069 --> 00:55:00,880
searching our backyard for objects that

1529
00:55:04,390 --> 00:55:02,079
came along

1530
00:55:05,430 --> 00:55:04,400
yeah right and you know i mean a lot of

1531
00:55:08,470 --> 00:55:05,440
people know

1532
00:55:12,150 --> 00:55:08,480
the very visible work of seti using

1533
00:55:14,950 --> 00:55:12,160
uh radio you know signals to try to find

1534
00:55:16,710 --> 00:55:14,960
life when there's literally a million

1535
00:55:19,589 --> 00:55:16,720
other ways we could be searching

1536
00:55:21,349 --> 00:55:19,599
right and you know we we sent out

1537
00:55:24,309 --> 00:55:21,359
voyager 1 voyager 2

1538
00:55:25,829 --> 00:55:24,319

new horizons we're sending space junk

1539

00:55:27,910 --> 00:55:25,839

and so

1540

00:55:29,990 --> 00:55:27,920

you know it's quite natural to imagine

1541

00:55:32,150 --> 00:55:30,000

there being objects in space that were

1542

00:55:35,190 --> 00:55:32,160

sent by other civilizations and

1543

00:55:36,870 --> 00:55:35,200

you know currently all our eggs are in

1544

00:55:38,789 --> 00:55:36,880

one basket here on earth

1545

00:55:41,270 --> 00:55:38,799

yeah everything we care about is here

1546

00:55:43,030 --> 00:55:41,280

and if something catastrophic happens

1547

00:55:44,870 --> 00:55:43,040

we will lose everything we care about

1548

00:55:46,950 --> 00:55:44,880

and i wrote actually a

1549

00:55:48,789 --> 00:55:46,960

a an essay to scientific american

1550

00:55:51,990 --> 00:55:48,799

recently talking about

1551

00:55:55,030 --> 00:55:52,000

noise spaceship which

1552

00:55:58,150 --> 00:55:55,040

uh relates to this the biblical story in

1553

00:56:01,270 --> 00:55:58,160

the old testament that talks about noah

1554

00:56:02,230 --> 00:56:01,280

who was worried about the the great

1555

00:56:05,510 --> 00:56:02,240

flood

1556

00:56:07,829 --> 00:56:05,520

killing all the animals so he uh built

1557

00:56:09,349 --> 00:56:07,839

an ark and by the way this the

1558

00:56:12,870 --> 00:56:09,359

dimensions of the ark

1559

00:56:14,230 --> 00:56:12,880

are given explicitly in the bible

1560

00:56:16,230 --> 00:56:14,240

they are not very different from the

1561

00:56:19,430 --> 00:56:16,240

dimensions of i should say

1562

00:56:21,829 --> 00:56:19,440

by chance uh but

1563

00:56:22,549 --> 00:56:21,839

the story goes that he put animals in

1564

00:56:25,589 --> 00:56:22,559

the ark

1565

00:56:26,230 --> 00:56:25,599

and save them from the great flood so we

1566

00:56:28,789 --> 00:56:26,240

can

1567

00:56:31,430 --> 00:56:28,799

have a similar concept saving life on

1568

00:56:33,990 --> 00:56:31,440

earth from a catastrophe

1569

00:56:35,670 --> 00:56:34,000

by sending out a spaceship now that

1570

00:56:37,190 --> 00:56:35,680

doesn't mean that the spaceship needs to

1571

00:56:40,150 --> 00:56:37,200

be huge

1572

00:56:42,470 --> 00:56:40,160

so that you can dock elephants and

1573

00:56:45,190 --> 00:56:42,480

whales and birds

1574

00:56:46,950 --> 00:56:45,200

actually all you need to know is the dna

1575

00:56:49,750 --> 00:56:46,960

of those animals

1576

00:56:50,549 --> 00:56:49,760

put it on a computer all this

1577

00:56:53,109 --> 00:56:50,559

information

1578

00:56:54,309 --> 00:56:53,119

and have a 3d printer and just go to

1579

00:56:58,789 --> 00:56:54,319

other places

1580

00:57:01,750 --> 00:56:58,799

and reproduce life synthetically

1581

00:57:02,549 --> 00:57:01,760

out of the knowledge that we have about

1582

00:57:05,750 --> 00:57:02,559

the dna

1583

00:57:07,430 --> 00:57:05,760

of all forms of life on earth

1584

00:57:09,030 --> 00:57:07,440

and so in principle you can send the

1585

00:57:11,990 --> 00:57:09,040

cubesat it doesn't need to be

1586

00:57:14,069 --> 00:57:12,000

a giant ark in a giant spaceship could

1587

00:57:17,270 --> 00:57:14,079

be a small thing that goes

1588

00:57:19,270 --> 00:57:17,280

to another planet and reproduces what we

1589

00:57:22,150 --> 00:57:19,280

care about here on earth

1590

00:57:22,549 --> 00:57:22,160

right we we've come a long way from uh

1591

00:57:24,870 --> 00:57:22,559

gold

1592

00:57:26,630 --> 00:57:24,880

discs right and sending those out i

1593

00:57:28,710 --> 00:57:26,640

think we're making progress

1594

00:57:30,150 --> 00:57:28,720

by the way uh about making progress you

1595

00:57:33,270 --> 00:57:30,160

know there is this

1596

00:57:35,829 --> 00:57:33,280

uh question could humans

1597

00:57:36,549 --> 00:57:35,839

survive in space or or could humans

1598

00:57:39,670 --> 00:57:36,559

adapt

1599

00:57:39,990 --> 00:57:39,680

to a habitat that floats in space well

1600

00:57:43,349 --> 00:57:40,000

you know

1601
00:57:43,589 --> 00:57:43,359
humans uh adapted from the environment

1602
00:57:46,150 --> 00:57:43,599
of

1603
00:57:47,349 --> 00:57:46,160
africa to an apartment building in

1604
00:57:49,349 --> 00:57:47,359
manhattan

1605
00:57:51,270 --> 00:57:49,359
it's a very different environment only

1606
00:57:53,030 --> 00:57:51,280
over a hundred thousand years within a

1607
00:57:55,430 --> 00:57:53,040
hundred thousand years

1608
00:57:57,589 --> 00:57:55,440
instead of being in the jungle you know

1609
00:58:00,069 --> 00:57:57,599
you find people living comfortably

1610
00:58:01,589 --> 00:58:00,079
well until the pandemic in an apartment

1611
00:58:05,510 --> 00:58:01,599
building

1612
00:58:06,470 --> 00:58:05,520
yeah the leap of living in space may not

1613
00:58:10,150 --> 00:58:06,480

be

1614

00:58:12,950 --> 00:58:10,160

much bigger yeah if i can attest to that

1615

00:58:15,670 --> 00:58:12,960

living right now in new york city

1616

00:58:16,789 --> 00:58:15,680

during a lockdown uh with the train

1617

00:58:19,030 --> 00:58:16,799

outside my window

1618

00:58:20,549 --> 00:58:19,040

i will take space any day over that i'll

1619

00:58:22,870 --> 00:58:20,559

be for sure

1620

00:58:24,870 --> 00:58:22,880

um all right well i guess i got two more

1621

00:58:28,549 --> 00:58:24,880

listener questions if you don't mind

1622

00:58:30,950 --> 00:58:28,559

um do you acknowledge any probability of

1623

00:58:32,630 --> 00:58:30,960

our our bombs that we set off you know

1624

00:58:35,030 --> 00:58:32,640

in the 40s and whatnot

1625

00:58:36,630 --> 00:58:35,040

was this some sort of beacon if there is

1626
00:58:39,910 --> 00:58:36,640
an intelligence out there

1627
00:58:43,109 --> 00:58:39,920
of acknowledging us and uh

1628
00:58:47,190 --> 00:58:43,119
kind of like says scout us

1629
00:58:48,789 --> 00:58:47,200
out in and that's one possible signal

1630
00:58:52,230 --> 00:58:48,799
that we can look for but

1631
00:58:55,750 --> 00:58:52,240
but i would say you know like signals of

1632
00:58:57,990 --> 00:58:55,760
of radiation like radio waves

1633
00:58:59,349 --> 00:58:58,000
we've been transmitting for a century

1634
00:59:02,069 --> 00:58:59,359
radio waves

1635
00:59:02,789 --> 00:59:02,079
and that means that for a hundred years

1636
00:59:04,710 --> 00:59:02,799
this

1637
00:59:07,270 --> 00:59:04,720
there is a sphere of radio waves that

1638
00:59:10,309 --> 00:59:07,280

went 100 light years away

1639

00:59:11,829 --> 00:59:10,319

and if there is any civilization within

1640

00:59:14,950 --> 00:59:11,839

a hundred light years

1641

00:59:17,430 --> 00:59:14,960

that has radio telescopes like we have

1642

00:59:18,870 --> 00:59:17,440

they will know about our existence i

1643

00:59:21,510 --> 00:59:18,880

actually did this calculation

1644

00:59:22,150 --> 00:59:21,520

and with our technology it's possible to

1645

00:59:24,950 --> 00:59:22,160

tell

1646

00:59:26,710 --> 00:59:24,960

that we exist out to a distance of tens

1647

00:59:28,549 --> 00:59:26,720

of light years

1648

00:59:31,190 --> 00:59:28,559

of course it will take a lot of time for

1649

00:59:33,349 --> 00:59:31,200

us to hear back

1650

00:59:36,549 --> 00:59:33,359

but it's already possible that we were

1651
00:59:38,870 --> 00:59:36,559
careless that we were not careful enough

1652
00:59:39,750 --> 00:59:38,880
not to announce that we exist and the

1653
00:59:43,190 --> 00:59:39,760
reason i say

1654
00:59:43,750 --> 00:59:43,200
that is i think it's much more prudent

1655
00:59:47,349 --> 00:59:43,760
much

1656
00:59:50,470 --> 00:59:47,359
smarter to be quiet and listen

1657
00:59:52,150 --> 00:59:50,480
first before speaking out because you

1658
00:59:55,510 --> 00:59:52,160
never know what the risks

1659
00:59:57,750 --> 00:59:55,520
are out there and we were not careful

1660
00:59:59,670 --> 00:59:57,760
once again a sign of us not being very

1661
01:00:02,789 --> 00:59:59,680
intelligent

1662
01:00:04,710 --> 01:00:02,799
so um who knows yeah

1663
01:00:06,470 --> 01:00:04,720

there are some predators out there and

1664

01:00:08,710 --> 01:00:06,480

we will hear from them at some point

1665

01:00:09,829 --> 01:00:08,720

yep yep i think if everyone just

1666

01:00:12,230 --> 01:00:09,839

listened a little more

1667

01:00:13,190 --> 01:00:12,240

uh our world would be better off and

1668

01:00:16,230 --> 01:00:13,200

hopefully

1669

01:00:16,870 --> 01:00:16,240

the many universes out there as well but

1670

01:00:18,630 --> 01:00:16,880

um

1671

01:00:20,789 --> 01:00:18,640

last listener question here comes from

1672

01:00:21,510 --> 01:00:20,799

mike on twitter he wants to know what is

1673

01:00:25,109 --> 01:00:21,520

your favorite

1674

01:00:26,549 --> 01:00:25,119

episode of star trek any incarnation do

1675

01:00:29,109 --> 01:00:26,559

you have an answer for that

1676

01:00:30,950 --> 01:00:29,119

yeah well um unfortunately you know i

1677

01:00:34,309 --> 01:00:30,960

don't like science fiction

1678

01:00:36,309 --> 01:00:34,319

uh because uh in uh

1679

01:00:37,910 --> 01:00:36,319

books of science many of the books or

1680

01:00:40,950 --> 01:00:37,920

films on science fiction

1681

01:00:44,470 --> 01:00:40,960

the laws of physics are violated and i

1682

01:00:46,230 --> 01:00:44,480

cannot i cannot enjoy it uh when i see

1683

01:00:47,910 --> 01:00:46,240

something that makes no sense to me as a

1684

01:00:50,069 --> 01:00:47,920

physicist

1685

01:00:52,309 --> 01:00:50,079

i just give up you know i i don't follow

1686

01:00:55,349 --> 01:00:52,319

the plot it makes no sense to me

1687

01:00:57,589 --> 01:00:55,359

yeah so um i don't like

1688

01:01:00,390 --> 01:00:57,599

science fiction actually i i enjoy

1689

01:01:03,030 --> 01:01:00,400

science and i enjoy fiction

1690

01:01:04,309 --> 01:01:03,040

but i well there are some exceptions i

1691

01:01:05,670 --> 01:01:04,319

should say there are some very good

1692

01:01:08,710 --> 01:01:05,680

films that are not far

1693

01:01:12,150 --> 01:01:08,720

from being scientifically accurate

1694

01:01:13,990 --> 01:01:12,160

but they're all minority yeah they they

1695

01:01:16,549 --> 01:01:14,000

truly are i know what you mean i'm the

1696

01:01:17,430 --> 01:01:16,559

same i uh i'm a playwright here in new

1697

01:01:19,270 --> 01:01:17,440

york city

1698

01:01:21,510 --> 01:01:19,280

and uh there's many times i go see a

1699

01:01:22,710 --> 01:01:21,520

play and i can't enjoy it because i'm

1700

01:01:25,750 --> 01:01:22,720

too

1701

01:01:28,390 --> 01:01:25,760

busy and my mind is reeling about

1702

01:01:30,789 --> 01:01:28,400

the dialogue being terrible or the the

1703

01:01:33,190 --> 01:01:30,799

structure of the play not being right so

1704

01:01:33,990 --> 01:01:33,200

i completely understand i'm also a star

1705

01:01:37,030 --> 01:01:34,000

wars guy

1706

01:01:40,630 --> 01:01:37,040

so um um

1707

01:01:45,030 --> 01:01:40,640

but in closing avi i'd love to ask um

1708

01:01:46,870 --> 01:01:45,040

you know the book covers more than just

1709

01:01:48,870 --> 01:01:46,880

i want to make that very clear to the

1710

01:01:50,950 --> 01:01:48,880

audience um you were kind enough to give

1711

01:01:51,430 --> 01:01:50,960

me an advanced copy to look over and i

1712

01:01:56,069 --> 01:01:51,440

was

1713

01:01:59,670 --> 01:01:56,079

and just moved into many directions so

1714

01:02:03,029 --> 01:01:59,680

besides what what do you hope that

1715

01:02:06,230 --> 01:02:03,039

readers will take away from the book uh

1716

01:02:07,589 --> 01:02:06,240

except just about this one interstellar

1717

01:02:10,069 --> 01:02:07,599

object that could

1718

01:02:11,029 --> 01:02:10,079

be alien what else did you really want

1719

01:02:13,270 --> 01:02:11,039

to say with the books

1720

01:02:15,589 --> 01:02:13,280

so it's really interesting that thinking

1721

01:02:19,270 --> 01:02:15,599

about alien life

1722

01:02:22,150 --> 01:02:19,280

teaches us about ourself and

1723

01:02:24,150 --> 01:02:22,160

you know the way we behave right now not

1724

01:02:27,029 --> 01:02:24,160

not even considering that possibility

1725

01:02:30,230 --> 01:02:27,039

within the mainstream of science

1726

01:02:34,230 --> 01:02:30,240

uh tells you something it tells you

1727

01:02:37,270 --> 01:02:34,240

why you know we don't behave uh

1728

01:02:40,230 --> 01:02:37,280

in in in a more uh

1729

01:02:40,950 --> 01:02:40,240

collegial way and we don't cooperate as

1730

01:02:43,430 --> 01:02:40,960

much and

1731

01:02:44,470 --> 01:02:43,440

you know i give the example in the book

1732

01:02:46,710 --> 01:02:44,480

of the

1733

01:02:48,549 --> 01:02:46,720

amount of money that was invested in the

1734

01:02:51,029 --> 01:02:48,559

second world war

1735

01:02:51,829 --> 01:02:51,039

that could have been used for science

1736

01:02:54,630 --> 01:02:51,839

and in fact

1737

01:02:55,910 --> 01:02:54,640

churchill wrote a paper just before the

1738

01:02:59,109 --> 01:02:55,920

war started

1739

01:02:59,910 --> 01:02:59,119

in which he discussed the possibility of

1740

01:03:02,630 --> 01:02:59,920

life

1741

01:03:04,150 --> 01:03:02,640

around other stars but he became the

1742

01:03:07,430 --> 01:03:04,160

prime minister

1743

01:03:10,789 --> 01:03:07,440

and didn't really pursue him

1744

01:03:12,470 --> 01:03:10,799

this this interest of his instead he had

1745

01:03:14,870 --> 01:03:12,480

to worry about

1746

01:03:16,549 --> 01:03:14,880

you know fighting the germans that were

1747

01:03:17,109 --> 01:03:16,559

killing a lot of the people in england

1748

01:03:19,349 --> 01:03:17,119

and

1749

01:03:20,710 --> 01:03:19,359

so there were huge amount of resources

1750

01:03:24,069 --> 01:03:20,720

dedicated to

1751

01:03:27,510 --> 01:03:24,079

a destructive purpose and if instead

1752

01:03:30,789 --> 01:03:27,520

it was dedicated to churches vision of

1753

01:03:33,829 --> 01:03:30,799

searching for life around other stars

1754

01:03:36,309 --> 01:03:33,839

we would perhaps know by now the answer

1755

01:03:37,510 --> 01:03:36,319

whether we are alone or not so my point

1756

01:03:40,069 --> 01:03:37,520

is

1757

01:03:41,109 --> 01:03:40,079

with a better perspective you know we

1758

01:03:43,990 --> 01:03:41,119

can

1759

01:03:45,029 --> 01:03:44,000

make much more progress as humans you

1760

01:03:48,630 --> 01:03:45,039

know

1761

01:03:49,349 --> 01:03:48,640

and i really wish that more people will

1762

01:03:51,270 --> 01:03:49,359

accept that

1763

01:03:52,549 --> 01:03:51,280

and that we can all work together

1764

01:03:54,549 --> 01:03:52,559

towards a better future and

1765

01:03:55,990 --> 01:03:54,559

not pretend that we know the answer in

1766

01:03:58,069 --> 01:03:56,000

advance and not

1767

01:03:59,910 --> 01:03:58,079

fight each other let's just try to

1768

01:04:01,990 --> 01:03:59,920

figure things out together

1769

01:04:04,069 --> 01:04:02,000

you know just as if we are kids trying

1770

01:04:06,390 --> 01:04:04,079

to learn about the world

1771

01:04:08,150 --> 01:04:06,400

and i should say that the one thing that

1772

01:04:10,950 --> 01:04:08,160

surprised me about the book

1773

01:04:13,109 --> 01:04:10,960

at this point in time is that it's not

1774

01:04:16,069 --> 01:04:13,119

it's ranked number one on amazon

1775

01:04:18,470 --> 01:04:16,079

in the astronomy section three weeks

1776

01:04:21,589 --> 01:04:18,480

before publication

1777

01:04:23,829 --> 01:04:21,599

without any reviews right

1778

01:04:25,190 --> 01:04:23,839

so i'm really surprised by that because

1779

01:04:28,390 --> 01:04:25,200

it means that there is

1780

01:04:29,990 --> 01:04:28,400

as you as you alluded to there is hunger

1781

01:04:32,950 --> 01:04:30,000

or interest

1782

01:04:34,230 --> 01:04:32,960

in this subject and partly it's because

1783

01:04:37,190 --> 01:04:34,240

the scientific community

1784

01:04:38,950 --> 01:04:37,200

is starving the public on you know

1785

01:04:42,950 --> 01:04:38,960

intentionally

1786

01:04:45,990 --> 01:04:42,960

suppressing any discussion that is open

1787

01:04:46,950 --> 01:04:46,000

on these issues and i'm trying to break

1788

01:04:49,190 --> 01:04:46,960

this barrier

1789

01:04:51,029 --> 01:04:49,200

in the book so i very much hope that

1790

01:04:53,750 --> 01:04:51,039

people will enjoy it

1791

01:04:55,910 --> 01:04:53,760

bobby i mean thank you for feeding us

1792

01:04:58,549 --> 01:04:55,920

that's that's really all i can say

1793

01:05:00,309 --> 01:04:58,559

as one of those hungry people i'm glad

1794

01:05:00,870 --> 01:05:00,319

that there's someone out someone out

1795

01:05:04,470 --> 01:05:00,880

there

1796

01:05:07,829 --> 01:05:04,480

thinking of uh speaking of humanity over

1797

01:05:08,870 --> 01:05:07,839

uh military over mainstream perception

1798

01:05:11,430 --> 01:05:08,880

of science and

1799

01:05:11,990 --> 01:05:11,440

uh really shaken things up man you are a

1800

01:05:14,150 --> 01:05:12,000

rebel

1801
01:05:15,430 --> 01:05:14,160
and uh you know as someone who grew up

1802
01:05:18,150 --> 01:05:15,440
on punk music

1803
01:05:20,150 --> 01:05:18,160
uh those are the people i respect so

1804
01:05:22,150 --> 01:05:20,160
tell us where we can get the book

1805
01:05:24,069 --> 01:05:22,160
and please tell us where we can find

1806
01:05:26,150 --> 01:05:24,079
everything you're up to

1807
01:05:27,589 --> 01:05:26,160
well you can find a book in any outlet

1808
01:05:30,230 --> 01:05:27,599
that sells books

1809
01:05:31,990 --> 01:05:30,240
for example on amazon uh it's already

1810
01:05:34,950 --> 01:05:32,000
out for sale and

1811
01:05:36,309 --> 01:05:34,960
it will come out in three weeks on

1812
01:05:39,510 --> 01:05:36,319
january 26

1813
01:05:41,430 --> 01:05:39,520

2021 in the us and then

1814

01:05:43,190 --> 01:05:41,440

it will be published in more than 20

1815

01:05:46,309 --> 01:05:43,200

countries worldwide

1816

01:05:49,829 --> 01:05:46,319

oh wow and i should say uh

1817

01:05:53,349 --> 01:05:49,839

over the past couple of days i had

1818

01:05:55,750 --> 01:05:53,359

you know a few filmmakers from hollywood

1819

01:05:58,710 --> 01:05:55,760

contact me

1820

01:06:00,870 --> 01:05:58,720

and i told my literary agent that if it

1821

01:06:04,630 --> 01:06:00,880

ever becomes a film

1822

01:06:06,950 --> 01:06:04,640

i want brad pitt to play my role

1823

01:06:09,109 --> 01:06:06,960

i can see it man hey he's done

1824

01:06:09,829 --> 01:06:09,119

interstellar before i'm sure he'll do it

1825

01:06:11,829 --> 01:06:09,839

again

1826

01:06:12,870 --> 01:06:11,839

i could see it i could definitely see it

1827

01:06:14,630 --> 01:06:12,880

well those uh

1828

01:06:16,309 --> 01:06:14,640

i know after the book comes out those

1829

01:06:16,950 --> 01:06:16,319

phone calls are going to keep coming man

1830

01:06:19,190 --> 01:06:16,960

so

1831

01:06:20,309 --> 01:06:19,200

thank you for all the work you've done

1832

01:06:22,710 --> 01:06:20,319

all the work you will

1833

01:06:23,910 --> 01:06:22,720

continue to do again the book is called

1834

01:06:26,069 --> 01:06:23,920

extraterrestrial

1835

01:06:28,309 --> 01:06:26,079

the first sign of intelligent life

1836

01:06:30,390 --> 01:06:28,319

beyond earth avi thank you so much for

1837

01:06:38,030 --> 01:06:30,400

joining me on somewhere in the skies