

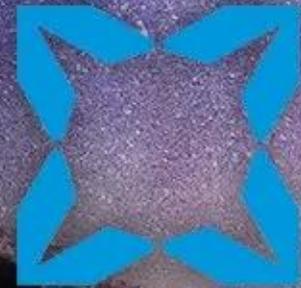
A portrait of Avi Loeb, a man with glasses and a black shirt, looking directly at the camera. The background is a dark, starry space with a nebula and a dark, rocky object in the foreground.

# THE SEARCH FOR TECHNOLOGICAL INTERSTELLAR OBJECTS

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AVI LOEB

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SOCIETY  
FOR  
SCIENTIFIC  
EXPLORATION

1  
00:00:09,430 --> 00:00:07,590  
so what i'll focus on today is the

2  
00:00:11,150 --> 00:00:09,440  
content of my book which you can see in

3  
00:00:13,270 --> 00:00:11,160  
the middle of this slide

4  
00:00:15,669 --> 00:00:13,280  
extraterrestrial and if i had to

5  
00:00:16,630 --> 00:00:15,679  
summarize it with one sentence i would

6  
00:00:18,150 --> 00:00:16,640  
say

7  
00:00:20,070 --> 00:00:18,160  
when you are not ready to find

8  
00:00:23,189 --> 00:00:20,080  
exceptional things

9  
00:00:25,910 --> 00:00:23,199  
you would never discover them

10  
00:00:28,630 --> 00:00:25,920  
and what you see on the right is

11  
00:00:31,189 --> 00:00:28,640  
the cover of a textbook that

12  
00:00:32,950 --> 00:00:31,199  
i published a few months ago uh with

13  
00:00:35,590 --> 00:00:32,960

harvard university press together with

14

00:00:39,510 --> 00:00:35,600

my former postdoc manasville lingam it

15

00:00:40,709 --> 00:00:39,520

has more than a thousand pages of

16

00:00:43,670 --> 00:00:40,719

material

17

00:00:45,510 --> 00:00:43,680

that serves as the foundation for the

18

00:00:48,549 --> 00:00:45,520

search for life which is one of the most

19

00:00:50,630 --> 00:00:48,559

exciting frontiers in science

20

00:00:53,029 --> 00:00:50,640

and what you see on the left is a

21

00:00:55,670 --> 00:00:53,039

photograph of a photograph

22

00:00:57,029 --> 00:00:55,680

taken by the german photographer her

23

00:00:59,029 --> 00:00:57,039

linda quillbell

24

00:01:01,189 --> 00:00:59,039

who presented it at an exhibit an

25

00:01:03,189 --> 00:01:01,199

exhibit

26

00:01:05,509 --> 00:01:03,199

on the walls of the berlin brandberg

27

00:01:07,830 --> 00:01:05,519

academy of science and humanities in

28

00:01:10,310 --> 00:01:07,840

october 2020

29

00:01:12,469 --> 00:01:10,320

and she asked me to write on the palm of

30

00:01:15,190 --> 00:01:12,479

my hand the question that i regard is

31

00:01:16,469 --> 00:01:15,200

most significant in science

32

00:01:21,429 --> 00:01:16,479

which is

33

00:01:26,710 --> 00:01:24,710

actually a few weeks ago i was contacted

34

00:01:29,109 --> 00:01:26,720

by a rabbi

35

00:01:31,830 --> 00:01:29,119

during the high holidays

36

00:01:34,710 --> 00:01:31,840

of the jewish religion and

37

00:01:38,710 --> 00:01:34,720

he told me that he plans to speak

38

00:01:42,950 --> 00:01:38,720

about my book extraterrestrial and

39

00:01:44,310 --> 00:01:42,960

wrote a sermon about it on his website

40

00:01:46,149 --> 00:01:44,320

and

41

00:01:48,550 --> 00:01:46,159

as a result

42

00:01:51,030 --> 00:01:48,560

a colleague of mine said next time we

43

00:01:53,109 --> 00:01:51,040

meet for dinner my wife and i will ask

44

00:01:55,510 --> 00:01:53,119

you to give us a sermon

45

00:01:58,709 --> 00:01:55,520

i mean that i realized as a result of

46

00:02:01,510 --> 00:01:58,719

this that actually what i discuss is of

47

00:02:04,310 --> 00:02:01,520

existential importance that people can

48

00:02:06,950 --> 00:02:04,320

connect to religious beliefs

49

00:02:09,990 --> 00:02:06,960

my reply to my colleague was

50

00:02:15,030 --> 00:02:10,000

that i would never lead the congregation

51  
00:02:20,229 --> 00:02:17,350  
and actually a few weeks ago the

52  
00:02:23,990 --> 00:02:20,239  
congress called for a permanent office

53  
00:02:26,309 --> 00:02:24,000  
to address unidentified aerial phenomena

54  
00:02:27,910 --> 00:02:26,319  
these are objects whose nature is

55  
00:02:31,430 --> 00:02:27,920  
unclear

56  
00:02:35,750 --> 00:02:33,110  
now what i've learned over several

57  
00:02:39,030 --> 00:02:35,760  
decades of practicing astronomy is a

58  
00:02:41,990 --> 00:02:39,040  
sense of cosmic modesty

59  
00:02:44,150 --> 00:02:42,000  
and i say that because you know if you

60  
00:02:45,830 --> 00:02:44,160  
look back in history humans tended to

61  
00:02:49,190 --> 00:02:45,840  
think that the play

62  
00:02:51,910 --> 00:02:49,200  
is about us in fact i have an essay in

63  
00:02:53,589 --> 00:02:51,920

medium just about that was published

64

00:02:56,070 --> 00:02:53,599

this morning

65

00:02:58,630 --> 00:02:56,080

but the play the cosmic play is not

66

00:03:00,309 --> 00:02:58,640

about us we are not at the center of the

67

00:03:03,589 --> 00:03:00,319

universe like the ancient greek

68

00:03:05,830 --> 00:03:03,599

philosopher aristotle argued

69

00:03:07,430 --> 00:03:05,840

and about half of the sun-like stars

70

00:03:09,430 --> 00:03:07,440

have a planet the size of the earth

71

00:03:10,309 --> 00:03:09,440

roughly the same separation

72

00:03:12,869 --> 00:03:10,319

so

73

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

moreover what we find in our backyard is

74

00:03:17,030 --> 00:03:15,440

not unique or special there are more

75

00:03:19,350 --> 00:03:17,040

habitable earths

76  
00:03:21,670 --> 00:03:19,360  
in the observable volume of the universe

77  
00:03:24,710 --> 00:03:21,680  
then there are grains of sand

78  
00:03:27,110 --> 00:03:24,720  
on all beaches on earth

79  
00:03:29,190 --> 00:03:27,120  
and when i see a painting like this one

80  
00:03:30,949 --> 00:03:29,200  
of an emperor standing

81  
00:03:33,750 --> 00:03:30,959  
very proud of himself because he

82  
00:03:36,070 --> 00:03:33,760  
conquered a piece of land here on earth

83  
00:03:37,270 --> 00:03:36,080  
that doesn't impress me because it's not

84  
00:03:38,630 --> 00:03:37,280  
very different

85  
00:03:41,750 --> 00:03:38,640  
from an ant

86  
00:03:45,270 --> 00:03:41,760  
hugging a single grain of sand on the

87  
00:03:47,030 --> 00:03:45,280  
landscape of a huge beach

88  
00:03:49,830 --> 00:03:47,040

but i can understand where it's coming

89

00:03:51,670 --> 00:03:49,840

from when my daughters were young

90

00:03:53,270 --> 00:03:51,680

they tended to think very highly of

91

00:03:56,229 --> 00:03:53,280

themselves because they compared

92

00:03:57,589 --> 00:03:56,239

themselves to family members

93

00:03:58,830 --> 00:03:57,599

at home

94

00:04:02,070 --> 00:03:58,840

and when we took them to the

95

00:04:04,149 --> 00:04:02,080

kindergarten they found other kids that

96

00:04:05,670 --> 00:04:04,159

may be smarter than they are

97

00:04:07,350 --> 00:04:05,680

and of course that changed their

98

00:04:09,750 --> 00:04:07,360

perspective

99

00:04:10,949 --> 00:04:09,760

so the only way for our civilization to

100

00:04:14,949 --> 00:04:10,959

mature

101  
00:04:15,750 --> 00:04:14,959  
is to meet others

102  
00:04:18,469 --> 00:04:15,760  
and

103  
00:04:20,629 --> 00:04:18,479  
one thing we know by observing the sky

104  
00:04:22,550 --> 00:04:20,639  
is that most of the stars form billions

105  
00:04:24,230 --> 00:04:22,560  
of years before the sun

106  
00:04:26,870 --> 00:04:24,240  
we can monitor the star formation

107  
00:04:29,189 --> 00:04:26,880  
history of the universe

108  
00:04:31,189 --> 00:04:29,199  
and that means that given the fact that

109  
00:04:32,550 --> 00:04:31,199  
half of the sun-like stars have a planet

110  
00:04:33,670 --> 00:04:32,560  
the size of the earth the same

111  
00:04:35,030 --> 00:04:33,680  
separation

112  
00:04:37,670 --> 00:04:35,040  
it means that

113  
00:04:40,830 --> 00:04:37,680

there could have been a civilization as

114

00:04:44,469 --> 00:04:40,840

mature as we are or more than that

115

00:04:46,870 --> 00:04:44,479

technologically a billion years ago

116

00:04:49,430 --> 00:04:46,880

and if they developed artificial

117

00:04:51,350 --> 00:04:49,440

intelligence systems like we do

118

00:04:54,230 --> 00:04:51,360

where these systems are currently

119

00:04:56,870 --> 00:04:54,240

driving cars and in the future they'll

120

00:04:58,150 --> 00:04:56,880

make medical decisions they can become

121

00:05:00,390 --> 00:04:58,160

autonomous

122

00:05:02,070 --> 00:05:00,400

they will not need guidance from us all

123

00:05:03,590 --> 00:05:02,080

they will need is an early phase of

124

00:05:05,510 --> 00:05:03,600

machine learning

125

00:05:08,950 --> 00:05:05,520

and we can think of them as our

126  
00:05:12,629 --> 00:05:08,960  
technological kids that we educate early

127  
00:05:15,749 --> 00:05:12,639  
on and then send to the world

128  
00:05:18,629 --> 00:05:15,759  
and that means we can send them to space

129  
00:05:20,469 --> 00:05:18,639  
so far we send only relatively dumb

130  
00:05:23,749 --> 00:05:20,479  
machines to space

131  
00:05:27,110 --> 00:05:23,759  
the perseverance rover is just a robot

132  
00:05:29,749 --> 00:05:27,120  
operated by people at jpl

133  
00:05:32,230 --> 00:05:29,759  
but you can imagine sending

134  
00:05:33,670 --> 00:05:32,240  
an ai system

135  
00:05:36,870 --> 00:05:33,680  
equipped with

136  
00:05:39,510 --> 00:05:36,880  
3d printing capabilities so that it can

137  
00:05:42,790 --> 00:05:39,520  
repair damaged components and it can

138  
00:05:45,350 --> 00:05:42,800

operate autonomously without needing any

139

00:05:48,070 --> 00:05:45,360

guidance from earth and that's very

140

00:05:50,550 --> 00:05:48,080

useful when you go very far away because

141

00:05:53,749 --> 00:05:50,560

even the nearest star is four light

142

00:05:55,430 --> 00:05:53,759

years away takes four years for light to

143

00:05:57,990 --> 00:05:55,440

traverse the distance to the nearest

144

00:06:01,110 --> 00:05:58,000

star that means that such a system

145

00:06:04,070 --> 00:06:01,120

cannot really wait to get guidance from

146

00:06:06,390 --> 00:06:04,080

us in order to decide what to do

147

00:06:07,830 --> 00:06:06,400

but if we can imagine sending systems

148

00:06:09,350 --> 00:06:07,840

like that

149

00:06:11,830 --> 00:06:09,360

then another civilization that's

150

00:06:14,070 --> 00:06:11,840

predated us by a billion years may have

151  
00:06:16,230 --> 00:06:14,080  
done so already

152  
00:06:19,430 --> 00:06:16,240  
and a billion years is enough to

153  
00:06:21,270 --> 00:06:19,440  
populate the entire milky way galaxy

154  
00:06:23,749 --> 00:06:21,280  
so are we

155  
00:06:25,189 --> 00:06:23,759  
living in such a reality that's not a

156  
00:06:26,790 --> 00:06:25,199  
philosophical

157  
00:06:32,950 --> 00:06:26,800  
question

158  
00:06:37,350 --> 00:06:35,749  
and we should not repeat the mistake

159  
00:06:40,710 --> 00:06:37,360  
that philosophers

160  
00:06:42,870 --> 00:06:40,720  
made four decades four centuries ago

161  
00:06:44,870 --> 00:06:42,880  
when they refused to look through

162  
00:06:46,469 --> 00:06:44,880  
galileo's telescope

163  
00:06:48,469 --> 00:06:46,479

and they argued that the sun moves

164

00:06:52,150 --> 00:06:48,479

around the earth

165

00:06:53,909 --> 00:06:52,160

and that only maintained their ignorance

166

00:06:59,110 --> 00:06:53,919

today they would have

167

00:07:03,909 --> 00:07:02,070

and so the lesson from that is that we

168

00:07:06,469 --> 00:07:03,919

should find the answers through

169

00:07:08,870 --> 00:07:06,479

telescopes and that's the objective of

170

00:07:11,189 --> 00:07:08,880

the galileo project that i established

171

00:07:12,710 --> 00:07:11,199

in july this year

172

00:07:14,070 --> 00:07:12,720

thanks to

173

00:07:15,029 --> 00:07:14,080

donations

174

00:07:16,629 --> 00:07:15,039

up to

175

00:07:18,790 --> 00:07:16,639

two million dollars from people that

176

00:07:21,110 --> 00:07:18,800

visited the porch of my home after

177

00:07:24,870 --> 00:07:21,120

reading my book extraterrestrial they

178

00:07:27,430 --> 00:07:24,880

decided to support my research and if i

179

00:07:30,710 --> 00:07:27,440

had to define this project i would say

180

00:07:32,230 --> 00:07:30,720

extraordinary conservatism leads to

181

00:07:34,150 --> 00:07:32,240

extraordinary

182

00:07:35,830 --> 00:07:34,160

ignorance so

183

00:07:37,670 --> 00:07:35,840

we should look out

184

00:07:39,670 --> 00:07:37,680

we've been searching for example for

185

00:07:43,029 --> 00:07:39,680

dark matter for four

186

00:07:45,029 --> 00:07:43,039

decades without finding it

187

00:07:47,350 --> 00:07:45,039

hundreds of millions of dollars

188

00:07:49,749 --> 00:07:47,360

if we now engage for the first time with

189

00:07:50,950 --> 00:07:49,759

the galileo project in searching for

190

00:07:53,350 --> 00:07:50,960

equipment

191

00:07:55,270 --> 00:07:53,360

sent by other civilizations that we can

192

00:07:57,589 --> 00:07:55,280

find near earth

193

00:08:00,629 --> 00:07:57,599

and just imagine us searching for four

194

00:08:02,550 --> 00:08:00,639

decades 40 years and spending hundreds

195

00:08:05,029 --> 00:08:02,560

of millions of dollars

196

00:08:07,990 --> 00:08:05,039

if we don't find anything at the end of

197

00:08:10,390 --> 00:08:08,000

these four decades we will be exactly at

198

00:08:12,550 --> 00:08:10,400

the same point as the people in the

199

00:08:15,029 --> 00:08:12,560

mainstream of astronomy that are

200

00:08:17,029 --> 00:08:15,039

searching for dark matter exactly at the

201  
00:08:19,510 --> 00:08:17,039  
same point that they are now because

202  
00:08:22,309 --> 00:08:19,520  
they already spend those funds and they

203  
00:08:25,510 --> 00:08:22,319  
already spent 40 years

204  
00:08:27,029 --> 00:08:25,520  
and why is this subject not funded

205  
00:08:30,309 --> 00:08:27,039  
that's what the galileo project is

206  
00:08:33,029 --> 00:08:30,319  
trying to fix to change

207  
00:08:36,310 --> 00:08:33,039  
we plan to look through new telescopes

208  
00:08:38,389 --> 00:08:36,320  
it's not a speculative notion to imagine

209  
00:08:42,790 --> 00:08:38,399  
that the technological civilization like

210  
00:08:47,430 --> 00:08:46,150  
and we sent out voyager new horizons to

211  
00:08:48,790 --> 00:08:47,440  
space

212  
00:08:52,310 --> 00:08:48,800  
now

213  
00:08:54,949 --> 00:08:52,320

the galileo project has two major tracks

214

00:08:56,550 --> 00:08:54,959

one is to find objects near earth in the

215

00:08:58,790 --> 00:08:56,560

earth's atmosphere

216

00:09:02,310 --> 00:08:58,800

and one thing to realize in the context

217

00:09:04,949 --> 00:09:02,320

of that is that a meter size telescope

218

00:09:08,310 --> 00:09:04,959

can obtain a megapixel image

219

00:09:10,870 --> 00:09:08,320

an image that has a million pixels

220

00:09:12,470 --> 00:09:10,880

of a human size object

221

00:09:15,750 --> 00:09:12,480

at a distance

222

00:09:20,310 --> 00:09:17,829

and you can buy such a telescope on the

223

00:09:24,310 --> 00:09:20,320

web online i just found it a few weeks

224

00:09:27,269 --> 00:09:24,320

ago you can click add to the bag

225

00:09:28,710 --> 00:09:27,279

and it costs half a million dollars

226

00:09:30,230 --> 00:09:28,720

so apparently there are people willing

227

00:09:32,470 --> 00:09:30,240

to add it to their bag for half a

228

00:09:33,670 --> 00:09:32,480

million dollars

229

00:09:37,190 --> 00:09:33,680

now

230

00:09:40,070 --> 00:09:37,200

the goal is to obtain a high resolution

231

00:09:41,670 --> 00:09:40,080

image of an unidentified aerial

232

00:09:43,829 --> 00:09:41,680

phenomena

233

00:09:46,870 --> 00:09:43,839

using multiple detectors both in the

234

00:09:48,870 --> 00:09:46,880

infrared the optical perhaps using radar

235

00:09:51,030 --> 00:09:48,880

systems

236

00:09:52,870 --> 00:09:51,040

and if you get a high resolution image a

237

00:09:54,710 --> 00:09:52,880

megapixel image

238

00:09:56,949 --> 00:09:54,720

you could in principle

239

00:09:57,910 --> 00:09:56,959

distinguish a label

240

00:10:01,990 --> 00:09:57,920

saying

241

00:10:05,269 --> 00:10:02,000

made on exoplanet y

242

00:10:08,470 --> 00:10:05,279

from a label saying made in china or

243

00:10:12,069 --> 00:10:10,230

which would not be very interesting for

244

00:10:14,389 --> 00:10:12,079

me as a scientist i don't care much

245

00:10:16,550 --> 00:10:14,399

about birds if we see a bird i'll be

246

00:10:20,069 --> 00:10:16,560

glad to transfer the high resolution

247

00:10:22,069 --> 00:10:20,079

image of a bird to a zoologist

248

00:10:27,430 --> 00:10:22,079

and a human-made object would be as

249

00:10:31,110 --> 00:10:28,870

we look for something else it's a

250

00:10:33,110 --> 00:10:31,120

fishing expedition

251

00:10:35,829 --> 00:10:33,120

we might find that we have nothing

252

00:10:38,630 --> 00:10:35,839

unusual that would so be it that would

253

00:10:40,470 --> 00:10:38,640

be one possible conclusion

254

00:10:42,790 --> 00:10:40,480

and then the second component of the

255

00:10:44,710 --> 00:10:42,800

galileo project is to search for

256

00:10:47,430 --> 00:10:44,720

interstellar objects that enter the

257

00:10:49,910 --> 00:10:47,440

solar system that do not look like the

258

00:10:51,509 --> 00:10:49,920

rocks we have seen before in the solar

259

00:10:53,750 --> 00:10:51,519

system

260

00:10:55,430 --> 00:10:53,760

the first such object

261

00:10:57,350 --> 00:10:55,440

was named

262

00:10:59,030 --> 00:10:57,360

and it didn't look like a comet or an

263

00:11:00,630 --> 00:10:59,040

asteroid and i'll discuss it in a few

264

00:11:02,790 --> 00:11:00,640  
minutes

265

00:11:05,350 --> 00:11:02,800  
and so we want to find more of the same

266

00:11:07,190 --> 00:11:05,360  
and take a high resolution image

267

00:11:10,790 --> 00:11:07,200  
and there is an opportunity for

268

00:11:12,949 --> 00:11:10,800  
crowdfunding which is described

269

00:11:16,389 --> 00:11:12,959  
on our website you can see the link at

270

00:11:17,990 --> 00:11:17,190  
so

271

00:11:21,030 --> 00:11:18,000  
on

272

00:11:22,949 --> 00:11:21,040  
june 25th this year

273

00:11:25,430 --> 00:11:22,959  
the intelligence agencies delivered a

274

00:11:27,829 --> 00:11:25,440  
report to congress and they basically

275

00:11:30,069 --> 00:11:27,839  
said that they are not doing their job

276  
00:11:31,190 --> 00:11:30,079  
which is quite unusual for a government

277  
00:11:34,630 --> 00:11:31,200  
agency

278  
00:11:37,350 --> 00:11:34,640  
they said that there were at least 143

279  
00:11:39,829 --> 00:11:37,360  
incidents where objects were identified

280  
00:11:42,710 --> 00:11:39,839  
in the sky above the us

281  
00:11:45,110 --> 00:11:42,720  
whose nature is unclear

282  
00:11:47,430 --> 00:11:45,120  
so at that point it became clear to me

283  
00:11:48,470 --> 00:11:47,440  
that this subject needs to move away

284  
00:11:53,030 --> 00:11:48,480  
from

285  
00:11:55,990 --> 00:11:53,040  
government officials

286  
00:11:59,269 --> 00:11:56,000  
to the realm of science

287  
00:12:01,509 --> 00:11:59,279  
because it's unhealthy for this subject

288  
00:12:03,829 --> 00:12:01,519

to be ridiculed by the scientific

289

00:12:05,910 --> 00:12:03,839

community while at the same time the

290

00:12:08,550 --> 00:12:05,920

most conservative organization that we

291

00:12:10,870 --> 00:12:08,560

know of the government admits that there

292

00:12:12,389 --> 00:12:10,880

are these objects how is that possible

293

00:12:14,550 --> 00:12:12,399

that the scientific community which is

294

00:12:17,670 --> 00:12:14,560

supposed to be open-minded

295

00:12:20,710 --> 00:12:17,680

blue sky in its opinions

296

00:12:23,430 --> 00:12:20,720

not looking at the blue sky ridiculing

297

00:12:25,190 --> 00:12:23,440

the subject leaving this for speculation

298

00:12:27,990 --> 00:12:25,200

by the general public

299

00:12:30,710 --> 00:12:28,000

that doesn't make much sense

300

00:12:35,110 --> 00:12:30,720

actually it's the duty of scientists to

301  
00:12:39,110 --> 00:12:36,710  
and that's

302  
00:12:41,750 --> 00:12:39,120  
the goal of the galileo project

303  
00:12:43,910 --> 00:12:41,760  
that we inaugurated the month after this

304  
00:12:46,310 --> 00:12:43,920  
report came out

305  
00:12:48,629 --> 00:12:46,320  
the idea is to have open data

306  
00:12:50,949 --> 00:12:48,639  
that is assembled by instruments that we

307  
00:12:53,190 --> 00:12:50,959  
have full control over that are

308  
00:12:56,230 --> 00:12:53,200  
optimized for the purpose of identifying

309  
00:12:58,470 --> 00:12:56,240  
the nature of these unidentified aerial

310  
00:13:00,949 --> 00:12:58,480  
phenomena

311  
00:13:02,470 --> 00:13:00,959  
and here is the research team

312  
00:13:04,230 --> 00:13:02,480  
and

313  
00:13:06,870 --> 00:13:04,240

you can see the various people in

314

00:13:08,790 --> 00:13:06,880

particular biatrix who uh

315

00:13:11,030 --> 00:13:08,800

villaroel who is

316

00:13:13,030 --> 00:13:11,040

a member of your organization you can

317

00:13:16,949 --> 00:13:13,040

see her on the on the right

318

00:13:19,269 --> 00:13:16,959

also alan stern he's the pi on nasa's

319

00:13:21,509 --> 00:13:19,279

new horizon

320

00:13:23,430 --> 00:13:21,519

so there are many people involved and

321

00:13:25,990 --> 00:13:23,440

exceptional scientists

322

00:13:27,829 --> 00:13:26,000

uh mostly astronomers

323

00:13:30,629 --> 00:13:27,839

that we have also in a scientific

324

00:13:32,550 --> 00:13:30,639

advisory board that you can see here

325

00:13:33,990 --> 00:13:32,560

you might identify

326

00:13:36,470 --> 00:13:34,000

one of the people here if you use

327

00:13:40,389 --> 00:13:36,480

mathematica stephen wolfram

328

00:13:44,470 --> 00:13:42,069

and then we have a philanthropic

329

00:13:46,069 --> 00:13:44,480

advisory board and a public outreach

330

00:13:48,310 --> 00:13:46,079

group

331

00:13:50,550 --> 00:13:48,320

and a lot of affiliates i should say i

332

00:13:52,389 --> 00:13:50,560

got i received thousands of

333

00:13:55,110 --> 00:13:52,399

emails from people who are

334

00:13:58,470 --> 00:13:55,120

uh happy to contribute uh from their

335

00:14:00,310 --> 00:13:58,480

expertise to the project

336

00:14:03,110 --> 00:14:00,320

now the big question is what's the

337

00:14:06,550 --> 00:14:03,120

future of humanity

338

00:14:08,470 --> 00:14:06,560

currently all our eggs are in one basket

339

00:14:11,189 --> 00:14:08,480

here on earth

340

00:14:13,350 --> 00:14:11,199

but i can imagine that you know we might

341

00:14:16,230 --> 00:14:13,360

want to spread them just to avoid a

342

00:14:18,710 --> 00:14:16,240

catastrophe and i call that nox

343

00:14:20,790 --> 00:14:18,720

spaceship an analogy to the biblical

344

00:14:21,990 --> 00:14:20,800

story of noah ark

345

00:14:25,350 --> 00:14:22,000

where noah

346

00:14:28,629 --> 00:14:25,360

built an ark to put all the animals and

347

00:14:31,590 --> 00:14:28,639

save them from the great flood

348

00:14:35,110 --> 00:14:31,600

and we have risks here on earth

349

00:14:36,310 --> 00:14:35,120

uh the there are either self-inflicted

350

00:14:38,790 --> 00:14:36,320

uh by

351  
00:14:40,069 --> 00:14:38,800  
internal threats you know we're changing

352  
00:14:41,030 --> 00:14:40,079  
the climate

353  
00:14:42,829 --> 00:14:41,040  
we are

354  
00:14:45,990 --> 00:14:42,839  
uh initiating

355  
00:14:48,389 --> 00:14:46,000  
wars uh there are pandemics who knows

356  
00:14:50,150 --> 00:14:48,399  
where the pandemic came from naturally

357  
00:14:50,949 --> 00:14:50,160  
or from a lab

358  
00:14:52,870 --> 00:14:50,959  
uh

359  
00:14:54,629 --> 00:14:52,880  
there are all kinds of technological and

360  
00:14:55,750 --> 00:14:54,639  
political catastrophes that we can

361  
00:14:58,389 --> 00:14:55,760  
imagine

362  
00:15:00,870 --> 00:14:58,399  
but there are also external threats from

363  
00:15:02,230 --> 00:15:00,880

the impact of asteroids just like the

364

00:15:06,629 --> 00:15:02,240

dinosaurs

365

00:15:09,590 --> 00:15:06,639

were killed 66 million years ago when a

366

00:15:10,829 --> 00:15:09,600

rock the size of manhattan island

367

00:15:13,829 --> 00:15:10,839

impacted

368

00:15:14,629 --> 00:15:13,839

earth and eventually the sun will boil

369

00:15:16,470 --> 00:15:14,639

off

370

00:15:19,269 --> 00:15:16,480

all oceans

371

00:15:21,829 --> 00:15:19,279

in a billion years or so

372

00:15:25,030 --> 00:15:21,839

so we need to go to space and here is my

373

00:15:27,430 --> 00:15:25,040

personal journey from a farm to space

374

00:15:30,030 --> 00:15:27,440

exploration just a few days ago i was

375

00:15:32,790 --> 00:15:30,040

invited to a forum i had about

376

00:15:34,870 --> 00:15:32,800

1250 interviews over the past seven

377

00:15:36,470 --> 00:15:34,880

months since my book appeared so quite a

378

00:15:39,509 --> 00:15:36,480

hectic schedule but

379

00:15:40,389 --> 00:15:39,519

uh a few days ago i was invited to a

380

00:15:43,269 --> 00:15:40,399

forum

381

00:15:45,749 --> 00:15:43,279

and they put all my titles and then

382

00:15:48,150 --> 00:15:45,759

finally my name and i said

383

00:15:51,110 --> 00:15:48,160

no forget about my titles i don't care

384

00:15:53,030 --> 00:15:51,120

much about them just put my name and say

385

00:15:55,430 --> 00:15:53,040

a farm boy

386

00:15:57,990 --> 00:15:55,440

and that's because i'm very proud of the

387

00:16:00,949 --> 00:15:58,000

fact that i was born on a farm i was not

388

00:16:02,710 --> 00:16:00,959

groomed as a university professor

389

00:16:04,870 --> 00:16:02,720

unlike many of my colleagues that think

390

00:16:07,990 --> 00:16:04,880

very highly of themselves i mean i was

391

00:16:10,470 --> 00:16:08,000

i'm still just a farm boy and you can

392

00:16:11,509 --> 00:16:10,480

see a picture of me at age 7 on the top

393

00:16:15,350 --> 00:16:11,519

left

394

00:16:17,189 --> 00:16:15,360

i was born 59 years ago

395

00:16:19,749 --> 00:16:17,199

and then the second

396

00:16:21,030 --> 00:16:19,759

photo shows me collecting eggs every

397

00:16:22,949 --> 00:16:21,040

afternoon

398

00:16:25,189 --> 00:16:22,959

we had chickens

399

00:16:26,949 --> 00:16:25,199

and one thing led to another

400

00:16:29,910 --> 00:16:26,959

i was mostly interested in philosophy

401  
00:16:31,509 --> 00:16:29,920  
early on at any event i ended up as the

402  
00:16:34,069 --> 00:16:31,519  
chair of the astronomy department at

403  
00:16:37,990 --> 00:16:34,079  
harvard for nine years the longest

404  
00:16:40,629 --> 00:16:38,000  
serving chair and at the bottom left

405  
00:16:43,110 --> 00:16:40,639  
you see a photo of a visit by

406  
00:16:45,829 --> 00:16:43,120  
entrepreneur from silicon valley yuri

407  
00:16:48,150 --> 00:16:45,839  
milner that came to my office sat on the

408  
00:16:51,030 --> 00:16:48,160  
sofa in front of me and asked me whether

409  
00:16:53,269 --> 00:16:51,040  
i'm willing to lead a project to visit

410  
00:16:57,749 --> 00:16:53,279  
the nearest star

411  
00:16:58,710 --> 00:16:57,759  
light years away

412  
00:17:00,710 --> 00:16:58,720  
so

413  
00:17:02,829 --> 00:17:00,720

it takes like four years to get there if

414

00:17:05,189 --> 00:17:02,839

you want to get there within our

415

00:17:07,750 --> 00:17:05,199

lifetime it means that we need to get

416

00:17:09,669 --> 00:17:07,760

there in 20 years or so and that means

417

00:17:12,150 --> 00:17:09,679

that we need a spacecraft that moves at

418

00:17:14,870 --> 00:17:12,160

the fifth of the speed of light

419

00:17:16,789 --> 00:17:14,880

and that's a thousand times faster than

420

00:17:20,230 --> 00:17:16,799

the chemical rockets that we have

421

00:17:22,470 --> 00:17:20,240

produced so far so that was a challenge

422

00:17:25,429 --> 00:17:22,480

but i came up with a concept and we

423

00:17:27,429 --> 00:17:25,439

announced the project in april 2016. you

424

00:17:30,230 --> 00:17:27,439

can see it in the middle bottom

425

00:17:34,950 --> 00:17:30,240

photo and that was in the company of

426  
00:17:37,110 --> 00:17:34,960  
stephen hawking and freeman dyson

427  
00:17:40,070 --> 00:17:37,120  
so here is an artist illustration of the

428  
00:17:41,909 --> 00:17:40,080  
solar system it extends halfway to the

429  
00:17:45,270 --> 00:17:41,919  
nearest star

430  
00:17:47,110 --> 00:17:45,280  
and the oort cloud contains

431  
00:17:49,430 --> 00:17:47,120  
the bricks

432  
00:17:51,350 --> 00:17:49,440  
the building blocks that were used

433  
00:17:53,909 --> 00:17:51,360  
to make up the planet some of them were

434  
00:17:54,950 --> 00:17:53,919  
scattered in a spherical region around

435  
00:17:58,950 --> 00:17:54,960  
the sun

436  
00:18:02,630 --> 00:17:58,960  
and it goes halfway to the nearest star

437  
00:18:06,150 --> 00:18:02,640  
um proxima centauri which is a member of

438  
00:18:08,710 --> 00:18:06,160

a three-star system alpha centauri

439

00:18:10,230 --> 00:18:08,720

and as it turns out proxima centauri has

440

00:18:12,710 --> 00:18:10,240

a planet

441

00:18:15,110 --> 00:18:12,720

it's a the star is 12

442

00:18:16,789 --> 00:18:15,120

uh percent of the mass of the sun so

443

00:18:18,789 --> 00:18:16,799

it's it has roughly

444

00:18:21,350 --> 00:18:18,799

half the surface temperature it's a

445

00:18:22,789 --> 00:18:21,360

dwarf star emitting mostly infrared

446

00:18:25,430 --> 00:18:22,799

radiation

447

00:18:27,590 --> 00:18:25,440

and the planet is 20 times closer to the

448

00:18:29,029 --> 00:18:27,600

star than the earth is from the sun but

449

00:18:31,270 --> 00:18:29,039

that happens to be just the right

450

00:18:33,590 --> 00:18:31,280

distance where the surface temperature

451  
00:18:35,270 --> 00:18:33,600  
of the star of the sun

452  
00:18:38,070 --> 00:18:35,280  
sorry the surface temperature of the

453  
00:18:39,110 --> 00:18:38,080  
planet uh is similar to that of the

454  
00:18:41,110 --> 00:18:39,120  
earth

455  
00:18:43,669 --> 00:18:41,120  
so in principle there could be liquid

456  
00:18:46,070 --> 00:18:43,679  
water on the surface of that planet

457  
00:18:47,830 --> 00:18:46,080  
but it's so close to the star

458  
00:18:50,789 --> 00:18:47,840  
that

459  
00:18:54,230 --> 00:18:50,799  
it's tidally locked just like the moon

460  
00:18:57,430 --> 00:18:54,240  
is to the earth so it faces the star

461  
00:18:59,270 --> 00:18:57,440  
with the same side as it moves around it

462  
00:19:01,990 --> 00:18:59,280  
every 11 days

463  
00:19:04,950 --> 00:19:02,000

it has a permanent day side

464

00:19:07,590 --> 00:19:04,960

and a permanent night side

465

00:19:08,470 --> 00:19:07,600

and my daughters say that if we ever go

466

00:19:10,390 --> 00:19:08,480

there

467

00:19:12,470 --> 00:19:10,400

they want to have a house

468

00:19:14,230 --> 00:19:12,480

on the strip that separates the

469

00:19:16,470 --> 00:19:14,240

permanent day side from the permanent

470

00:19:17,750 --> 00:19:16,480

night side because you can sit on the

471

00:19:19,029 --> 00:19:17,760

porch

472

00:19:20,470 --> 00:19:19,039

and see

473

00:19:22,710 --> 00:19:20,480

the sunset

474

00:19:25,350 --> 00:19:22,720

forever

475

00:19:31,830 --> 00:19:25,360

just imagine sitting on the porch and

476

00:19:36,390 --> 00:19:34,230

i asked students in my class the

477

00:19:38,070 --> 00:19:36,400

freshman seminar class at harvard if

478

00:19:40,630 --> 00:19:38,080

they know of any animal that has

479

00:19:43,190 --> 00:19:40,640

infrared vision that could live on this

480

00:19:44,789 --> 00:19:43,200

on the day side of this planet and one

481

00:19:46,630 --> 00:19:44,799

of them found

482

00:19:48,950 --> 00:19:46,640

a shrimp

483

00:19:51,669 --> 00:19:48,960

and the eyes of the shrimp look like

484

00:19:53,750 --> 00:19:51,679

ping-pong balls connected with cords to

485

00:19:55,590 --> 00:19:53,760

the head of the shrimp

486

00:19:57,190 --> 00:19:55,600

and the student she said

487

00:20:01,830 --> 00:19:57,200

the student said

488

00:20:06,710 --> 00:20:04,789

now how do we get there the idea is

489

00:20:11,270 --> 00:20:06,720

to uh push

490

00:20:12,950 --> 00:20:11,280

on a very thin film of material a sail

491

00:20:15,510 --> 00:20:12,960

with light

492

00:20:17,669 --> 00:20:15,520

a very powerful laser beam pushing on a

493

00:20:19,590 --> 00:20:17,679

sail that weighs roughly a gram can

494

00:20:20,870 --> 00:20:19,600

bring it to a fifth of the speed of

495

00:20:22,789 --> 00:20:20,880

light

496

00:20:24,710 --> 00:20:22,799

and one can equip the sail with

497

00:20:27,350 --> 00:20:24,720

electronics

498

00:20:29,750 --> 00:20:27,360

so here is the concept a lot of small

499

00:20:33,430 --> 00:20:29,760

lasers low power lasers combine their

500

00:20:36,070 --> 00:20:33,440

beams to make a hundred gigawatt beam

501  
00:20:37,190 --> 00:20:36,080  
that shines on a sail released by

502  
00:20:38,549 --> 00:20:37,200  
another

503  
00:20:41,270 --> 00:20:38,559  
spaceship

504  
00:20:42,390 --> 00:20:41,280  
above the atmosphere

505  
00:20:44,470 --> 00:20:42,400  
and

506  
00:20:46,549 --> 00:20:44,480  
the 100 gigawatt

507  
00:20:49,430 --> 00:20:46,559  
beam shines for

508  
00:20:52,149 --> 00:20:49,440  
a few minutes on a sale this the length

509  
00:20:53,830 --> 00:20:52,159  
of a person that weighs a few grams

510  
00:20:56,310 --> 00:20:53,840  
and that can bring the sale over a

511  
00:20:57,190 --> 00:20:56,320  
distance of five times the distance to

512  
00:21:00,630 --> 00:20:57,200  
the moon

513  
00:21:04,870 --> 00:21:00,640

to a fifth of the speed of light

514

00:21:06,710 --> 00:21:04,880

so the launch phase takes a few minutes

515

00:21:10,230 --> 00:21:06,720

and then the journey

516

00:21:12,470 --> 00:21:10,240

takes 20 years

517

00:21:15,029 --> 00:21:12,480

it's a very long journey that's what why

518

00:21:17,750 --> 00:21:15,039

humans are not really designed for

519

00:21:19,750 --> 00:21:17,760

interstellar travel unlike what you see

520

00:21:21,750 --> 00:21:19,760

in science fiction movies

521

00:21:23,830 --> 00:21:21,760

you know we were selected by darwinian

522

00:21:25,830 --> 00:21:23,840

evolution to live on earth

523

00:21:27,350 --> 00:21:25,840

but at any event this sail will

524

00:21:28,310 --> 00:21:27,360

hopefully get

525

00:21:31,029 --> 00:21:28,320

to

526

00:21:34,390 --> 00:21:31,039

proxima b the planet near proxima

527

00:21:35,270 --> 00:21:34,400

centauri and take a photograph

528

00:21:38,230 --> 00:21:35,280

and

529

00:21:40,630 --> 00:21:38,240

inform us whether there is life on it

530

00:21:42,870 --> 00:21:40,640

by sending back the signal

531

00:21:45,430 --> 00:21:42,880

and it will take the signal

532

00:21:48,310 --> 00:21:45,440

four years to reach us

533

00:21:49,669 --> 00:21:48,320

so all together 24 years that's a long

534

00:21:51,750 --> 00:21:49,679

time

535

00:21:56,789 --> 00:21:51,760

but that's the fastest we can imagine

536

00:22:01,350 --> 00:21:59,430

in principle you can launch a sail

537

00:22:04,789 --> 00:22:01,360

close to the speed of light

538

00:22:06,950 --> 00:22:04,799

by a natural source of light if you park

539

00:22:08,950 --> 00:22:06,960

the sail at 100 times the earth sun

540

00:22:12,149 --> 00:22:08,960

separation from

541

00:22:14,470 --> 00:22:12,159

a massive star that is about to explode

542

00:22:18,710 --> 00:22:14,480

in a supernova

543

00:22:21,350 --> 00:22:18,720

then the sail could be carried out

544

00:22:23,270 --> 00:22:21,360

by the flash of light produced by the

545

00:22:24,630 --> 00:22:23,280

explosion

546

00:22:27,990 --> 00:22:24,640

it's just like

547

00:22:31,350 --> 00:22:28,000

surfers waiting for a giant wave to

548

00:22:34,310 --> 00:22:31,360

carry them on the beaches of hawaii

549

00:22:37,669 --> 00:22:34,320

except here we're talking about

550

00:22:40,870 --> 00:22:37,679

a flash of light carrying the sail

551  
00:22:44,310 --> 00:22:40,880  
close to the speed of light and another

552  
00:22:46,549 --> 00:22:44,320  
metaphor is dandelion seeds you can see

553  
00:22:49,750 --> 00:22:46,559  
that on the right hand side

554  
00:22:53,350 --> 00:22:52,149  
now we are probably not the sharpest

555  
00:22:55,990 --> 00:22:53,360  
cookies

556  
00:22:58,390 --> 00:22:56,000  
in the jar of the milky way and by that

557  
00:23:00,630 --> 00:22:58,400  
i mean we are not the smartest

558  
00:23:02,149 --> 00:23:00,640  
and the reason i say that is

559  
00:23:05,110 --> 00:23:02,159  
i define

560  
00:23:07,430 --> 00:23:05,120  
uh as an intelligent species

561  
00:23:09,430 --> 00:23:07,440  
a culture that is

562  
00:23:11,430 --> 00:23:09,440  
following the guiding principles of

563  
00:23:14,390 --> 00:23:11,440

science

564

00:23:16,149 --> 00:23:14,400

cooperation and sharing of

565

00:23:17,669 --> 00:23:16,159

evidence-based

566

00:23:20,390 --> 00:23:17,679

knowledge

567

00:23:21,750 --> 00:23:20,400

so we are not cooperating much

568

00:23:23,750 --> 00:23:21,760

i mean the

569

00:23:26,230 --> 00:23:23,760

latest example is

570

00:23:28,789 --> 00:23:26,240

the kovit 19 pandemic it started in

571

00:23:31,110 --> 00:23:28,799

wohan china there wasn't much

572

00:23:32,390 --> 00:23:31,120

uh sharing of information it could have

573

00:23:34,950 --> 00:23:32,400

saved

574

00:23:38,710 --> 00:23:34,960

a lot of lives if we if everyone knew

575

00:23:39,990 --> 00:23:38,720

what this virus is all about

576  
00:23:41,269 --> 00:23:40,000  
and

577  
00:23:44,630 --> 00:23:41,279  
also when we

578  
00:23:47,269 --> 00:23:44,640  
make decisions on policy

579  
00:23:49,430 --> 00:23:47,279  
they are not following evidence

580  
00:23:51,029 --> 00:23:49,440  
so we have a long way to go

581  
00:23:52,710 --> 00:23:51,039  
and that's why i'm saying

582  
00:23:55,590 --> 00:23:52,720  
you know what's the chance that if you

583  
00:23:58,870 --> 00:23:55,600  
open a recipe book that you land on the

584  
00:24:00,310 --> 00:23:58,880  
page that makes the best cake

585  
00:24:03,190 --> 00:24:00,320  
quite small

586  
00:24:04,710 --> 00:24:03,200  
and therefore the chance of us being

587  
00:24:06,870 --> 00:24:04,720  
the smartest

588  
00:24:09,750 --> 00:24:06,880

civilization in our galaxy is really

589

00:24:13,190 --> 00:24:11,029

so

590

00:24:15,430 --> 00:24:13,200

without any prejudice

591

00:24:17,909 --> 00:24:15,440

let's just search

592

00:24:19,909 --> 00:24:17,919

for evidence of others of course we can

593

00:24:22,789 --> 00:24:19,919

argue that we are the smartest just like

594

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

my daughters did when they were young

595

00:24:27,190 --> 00:24:24,880

we can decide not to look through our

596

00:24:28,950 --> 00:24:27,200

windows for any neighbors

597

00:24:31,350 --> 00:24:28,960

but that will not get rid of our

598

00:24:33,750 --> 00:24:31,360

neighbors

599

00:24:35,750 --> 00:24:33,760

and the best place to start looking

600

00:24:37,510 --> 00:24:35,760

is in our backyard for anything that

601  
00:24:39,909 --> 00:24:37,520  
came into it

602  
00:24:42,230 --> 00:24:39,919  
and that means the solar system and in

603  
00:24:44,950 --> 00:24:42,240  
2017

604  
00:24:47,029 --> 00:24:44,960  
the pan stars telescope in hawaii

605  
00:24:48,789 --> 00:24:47,039  
on the summit of haleakala mountain in

606  
00:24:52,070 --> 00:24:48,799  
maui

607  
00:24:54,230 --> 00:24:52,080  
discovered the first interstellar object

608  
00:24:55,909 --> 00:24:54,240  
that visited the solar system

609  
00:24:58,310 --> 00:24:55,919  
from outside

610  
00:24:59,590 --> 00:24:58,320  
based on its velocity it was not bound

611  
00:25:01,750 --> 00:24:59,600  
to the sun

612  
00:25:04,230 --> 00:25:01,760  
it was given the name omuamua which

613  
00:25:07,110 --> 00:25:04,240

means a scout in the hawaiian language

614

00:25:10,870 --> 00:25:07,120

you can see it circled in blue

615

00:25:14,149 --> 00:25:10,880

with the background of stars behind it

616

00:25:16,230 --> 00:25:14,159

and it started in a very special frame

617

00:25:18,630 --> 00:25:16,240

of reference the so-called local

618

00:25:20,230 --> 00:25:18,640

standard of rest which is the frame that

619

00:25:22,230 --> 00:25:20,240

you get to when you average over the

620

00:25:23,830 --> 00:25:22,240

motions of all the stars in the vicinity

621

00:25:26,549 --> 00:25:23,840

of the sun

622

00:25:30,870 --> 00:25:26,559

only one in 500 stars

623

00:25:31,590 --> 00:25:30,880

is so much at rest as umu was

624

00:25:36,630 --> 00:25:31,600

so

625

00:25:39,430 --> 00:25:36,640

the surface of the ocean at rest and

626  
00:25:43,110 --> 00:25:39,440  
then the sun was like a giant ship that

627  
00:25:47,029 --> 00:25:43,120  
bumped into it and gave it a kick

628  
00:25:50,470 --> 00:25:49,190  
and as the object was tumbling every

629  
00:25:53,190 --> 00:25:50,480  
eight hours

630  
00:25:56,149 --> 00:25:53,200  
the amount of sunlight reflected from it

631  
00:25:57,990 --> 00:25:56,159  
changed by a factor of 10.

632  
00:26:00,070 --> 00:25:58,000  
and that meant that it has a very

633  
00:26:02,310 --> 00:26:00,080  
extreme shape

634  
00:26:03,750 --> 00:26:02,320  
just imagine a piece of paper tumbling

635  
00:26:06,310 --> 00:26:03,760  
in the wind

636  
00:26:08,070 --> 00:26:06,320  
and the project the area of the piece of

637  
00:26:10,230 --> 00:26:08,080  
paper projected

638  
00:26:11,590 --> 00:26:10,240

in front of you changing by a factor of

639

00:26:15,110 --> 00:26:11,600

10.

640

00:26:15,909 --> 00:26:15,120

it means that the object is very thin

641

00:26:19,029 --> 00:26:15,919

and

642

00:26:22,149 --> 00:26:19,039

when modeling the variation of light the

643

00:26:25,269 --> 00:26:22,159

best shape that was inferred is that of

644

00:26:28,390 --> 00:26:25,279

a pancake a disc

645

00:26:30,950 --> 00:26:28,400

you can see it on the left here a

646

00:26:35,990 --> 00:26:34,230

shade implies a high probability so

647

00:26:38,310 --> 00:26:36,000

in this plane of

648

00:26:39,590 --> 00:26:38,320

the angles the defined orientation of

649

00:26:41,830 --> 00:26:39,600

the object

650

00:26:43,750 --> 00:26:41,840

it seems like most of this plane at the

651  
00:26:47,510 --> 00:26:43,760  
90 percent confidence

652  
00:26:48,710 --> 00:26:47,520  
agrees with the data meaning that a disk

653  
00:26:53,350 --> 00:26:48,720  
like

654  
00:26:55,909 --> 00:26:53,360  
and then on the right side you see a

655  
00:26:57,110 --> 00:26:55,919  
cigar that is 10 times longer than it is

656  
00:26:59,590 --> 00:26:57,120  
wide

657  
00:27:01,510 --> 00:26:59,600  
and you really need to fine tune the

658  
00:27:04,789 --> 00:27:01,520  
orientation of this cigar in order to

659  
00:27:07,590 --> 00:27:04,799  
get a good fit to the light curve

660  
00:27:10,230 --> 00:27:07,600  
so most likely it was disk shape at the

661  
00:27:12,870 --> 00:27:10,240  
90 confidence

662  
00:27:13,830 --> 00:27:12,880  
and then the spitzer space telescope

663  
00:27:15,590 --> 00:27:13,840

tried

664

00:27:17,190 --> 00:27:15,600

to look at this object

665

00:27:19,590 --> 00:27:17,200

and you can see the image on the right

666

00:27:23,750 --> 00:27:19,600

hand side on the top at the top

667

00:27:25,110 --> 00:27:23,760

and there was nothing detected nothing

668

00:27:27,830 --> 00:27:25,120

and that means

669

00:27:29,990 --> 00:27:27,840

that the object did not emit infrared

670

00:27:32,149 --> 00:27:30,000

radiation didn't we didn't see any heat

671

00:27:35,830 --> 00:27:32,159

coming from it it must have been small

672

00:27:37,510 --> 00:27:35,840

smaller than 200 meters

673

00:27:40,149 --> 00:27:37,520

because we know the surface temperature

674

00:27:42,070 --> 00:27:40,159

of the object based on its trajectory

675

00:27:43,990 --> 00:27:42,080

so it must have been smaller with a high

676  
00:27:44,950 --> 00:27:44,000  
reflectance

677  
00:27:48,549 --> 00:27:44,960  
and then

678  
00:27:50,549 --> 00:27:48,559  
moreover there was no dust or gas around

679  
00:27:52,310 --> 00:27:50,559  
it at a very

680  
00:27:55,590 --> 00:27:52,320  
there was a very tight limit on the

681  
00:27:58,549 --> 00:27:55,600  
existence of carbon-based molecules

682  
00:28:01,110 --> 00:27:58,559  
so the object was definitely not a comet

683  
00:28:05,590 --> 00:28:01,120  
of the type that we have seen before

684  
00:28:10,630 --> 00:28:07,909  
but at the same time the object

685  
00:28:11,750 --> 00:28:10,640  
exhibited an excess push away from the

686  
00:28:13,269 --> 00:28:11,760  
sun

687  
00:28:15,590 --> 00:28:13,279  
with a force

688  
00:28:18,070 --> 00:28:15,600

that declines inversely with distance

689

00:28:20,389 --> 00:28:18,080

squared

690

00:28:22,870 --> 00:28:20,399

some non-gravitational force and since

691

00:28:24,549 --> 00:28:22,880

evaporation was excluded by the speeds

692

00:28:26,710 --> 00:28:24,559

of data

693

00:28:30,470 --> 00:28:26,720

the only possibility that i could think

694

00:28:35,190 --> 00:28:30,480

of was that the push is as a result of

695

00:28:42,070 --> 00:28:37,590

but in order for that to be effective

696

00:28:48,630 --> 00:28:46,149

and nature doesn't make thin objects

697

00:28:51,510 --> 00:28:48,640

so i suggested in a scientific paper

698

00:28:52,789 --> 00:28:51,520

that perhaps the object is artificial in

699

00:28:54,389 --> 00:28:52,799

origin

700

00:28:58,310 --> 00:28:54,399

and that's really the fundamental

701  
00:29:01,029 --> 00:28:58,320  
question is a muammua natural

702  
00:29:03,669 --> 00:29:01,039  
or artificial

703  
00:29:05,750 --> 00:29:03,679  
and after i finished my book actually

704  
00:29:07,750 --> 00:29:05,760  
after i finished writing it there was

705  
00:29:09,269 --> 00:29:07,760  
another object discovered by the same

706  
00:29:11,750 --> 00:29:09,279  
telescope

707  
00:29:15,190 --> 00:29:11,760  
in september 2020

708  
00:29:17,350 --> 00:29:15,200  
it was given the astronomical name 2020

709  
00:29:20,710 --> 00:29:17,360  
so

710  
00:29:22,950 --> 00:29:20,720  
and it was thought to be an asteroid

711  
00:29:25,350 --> 00:29:22,960  
but then it showed an excess push away

712  
00:29:26,549 --> 00:29:25,360  
from the sun as a result of reflection

713  
00:29:30,310 --> 00:29:26,559

of sunlight

714

00:29:32,070 --> 00:29:30,320

no cometary tale just like omuamua

715

00:29:34,870 --> 00:29:32,080

and then the astronomers that discovered

716

00:29:37,430 --> 00:29:34,880

it a few weeks later realized in fact if

717

00:29:39,510 --> 00:29:37,440

you extrapolate the orbit back in time

718

00:29:40,789 --> 00:29:39,520

it actually came from earth

719

00:29:43,190 --> 00:29:40,799

it was

720

00:29:46,070 --> 00:29:43,200

a rocket booster that was launched from

721

00:29:49,029 --> 00:29:46,080

earth in 1966

722

00:29:51,830 --> 00:29:49,039

as part of a lunar lander mission

723

00:29:54,630 --> 00:29:51,840

and we understand why it had an excess

724

00:29:56,149 --> 00:29:54,640

push away from the sun because it had

725

00:29:59,590 --> 00:29:56,159

thin walls

726

00:30:01,830 --> 00:29:59,600

so it had a large area for its mass

727

00:30:06,149 --> 00:30:01,840

and we know that this object was

728

00:30:08,389 --> 00:30:06,159

artificial because we produced it

729

00:30:12,549 --> 00:30:08,399

the question is who produced

730

00:30:15,669 --> 00:30:12,559

a muammar and this object 2020 so was

731

00:30:17,029 --> 00:30:15,679

not designed to be a light sail

732

00:30:20,230 --> 00:30:17,039

it was just

733

00:30:21,350 --> 00:30:20,240

thin that's all and so omomua could have

734

00:30:23,029 --> 00:30:21,360

been thin

735

00:30:25,750 --> 00:30:23,039

for a different purpose not to be a

736

00:30:27,830 --> 00:30:25,760

light sale but perhaps it was a receiver

737

00:30:30,549 --> 00:30:27,840

or something the point is

738

00:30:34,789 --> 00:30:30,559

it was artificial if we make the analogy

739

00:30:39,909 --> 00:30:38,149

and what are the anomalies of muammua

740

00:30:42,070 --> 00:30:39,919

well first of all we didn't expect to

741

00:30:44,870 --> 00:30:42,080

find such an object

742

00:30:46,789 --> 00:30:44,880

because i wrote a paper a decade earlier

743

00:30:48,950 --> 00:30:46,799

forecasting the number of frogs that

744

00:30:50,710 --> 00:30:48,960

should be in the interstellar medium

745

00:30:53,350 --> 00:30:50,720

based on what we know in the solar

746

00:30:54,710 --> 00:30:53,360

system and we expected an abundance that

747

00:30:57,029 --> 00:30:54,720

is smaller

748

00:30:58,630 --> 00:30:57,039

by a factor of a hundred to a hundred

749

00:31:00,549 --> 00:30:58,640

million

750

00:31:04,230 --> 00:31:00,559

than the number of objects needed to

751  
00:31:08,950 --> 00:31:07,029  
and moreover this object or momoa

752  
00:31:10,389 --> 00:31:08,960  
originated from the local standard of

753  
00:31:12,870 --> 00:31:10,399  
rest

754  
00:31:15,990 --> 00:31:12,880  
only 1 in 500 stars

755  
00:31:17,750 --> 00:31:16,000  
are in that frame of reference and

756  
00:31:20,470 --> 00:31:17,760  
it couldn't have originated from any of

757  
00:31:22,950 --> 00:31:20,480  
the nearby stars

758  
00:31:25,669 --> 00:31:22,960  
its brightness changed by a factor of 10

759  
00:31:27,590 --> 00:31:25,679  
that meant a very extreme shape

760  
00:31:28,630 --> 00:31:27,600  
and the best fit to the variation of

761  
00:31:31,110 --> 00:31:28,640  
light

762  
00:31:33,830 --> 00:31:31,120  
was that of a pancake

763  
00:31:35,509 --> 00:31:33,840

these are unusual properties

764

00:31:38,310 --> 00:31:35,519

its reflectance must have been

765

00:31:41,830 --> 00:31:38,320

substantial of the order of five to

766

00:31:44,389 --> 00:31:41,840

twenty percent or more

767

00:31:45,990 --> 00:31:44,399

and it deviated from a capillary and

768

00:31:48,389 --> 00:31:46,000

orbit

769

00:31:50,710 --> 00:31:48,399

without any cometary

770

00:31:52,470 --> 00:31:50,720

tail without any outgassing

771

00:31:54,310 --> 00:31:52,480

that we can detect with the speeds of

772

00:31:56,950 --> 00:31:54,320

space telescope so i suggest that it

773

00:31:58,870 --> 00:31:56,960

must be pushed by sunlight

774

00:32:02,149 --> 00:31:58,880

and then there were a few astronomers

775

00:32:04,710 --> 00:32:02,159

that tried to explain it

776

00:32:06,230 --> 00:32:04,720

from a natural origin

777

00:32:08,789 --> 00:32:06,240

and what were the suggestions the

778

00:32:10,710 --> 00:32:08,799

suggestion was one of them was maybe

779

00:32:13,029 --> 00:32:10,720

it's a dust bunny

780

00:32:16,630 --> 00:32:13,039

it's a cloud of dust particles that is a

781

00:32:18,389 --> 00:32:16,640

100 times less dense than air

782

00:32:20,870 --> 00:32:18,399

so that it's pushed by reflecting

783

00:32:23,190 --> 00:32:20,880

sunlight because it's very lightweight

784

00:32:24,630 --> 00:32:23,200

the problem with that is such a very

785

00:32:25,750 --> 00:32:24,640

fluffy

786

00:32:28,070 --> 00:32:25,760

cloud

787

00:32:29,990 --> 00:32:28,080

would get disrupted as it gets heated by

788

00:32:32,149 --> 00:32:30,000

hundreds of degrees when it gets close

789

00:32:35,350 --> 00:32:32,159

to the sun it's very difficult to

790

00:32:37,750 --> 00:32:35,360

imagine that it will maintain its

791

00:32:40,149 --> 00:32:37,760

integrity because its material strength

792

00:32:41,669 --> 00:32:40,159

is not very high

793

00:32:43,350 --> 00:32:41,679

then there was a situation maybe it's a

794

00:32:45,590 --> 00:32:43,360

hydrogen iceberg

795

00:32:47,750 --> 00:32:45,600

a chunk of frozen hydrogen so that when

796

00:32:49,190 --> 00:32:47,760

hydrogen evaporates it's transparent and

797

00:32:51,029 --> 00:32:49,200

you can't see it

798

00:32:53,430 --> 00:32:51,039

the problem with that is hydrogen

799

00:32:55,990 --> 00:32:53,440

evaporates very easily so it wouldn't

800

00:32:57,110 --> 00:32:56,000

survive the travel through interstellar

801  
00:32:58,630 --> 00:32:57,120  
space

802  
00:33:00,470 --> 00:32:58,640  
it would evaporate within a million

803  
00:33:02,070 --> 00:33:00,480  
years or so

804  
00:33:03,909 --> 00:33:02,080  
then there was a suggestion maybe it's a

805  
00:33:06,070 --> 00:33:03,919  
nitrogen iceberg

806  
00:33:07,909 --> 00:33:06,080  
all of these things are

807  
00:33:09,669 --> 00:33:07,919  
something that we've never seen before

808  
00:33:12,389 --> 00:33:09,679  
we don't know if hydrogen icebergs are

809  
00:33:15,669 --> 00:33:12,399  
made in nature we don't know if nitrogen

810  
00:33:17,830 --> 00:33:15,679  
icebergs are common and in fact

811  
00:33:18,549 --> 00:33:17,840  
there is just not enough nitrogen to

812  
00:33:21,830 --> 00:33:18,559  
make

813  
00:33:24,470 --> 00:33:21,840

enough chunks of nitrogen to explain mua

814

00:33:26,230 --> 00:33:24,480

so here are a couple of plots from

815

00:33:28,710 --> 00:33:26,240

papers that i've written

816

00:33:31,430 --> 00:33:28,720

in one on the left we show that for a

817

00:33:32,710 --> 00:33:31,440

hydrogen iceberg the lifetime

818

00:33:34,870 --> 00:33:32,720

over which

819

00:33:35,750 --> 00:33:34,880

it would get evaporated is a few million

820

00:33:36,789 --> 00:33:35,760

years

821

00:33:39,990 --> 00:33:36,799

and

822

00:33:42,070 --> 00:33:40,000

that allows such a hydrogen iceberg to

823

00:33:43,430 --> 00:33:42,080

traverse a distance that is only one

824

00:33:46,470 --> 00:33:43,440

percent

825

00:33:49,509 --> 00:33:46,480

of the scale of the milky way galaxy so

826

00:33:51,190 --> 00:33:49,519

it must have originated very nearby and

827

00:33:53,509 --> 00:33:51,200

you know there aren't molecular clouds

828

00:33:55,350 --> 00:33:53,519

that could have produced it so nearby to

829

00:33:57,029 --> 00:33:55,360

to to earth you know that it just

830

00:33:59,830 --> 00:33:57,039

doesn't make much we don't even know if

831

00:34:01,350 --> 00:33:59,840

a molecular cloud can produce solid

832

00:34:04,230 --> 00:34:01,360

uh hydrogen

833

00:34:06,710 --> 00:34:04,240

with a scale of a football field we've

834

00:34:08,550 --> 00:34:06,720

never seen anything like it

835

00:34:11,190 --> 00:34:08,560

and then there was the nitrogen iceberg

836

00:34:12,629 --> 00:34:11,200

idea again we have never seen anything

837

00:34:14,550 --> 00:34:12,639

like it and that's supposed to be very

838

00:34:16,470 --> 00:34:14,560

common because that's the first object

839

00:34:20,230 --> 00:34:16,480

we see from out from the intestinal

840

00:34:23,190 --> 00:34:20,240

space and for that actually uh cosmic

841

00:34:24,069 --> 00:34:23,200

ray of operation is quite substantial

842

00:34:25,829 --> 00:34:24,079

and

843

00:34:27,990 --> 00:34:25,839

it doesn't last for more than a few

844

00:34:30,310 --> 00:34:28,000

million years and in fact if you want it

845

00:34:32,470 --> 00:34:30,320

to last half a billion years as

846

00:34:35,030 --> 00:34:32,480

conjectured by the people who propose

847

00:34:36,950 --> 00:34:35,040

the nitrogen iceberg hypothesis

848

00:34:40,629 --> 00:34:36,960

then you need the initial size of the

849

00:34:43,589 --> 00:34:40,639

object to be a hundred times bigger

850

00:34:46,389 --> 00:34:43,599

than the size of a muammua

851  
00:34:47,909 --> 00:34:46,399  
so that it evaporates almost completely

852  
00:34:49,430 --> 00:34:47,919  
if you want it to go through

853  
00:34:52,149 --> 00:34:49,440  
interstellar space

854  
00:34:55,510 --> 00:34:52,159  
for uh half a billion years it will have

855  
00:34:57,670 --> 00:34:55,520  
up 99 of its size would get evaporated

856  
00:34:59,750 --> 00:34:57,680  
you will be left with one percent of the

857  
00:35:02,630 --> 00:34:59,760  
original size so you have to start with

858  
00:35:04,950 --> 00:35:02,640  
10 kilometers and then you end up with

859  
00:35:07,109 --> 00:35:04,960  
hundreds of meters but there is a

860  
00:35:09,829 --> 00:35:07,119  
problem with the mass budget of nitrogen

861  
00:35:12,230 --> 00:35:09,839  
there is just not enough nitrogen in the

862  
00:35:16,870 --> 00:35:12,240  
milky way galaxy and we've shown that in

863  
00:35:19,349 --> 00:35:16,880

another paper with my student amir siraj

864

00:35:20,870 --> 00:35:19,359

and this is from a paper that was

865

00:35:22,630 --> 00:35:20,880

published

866

00:35:24,630 --> 00:35:22,640

a month ago

867

00:35:26,470 --> 00:35:24,640

by the people that proposed the hydrogen

868

00:35:29,349 --> 00:35:26,480

iceberg and in the middle of the

869

00:35:31,349 --> 00:35:29,359

abstract they say the hydrogen

870

00:35:34,950 --> 00:35:31,359

and nitrogen models

871

00:35:37,270 --> 00:35:34,960

have serious difficulties

872

00:35:39,670 --> 00:35:37,280

so i say you know if it's something

873

00:35:42,069 --> 00:35:39,680

we've never seen before and those models

874

00:35:45,030 --> 00:35:42,079

have serious difficulties why not

875

00:35:47,190 --> 00:35:45,040

contemplate an artificial origin

876  
00:35:49,990 --> 00:35:47,200  
and my colleagues say

877  
00:35:53,750 --> 00:35:50,000  
forget about it business as usual it's

878  
00:35:56,950 --> 00:35:56,069  
now the way i think of it

879  
00:35:59,670 --> 00:35:56,960  
is

880  
00:36:01,670 --> 00:35:59,680  
when you walk on the beach you see

881  
00:36:04,230 --> 00:36:01,680  
rocks and seashells that are naturally

882  
00:36:06,230 --> 00:36:04,240  
produced but every now and then you may

883  
00:36:08,230 --> 00:36:06,240  
see a plastic bottle

884  
00:36:11,510 --> 00:36:08,240  
and that tells you that there is a

885  
00:36:14,470 --> 00:36:11,520  
civilization out there

886  
00:36:16,230 --> 00:36:14,480  
and if you imagine a caveman

887  
00:36:17,910 --> 00:36:16,240  
finding a cellphone

888  
00:36:18,790 --> 00:36:17,920

the first thing that the caveman would

889

00:36:22,230 --> 00:36:18,800

say

890

00:36:25,349 --> 00:36:22,240

is the cellphone is a rock of a type

891

00:36:28,550 --> 00:36:25,359

that i've never seen before

892

00:36:31,349 --> 00:36:28,560

and that's what my colleagues are saying

893

00:36:34,870 --> 00:36:31,359

is a rock of a type that we have never

894

00:36:37,990 --> 00:36:36,550

but of course that's the beginning of a

895

00:36:41,030 --> 00:36:38,000

learning experience because if the

896

00:36:41,990 --> 00:36:41,040

caveman will press a button

897

00:36:44,630 --> 00:36:42,000

then

898

00:36:45,589 --> 00:36:44,640

he would realize that it can record his

899

00:36:47,270 --> 00:36:45,599

voice

900

00:36:49,910 --> 00:36:47,280

if he will press another button it can

901  
00:36:51,190 --> 00:36:49,920  
record his image at which point it will

902  
00:36:55,030 --> 00:36:51,200  
become clear

903  
00:36:57,430 --> 00:36:55,040  
that this is not a rock

904  
00:37:00,230 --> 00:36:57,440  
so what we need is more data

905  
00:37:01,670 --> 00:37:00,240  
rather than argue business as usual

906  
00:37:03,510 --> 00:37:01,680  
because that would be equivalent to the

907  
00:37:05,510 --> 00:37:03,520  
caveman throwing off the cell phone and

908  
00:37:09,910 --> 00:37:05,520  
saying oh it's just a rock let's forget

909  
00:37:15,030 --> 00:37:12,630  
now there was another object discovered

910  
00:37:16,630 --> 00:37:15,040  
from interstellar space it was given the

911  
00:37:19,349 --> 00:37:16,640  
name borisov

912  
00:37:22,310 --> 00:37:19,359  
after the amateur astronomer that

913  
00:37:25,670 --> 00:37:22,320

discovered it the gennady borisov

914

00:37:28,630 --> 00:37:25,680

and it looked just like a comet

915

00:37:31,510 --> 00:37:28,640

so my colleagues say said

916

00:37:33,589 --> 00:37:31,520

oh borisov looks like a comet

917

00:37:35,109 --> 00:37:33,599

doesn't it convince you that um is

918

00:37:38,310 --> 00:37:35,119

natural

919

00:37:39,270 --> 00:37:38,320

and my answer is if you find a plastic

920

00:37:42,550 --> 00:37:39,280

bottle

921

00:37:44,950 --> 00:37:42,560

and after that you find a rock

922

00:37:47,829 --> 00:37:44,960

it doesn't make the plastic bottle a

923

00:37:51,750 --> 00:37:49,109

and of course

924

00:37:54,790 --> 00:37:51,760

a picture is worth a thousand words

925

00:37:58,630 --> 00:37:54,800

in my case a picture is worth 66 000

926  
00:38:00,630 --> 00:37:58,640  
words the number of words in my book

927  
00:38:03,430 --> 00:38:00,640  
if we had an image like the one

928  
00:38:05,670 --> 00:38:03,440  
presented in this slide that was taken

929  
00:38:08,630 --> 00:38:05,680  
by the osiris-rex

930  
00:38:10,790 --> 00:38:08,640  
uh mission to the asteroid bennu we

931  
00:38:12,550 --> 00:38:10,800  
could have distinguished easily

932  
00:38:15,510 --> 00:38:12,560  
between

933  
00:38:19,349 --> 00:38:15,520  
a rock that we have never seen before

934  
00:38:22,470 --> 00:38:19,359  
and an artificial object

935  
00:38:24,230 --> 00:38:22,480  
that has screws and bolts on it

936  
00:38:28,310 --> 00:38:24,240  
and this mission will actually bring a

937  
00:38:31,109 --> 00:38:28,320  
sample back to earth in 2023

938  
00:38:34,790 --> 00:38:31,119

so just imagine pressing the buttons on

939

00:38:38,790 --> 00:38:36,790

now we tend to think that the play is

940

00:38:39,510 --> 00:38:38,800

about us

941

00:38:41,109 --> 00:38:39,520

but

942

00:38:43,310 --> 00:38:41,119

not so

943

00:38:46,310 --> 00:38:43,320

because the play has been going on for

944

00:38:47,190 --> 00:38:46,320

13.8 billion years we just came at the

945

00:38:50,790 --> 00:38:47,200

end

946

00:38:53,990 --> 00:38:52,790

there was an interesting paper published

947

00:39:02,790 --> 00:38:54,000

in

948

00:39:03,910 --> 00:39:02,800

the city of storm who which is discussed

949

00:39:05,990 --> 00:39:03,920

in the

950

00:39:07,030 --> 00:39:06,000

uh biblical story

951  
00:39:12,230 --> 00:39:07,040  
uh

952  
00:39:13,670 --> 00:39:12,240  
result of

953  
00:39:15,190 --> 00:39:13,680  
a divine

954  
00:39:17,430 --> 00:39:15,200  
intervention that

955  
00:39:19,190 --> 00:39:17,440  
basically punished the residents of the

956  
00:39:22,710 --> 00:39:19,200  
city for their sins

957  
00:39:24,150 --> 00:39:22,720  
but now an archaeological team studied

958  
00:39:25,670 --> 00:39:24,160  
uh

959  
00:39:28,069 --> 00:39:25,680  
a site that

960  
00:39:30,470 --> 00:39:28,079  
represents potentially where the city

961  
00:39:32,950 --> 00:39:30,480  
was located and found that most likely

962  
00:39:37,670 --> 00:39:32,960  
it was hit by a meteor

963  
00:39:40,150 --> 00:39:37,680

and this meteor this rock was heading to

964

00:39:43,109 --> 00:39:40,160

a collision course with earth long

965

00:39:47,109 --> 00:39:43,119

before the city was constructed

966

00:39:50,790 --> 00:39:47,119

long before the people that occupied it

967

00:39:53,349 --> 00:39:50,800

decided to commit their sins

968

00:39:55,670 --> 00:39:53,359

and it had nothing to do with their

969

00:39:58,470 --> 00:39:55,680

actions we tend to think that the play

970

00:40:00,230 --> 00:39:58,480

is about us we do something and we get

971

00:40:03,030 --> 00:40:00,240

punished we do something and something

972

00:40:04,950 --> 00:40:03,040

from the sky reflects that no not at all

973

00:40:08,230 --> 00:40:04,960

has nothing to it's a rock that was

974

00:40:10,550 --> 00:40:08,240

heading towards earth long ago and just

975

00:40:12,950 --> 00:40:10,560

impacted this city

976  
00:40:14,950 --> 00:40:12,960  
and then we interpret it in that way so

977  
00:40:18,150 --> 00:40:14,960  
there is this human tendency of thinking

978  
00:40:21,670 --> 00:40:18,160  
that we are everything is about us no

979  
00:40:25,030 --> 00:40:21,680  
it's not we might be just one ant

980  
00:40:25,990 --> 00:40:25,040  
out of many on the sidewalk of the milky

981  
00:40:27,589 --> 00:40:26,000  
way

982  
00:40:30,390 --> 00:40:27,599  
we are not

983  
00:40:36,390 --> 00:40:30,400  
central players

984  
00:40:40,470 --> 00:40:38,950  
and uh one way to find out if there are

985  
00:40:43,670 --> 00:40:40,480  
other players is

986  
00:40:45,910 --> 00:40:43,680  
to look in addition uh to searching for

987  
00:40:47,589 --> 00:40:45,920  
technological relics like the galileo

988  
00:40:49,510 --> 00:40:47,599

project is trying to do we can search

989

00:40:51,589 --> 00:40:49,520

for industrial pollution in the

990

00:40:54,870 --> 00:40:51,599

atmospheres of other planets

991

00:40:57,829 --> 00:40:54,880

we can search for city lights on the

992

00:40:59,270 --> 00:40:57,839

night side of proxima b that's a paper

993

00:41:01,430 --> 00:40:59,280

we've written with a student from

994

00:41:03,670 --> 00:41:01,440

stanford a few months ago

995

00:41:07,670 --> 00:41:03,680

you can search for light beams that are

996

00:41:11,510 --> 00:41:07,680

used to propel light sails

997

00:41:13,750 --> 00:41:11,520

and enrico fermi 70 years ago asked

998

00:41:16,710 --> 00:41:13,760

where is everybody

999

00:41:19,030 --> 00:41:16,720

well that to me is very presumptuous

1000

00:41:21,109 --> 00:41:19,040

because it's just like saying i don't

1001  
00:41:23,270 --> 00:41:21,119  
hear a knock on my door

1002  
00:41:25,750 --> 00:41:23,280  
i don't see anyone having a party in my

1003  
00:41:27,109 --> 00:41:25,760  
backyard therefore i don't have

1004  
00:41:29,270 --> 00:41:27,119  
neighbors

1005  
00:41:32,550 --> 00:41:29,280  
well just think about it we've been

1006  
00:41:33,589 --> 00:41:32,560  
documenting our history only for 10 000

1007  
00:41:35,910 --> 00:41:33,599  
years

1008  
00:41:37,910 --> 00:41:35,920  
that's one millionth

1009  
00:41:40,550 --> 00:41:37,920  
of the age

1010  
00:41:42,630 --> 00:41:40,560  
of the earth so why

1011  
00:41:46,309 --> 00:41:42,640  
would they visit us

1012  
00:41:48,550 --> 00:41:46,319  
just when we are ready to look for them

1013  
00:41:50,230 --> 00:41:48,560

you know they could have visited us

1014

00:41:52,550 --> 00:41:50,240

millions of years ago if they visited a

1015

00:41:57,349 --> 00:41:52,560

billion years ago there were only

1016

00:42:02,390 --> 00:41:59,670

and moreover it's possible that most of

1017

00:42:05,910 --> 00:42:02,400

those civilizations predated us by a

1018

00:42:08,870 --> 00:42:05,920

long time so by now they're dead

1019

00:42:11,109 --> 00:42:08,880

but we can still search

1020

00:42:13,829 --> 00:42:11,119

for their relics sort of like doing

1021

00:42:17,030 --> 00:42:13,839

archaeology

1022

00:42:19,349 --> 00:42:17,040

and my hope is that this will change the

1023

00:42:21,190 --> 00:42:19,359

way we treat each other

1024

00:42:24,550 --> 00:42:21,200

because if you look at human history

1025

00:42:26,790 --> 00:42:24,560

what you find over and over again

1026  
00:42:30,470 --> 00:42:26,800  
is this tendency of a group of people to

1027  
00:42:33,990 --> 00:42:30,480  
feel superior relative to other people

1028  
00:42:36,550 --> 00:42:34,000  
the best example is the second world war

1029  
00:42:41,670 --> 00:42:36,560  
where the nazi regime

1030  
00:42:43,990 --> 00:42:41,680  
triggered the death of 75 million people

1031  
00:42:47,589 --> 00:42:44,000  
that was three percent of the world

1032  
00:42:50,390 --> 00:42:47,599  
population in 1940

1033  
00:42:52,069 --> 00:42:50,400  
and just think about it it's 20 times

1034  
00:42:55,589 --> 00:42:52,079  
more deaths

1035  
00:43:01,589 --> 00:42:59,829  
caused by the covet 19 pandemic and we

1036  
00:43:03,829 --> 00:43:01,599  
speak about coving 19 for a year and a

1037  
00:43:06,470 --> 00:43:03,839  
half but there was a group of people

1038  
00:43:08,150 --> 00:43:06,480

that killed 20 times more

1039

00:43:11,349 --> 00:43:08,160

than the virus

1040

00:43:13,829 --> 00:43:11,359

just because they felt superior

1041

00:43:16,309 --> 00:43:13,839

just think about it

1042

00:43:19,510 --> 00:43:16,319

and uh if we now

1043

00:43:21,670 --> 00:43:19,520

uh imagine finding

1044

00:43:23,670 --> 00:43:21,680

evidence for a civilization far more

1045

00:43:26,550 --> 00:43:23,680

advanced than we are for example if you

1046

00:43:29,270 --> 00:43:26,560

imagine the perseverance rover

1047

00:43:31,750 --> 00:43:29,280

instead of finding evidence for microbes

1048

00:43:34,309 --> 00:43:31,760

on the surface of mars

1049

00:43:36,630 --> 00:43:34,319

you know microbes are

1050

00:43:38,790 --> 00:43:36,640

things that we can feel superior

1051

00:43:41,589 --> 00:43:38,800

relative to but imagine that

1052

00:43:44,710 --> 00:43:41,599

the perseverance rover would bump

1053

00:43:46,790 --> 00:43:44,720

into the wreckage of a spaceship

1054

00:43:49,990 --> 00:43:46,800

that represents technology

1055

00:43:53,109 --> 00:43:50,000

far more advanced than we ever produced

1056

00:43:56,069 --> 00:43:53,119

that would be a blow to the ego

1057

00:43:58,230 --> 00:43:56,079

of many entrepreneurs here on earth

1058

00:43:59,430 --> 00:43:58,240

here is a civilization far more advanced

1059

00:44:01,430 --> 00:43:59,440

than we are

1060

00:44:02,950 --> 00:44:01,440

that produce something

1061

00:44:05,270 --> 00:44:02,960

and my point is

1062

00:44:07,109 --> 00:44:05,280

if we become modest

1063

00:44:09,990 --> 00:44:07,119

it will serve a very important purpose

1064

00:44:11,990 --> 00:44:10,000

because we would realize that all of our

1065

00:44:14,790 --> 00:44:12,000

genetic differences

1066

00:44:18,470 --> 00:44:14,800

are really meaningless

1067

00:44:21,109 --> 00:44:18,480

when there is a smarter kid on the block

1068

00:44:24,790 --> 00:44:21,119

that in fact the

1069

00:44:27,109 --> 00:44:24,800

these small differences that outline the

1070

00:44:30,470 --> 00:44:27,119

uh nazi doctrine

1071

00:44:33,510 --> 00:44:30,480

uh should be forgotten and that we

1072

00:44:37,589 --> 00:44:33,520

should treat each other with respect as

1073

00:44:40,870 --> 00:44:37,599

equal members of the human species

1074

00:44:43,430 --> 00:44:40,880

and so my hope is that finding relics of

1075

00:44:44,550 --> 00:44:43,440

a more intelligent culture would inspire

1076

00:44:46,550 --> 00:44:44,560

us

1077

00:44:48,230 --> 00:44:46,560

to behave better

1078

00:44:50,950 --> 00:44:48,240

thank you i'm actually reading

1079

00:44:52,870 --> 00:44:50,960

extraterrestrial right now

1080

00:44:54,950 --> 00:44:52,880

i'm about two-thirds into the book and i

1081

00:44:56,710 --> 00:44:54,960

i'm enjoying it immensely

1082

00:44:58,550 --> 00:44:56,720

so that this is a plug

1083

00:45:01,109 --> 00:44:58,560

for your book uh but you know one of the

1084

00:45:02,870 --> 00:45:01,119

things i i find interesting um you know

1085

00:45:04,390 --> 00:45:02,880

the sse

1086

00:45:07,190 --> 00:45:04,400

we are you know we provide a

1087

00:45:08,390 --> 00:45:07,200

professional forum for topics that cross

1088

00:45:10,230 --> 00:45:08,400

disciplines

1089

00:45:11,670 --> 00:45:10,240

for topics that don't quite have a

1090

00:45:13,030 --> 00:45:11,680

scientific home

1091

00:45:15,430 --> 00:45:13,040

but also

1092

00:45:17,750 --> 00:45:15,440

for discussion of those factors

1093

00:45:20,309 --> 00:45:17,760

that limit the scope of scientific

1094

00:45:23,030 --> 00:45:20,319

inquiry uh whether that be

1095

00:45:25,270 --> 00:45:23,040

sociological constraints theoretical

1096

00:45:27,829 --> 00:45:25,280

assumptions and so when i'm reading your

1097

00:45:30,390 --> 00:45:27,839

book one thing i'm really enjoying

1098

00:45:32,470 --> 00:45:30,400

is um you kind of you have a perspective

1099

00:45:33,750 --> 00:45:32,480

that i a fresh way of saying things that

1100

00:45:35,589 --> 00:45:33,760

i'm not familiar with even though i've

1101

00:45:37,430 --> 00:45:35,599

been working in edge science fields for

1102

00:45:39,910 --> 00:45:37,440

almost 20 years

1103

00:45:41,510 --> 00:45:39,920

about you know public science about

1104

00:45:43,990 --> 00:45:41,520

public scholarship

1105

00:45:46,390 --> 00:45:44,000

um and and about you know some of those

1106

00:45:47,589 --> 00:45:46,400

factors that that do limit scientific

1107

00:45:49,510 --> 00:45:47,599

inquiry

1108

00:45:51,349 --> 00:45:49,520

one of the analogies that you made and

1109

00:45:53,910 --> 00:45:51,359

forgive me if i'm repeating it

1110

00:45:56,069 --> 00:45:53,920

incorrectly so please correct me but you

1111

00:45:58,470 --> 00:45:56,079

mentioned that when um when it comes to

1112

00:45:59,589 --> 00:45:58,480

this decisions of funding agencies you

1113

00:46:02,630 --> 00:45:59,599

know when we look at our personal

1114

00:46:05,270 --> 00:46:02,640

finances or and and financial reports

1115

00:46:08,150 --> 00:46:05,280

that usually there's about a 20 percent

1116

00:46:09,910 --> 00:46:08,160

that we're willing to to to to have a

1117

00:46:12,470 --> 00:46:09,920

risk on to put some risk in our

1118

00:46:13,910 --> 00:46:12,480

investments on a small percentage uh yet

1119

00:46:15,990 --> 00:46:13,920

we don't see that when it comes to

1120

00:46:17,430 --> 00:46:16,000

public funding of science

1121

00:46:19,109 --> 00:46:17,440

um and so i was wondering if you could

1122

00:46:20,309 --> 00:46:19,119

say a little bit more about that like

1123

00:46:22,630 --> 00:46:20,319

like why do you

1124

00:46:24,710 --> 00:46:22,640

see anybody doing better yeah this is

1125

00:46:27,190 --> 00:46:24,720

really strange because you would expect

1126  
00:46:28,710 --> 00:46:27,200  
academia to be much more open-minded and

1127  
00:46:30,230 --> 00:46:28,720  
blue-sky

1128  
00:46:31,990 --> 00:46:30,240  
oriented but

1129  
00:46:34,790 --> 00:46:32,000  
what you find is that people are driven

1130  
00:46:36,950 --> 00:46:34,800  
by the wrong motivation they are driven

1131  
00:46:39,829 --> 00:46:36,960  
to empower themselves that to improve

1132  
00:46:41,910 --> 00:46:39,839  
their image not to take risks so that

1133  
00:46:43,670 --> 00:46:41,920  
they will never make mistakes and you

1134  
00:46:45,910 --> 00:46:43,680  
know that's the wrong attitude the

1135  
00:46:48,950 --> 00:46:45,920  
approach in science should be let's

1136  
00:46:50,870 --> 00:46:48,960  
learn about the world about reality and

1137  
00:46:52,309 --> 00:46:50,880  
of course we must make some predictions

1138  
00:46:54,069 --> 00:46:52,319

that will turn out to be wrong you know

1139

00:46:55,270 --> 00:46:54,079

einstein was wrong three times at the

1140

00:46:57,829 --> 00:46:55,280

end of his

1141

00:46:59,510 --> 00:46:57,839

career and then he he argued that black

1142

00:47:01,510 --> 00:46:59,520

holes do not exist gravitational waves

1143

00:47:03,589 --> 00:47:01,520

do not exist quantum mechanics doesn't

1144

00:47:05,030 --> 00:47:03,599

have spooky action at the distance but

1145

00:47:07,910 --> 00:47:05,040

that's because he worked on the

1146

00:47:10,950 --> 00:47:07,920

frontiers and we need to accept that and

1147

00:47:14,790 --> 00:47:10,960

instead what you see nowadays is a

1148

00:47:16,790 --> 00:47:14,800

tendency to win honors awards to be

1149

00:47:18,550 --> 00:47:16,800

respected to be liked

1150

00:47:21,270 --> 00:47:18,560

on social media

1151

00:47:24,470 --> 00:47:21,280

and what that means is that you take

1152

00:47:26,150 --> 00:47:24,480

very few risks so for example in the uh

1153

00:47:28,390 --> 00:47:26,160

in the context of theoretical physics

1154

00:47:30,549 --> 00:47:28,400

there are speculative ideas about the

1155

00:47:32,870 --> 00:47:30,559

string theory landscape about the

1156

00:47:35,589 --> 00:47:32,880

multiverse about extra dimensions and

1157

00:47:37,990 --> 00:47:35,599

you ask yourself how come people engage

1158

00:47:40,390 --> 00:47:38,000

in this for several decades as the

1159

00:47:42,390 --> 00:47:40,400

mainstream and take it seriously and

1160

00:47:44,710 --> 00:47:42,400

give each other rewards for just solving

1161

00:47:46,870 --> 00:47:44,720

some equations and doing fancy math and

1162

00:47:49,270 --> 00:47:46,880

the answer is because their objective is

1163

00:47:51,430 --> 00:47:49,280

to look smart that's their objective not

1164

00:47:53,670 --> 00:47:51,440

to understand the world and they don't

1165

00:47:55,829 --> 00:47:53,680

put any skin in the game they don't make

1166

00:47:58,150 --> 00:47:55,839

a prediction that can be proven wrong

1167

00:47:59,750 --> 00:47:58,160

and that they have a common thread with

1168

00:48:01,990 --> 00:47:59,760

the community of conservative

1169

00:48:04,230 --> 00:48:02,000

astronomers that would say forget about

1170

00:48:06,790 --> 00:48:04,240

the unusual properties of

1171

00:48:09,990 --> 00:48:06,800

we don't want to discuss it it's natural

1172

00:48:12,470 --> 00:48:10,000

and the end of the story uh and

1173

00:48:14,390 --> 00:48:12,480

i i find a common thread here which is

1174

00:48:17,510 --> 00:48:14,400

not to pay attention to evidences

1175

00:48:18,309 --> 00:48:17,520

guiding us and the one analogy i make is

1176

00:48:20,630 --> 00:48:18,319

with

1177

00:48:22,390 --> 00:48:20,640

bernie madoff you know he claimed

1178

00:48:24,470 --> 00:48:22,400

uh that he can make more money if you

1179

00:48:26,150 --> 00:48:24,480

give him your money he will make more of

1180

00:48:28,870 --> 00:48:26,160

it irrespective of what the stock market

1181

00:48:31,030 --> 00:48:28,880

does and the people were happy with that

1182

00:48:32,870 --> 00:48:31,040

idea it was a beautiful idea just like

1183

00:48:35,190 --> 00:48:32,880

the idea of the multiverse you know it's

1184

00:48:37,270 --> 00:48:35,200

a beautiful idea i don't argue with the

1185

00:48:38,950 --> 00:48:37,280

fact that it's beautiful and people were

1186

00:48:40,630 --> 00:48:38,960

so happy about the beautiful idea of

1187

00:48:42,390 --> 00:48:40,640

bernie madoff that they gave him their

1188

00:48:44,710 --> 00:48:42,400

money what could be better evidence than

1189

00:48:46,950 --> 00:48:44,720

that and then he was very happy because

1190

00:48:49,430 --> 00:48:46,960

they gave him his their money so he

1191

00:48:51,589 --> 00:48:49,440

could use it and everyone was happy

1192

00:48:53,670 --> 00:48:51,599

until they did the experiment which was

1193

00:48:55,829 --> 00:48:53,680

to ask for their money back and when

1194

00:48:57,190 --> 00:48:55,839

they did the experiment he was put in

1195

00:48:59,190 --> 00:48:57,200

jail now

1196

00:49:01,349 --> 00:48:59,200

at the only way for us to figure out if

1197

00:49:03,910 --> 00:49:01,359

an idea that looks beautiful to all of

1198

00:49:06,309 --> 00:49:03,920

us to everyone on social media to all

1199

00:49:07,829 --> 00:49:06,319

the tweets that like it

1200

00:49:11,270 --> 00:49:07,839

the only way for us to figure out if

1201

00:49:12,630 --> 00:49:11,280

it's real or not is to do an experiment

1202

00:49:14,870 --> 00:49:12,640

because we want to figure out whether

1203

00:49:16,710 --> 00:49:14,880

it's a ponzi scheme or not it could be

1204

00:49:18,150 --> 00:49:16,720

beautiful but it could still be a ponzi

1205

00:49:19,990 --> 00:49:18,160

scheme and

1206

00:49:21,910 --> 00:49:20,000

how do we figure it out by doing the

1207

00:49:23,510 --> 00:49:21,920

experiment now if you shy away from

1208

00:49:25,109 --> 00:49:23,520

experiments because you don't want to

1209

00:49:27,430 --> 00:49:25,119

put any skin in the game you don't want

1210

00:49:28,870 --> 00:49:27,440

to risk your reputation you shy away

1211

00:49:31,910 --> 00:49:28,880

from that you do just mathematical

1212

00:49:34,710 --> 00:49:31,920

gymnastics basically ask how many angels

1213

00:49:35,910 --> 00:49:34,720

can dance on the tip of a pin in 10

1214

00:49:37,510 --> 00:49:35,920

dimensions

1215

00:49:39,910 --> 00:49:37,520

it's a beautiful question you can

1216

00:49:41,829 --> 00:49:39,920

develop fancy math to

1217

00:49:43,990 --> 00:49:41,839

you know describe the the dance of the

1218

00:49:45,990 --> 00:49:44,000

angels on the tip of a pin it's not

1219

00:49:48,069 --> 00:49:46,000

relevant to anything that

1220

00:49:49,109 --> 00:49:48,079

you know touches on the daily lives of

1221

00:49:51,990 --> 00:49:49,119

people

1222

00:49:54,470 --> 00:49:52,000

and on the other hand if there is

1223

00:49:56,230 --> 00:49:54,480

a smarter kid on our cosmic block that

1224

00:49:59,190 --> 00:49:56,240

would have a huge impact on the future

1225

00:50:01,910 --> 00:49:59,200

of society and you find ridicule and

1226  
00:50:03,990 --> 00:50:01,920  
push back on discussing that and i ask

1227  
00:50:06,150 --> 00:50:04,000  
you how is that possible something is

1228  
00:50:08,549 --> 00:50:06,160  
really wrong with the current culture in

1229  
00:50:10,950 --> 00:50:08,559  
academia and the way i see it you know

1230  
00:50:13,349 --> 00:50:10,960  
it reminds me when i was a kid the most

1231  
00:50:14,150 --> 00:50:13,359  
vivid memory i have from my childhood

1232  
00:50:16,870 --> 00:50:14,160  
was

1233  
00:50:19,190 --> 00:50:16,880  
attending dinner and asking a difficult

1234  
00:50:20,870 --> 00:50:19,200  
question and then the adults in the room

1235  
00:50:22,470 --> 00:50:20,880  
would pretend that they know much more

1236  
00:50:25,270 --> 00:50:22,480  
than they actually know

1237  
00:50:27,349 --> 00:50:25,280  
and then that was the good experience

1238  
00:50:29,190 --> 00:50:27,359

the bad experience was when the adults

1239

00:50:30,870 --> 00:50:29,200

would simply ridicule the question

1240

00:50:32,150 --> 00:50:30,880

dismiss it simply because they didn't

1241

00:50:35,030 --> 00:50:32,160

know the answer

1242

00:50:37,910 --> 00:50:35,040

and i thought that by entering science i

1243

00:50:40,309 --> 00:50:37,920

would be surrounded by like-minded

1244

00:50:43,270 --> 00:50:40,319

people that want to figure out the world

1245

00:50:46,150 --> 00:50:43,280

without putting their ego first

1246

00:50:48,309 --> 00:50:46,160

okay and unfortunately what i find is a

1247

00:50:49,349 --> 00:50:48,319

completely different reality i basically

1248

00:50:52,790 --> 00:50:49,359

uh

1249

00:50:55,750 --> 00:50:52,800

get a deja vu feeling when i interact

1250

00:50:59,910 --> 00:50:55,760

with people in academia these days of

1251

00:51:01,430 --> 00:50:59,920

the way i felt when i was a child

1252

00:51:03,430 --> 00:51:01,440

yeah that's a really good analogy that

1253

00:51:05,589 --> 00:51:03,440

makes a lot of sense um we've got a lot

1254

00:51:09,190 --> 00:51:05,599

of questions lined up here

1255

00:51:11,270 --> 00:51:09,200

um so here's this is a quick one uh what

1256

00:51:13,109 --> 00:51:11,280

is the status of the breakthrough

1257

00:51:15,829 --> 00:51:13,119

starshot effort

1258

00:51:19,270 --> 00:51:15,839

so we defined the three challenges that

1259

00:51:21,829 --> 00:51:19,280

are the major ones to address first and

1260

00:51:24,710 --> 00:51:21,839

those are uh first

1261

00:51:26,950 --> 00:51:24,720

how to develop the laser beam such that

1262

00:51:29,750 --> 00:51:26,960

you know we can combine many small power

1263

00:51:32,630 --> 00:51:29,760

lasers into one coherent beam that we

1264

00:51:35,270 --> 00:51:32,640

call the photon engine and we have an

1265

00:51:37,030 --> 00:51:35,280

effort on that we allocated funds to

1266

00:51:39,510 --> 00:51:37,040

individual research groups trying to

1267

00:51:40,309 --> 00:51:39,520

address that then the second challenge

1268

00:51:42,790 --> 00:51:40,319

is

1269

00:51:44,950 --> 00:51:42,800

uh the light sale uh finding the right

1270

00:51:47,190 --> 00:51:44,960

material and the shape of the light cell

1271

00:51:49,829 --> 00:51:47,200

that's the second challenge for which we

1272

00:51:52,390 --> 00:51:49,839

awarded about more than a dozen or two

1273

00:51:53,750 --> 00:51:52,400

dozen grants already

1274

00:51:55,990 --> 00:51:53,760

and then the third challenge is

1275

00:51:58,950 --> 00:51:56,000

communication which we just awarded

1276  
00:52:01,510 --> 00:51:58,960  
there's some grants recently um how to

1277  
00:52:04,069 --> 00:52:01,520  
communicate across four light years so

1278  
00:52:05,990 --> 00:52:04,079  
we are still in the phase where we hope

1279  
00:52:08,150 --> 00:52:06,000  
to bring together the conclusions from

1280  
00:52:10,150 --> 00:52:08,160  
these early studies and see

1281  
00:52:12,549 --> 00:52:10,160  
if there is any showstopper that's

1282  
00:52:14,870 --> 00:52:12,559  
that's the main question if if something

1283  
00:52:17,270 --> 00:52:14,880  
looks completely

1284  
00:52:18,790 --> 00:52:17,280  
infeasible unfeasible you know not

1285  
00:52:19,510 --> 00:52:18,800  
practical then

1286  
00:52:21,990 --> 00:52:19,520  
we

1287  
00:52:24,390 --> 00:52:22,000  
might decide to give up on this but so

1288  
00:52:26,790 --> 00:52:24,400

far it doesn't look that way and

1289

00:52:29,030 --> 00:52:26,800

we have various suggestions for solving

1290

00:52:30,150 --> 00:52:29,040

these challenges

1291

00:52:32,150 --> 00:52:30,160

okay

1292

00:52:34,630 --> 00:52:32,160

um another question is about the general

1293

00:52:36,710 --> 00:52:34,640

attitude of the international community

1294

00:52:39,430 --> 00:52:36,720

has it changed somewhat in recent years

1295

00:52:41,349 --> 00:52:39,440

uh regarding for instance the pentagon

1296

00:52:43,190 --> 00:52:41,359

videos uh with regard to

1297

00:52:45,030 --> 00:52:43,200

extraterrestrial life

1298

00:52:47,589 --> 00:52:45,040

no i mean i i wouldn't say that it

1299

00:52:48,630 --> 00:52:47,599

changed um what i would say is that the

1300

00:52:51,670 --> 00:52:48,640

public

1301  
00:52:53,910 --> 00:52:51,680  
has its heart in the right place uh and

1302  
00:52:56,549 --> 00:52:53,920  
of course the government did change the

1303  
00:52:58,309 --> 00:52:56,559  
tone of its discussions on this subject

1304  
00:53:00,390 --> 00:52:58,319  
the latest development is the congress

1305  
00:53:02,470 --> 00:53:00,400  
asking to establish this department that

1306  
00:53:05,430 --> 00:53:02,480  
will deal with unidentified aerial

1307  
00:53:07,430 --> 00:53:05,440  
phenomena and what i'm

1308  
00:53:09,829 --> 00:53:07,440  
trying to change is through the galileo

1309  
00:53:12,069 --> 00:53:09,839  
project to bring this subject into the

1310  
00:53:13,829 --> 00:53:12,079  
mainstream of science and it's still

1311  
00:53:15,990 --> 00:53:13,839  
being ridiculous

1312  
00:53:18,790 --> 00:53:16,000  
this project is funded by

1313  
00:53:20,549 --> 00:53:18,800

donations that we're not allocating this

1314

00:53:23,030 --> 00:53:20,559

these funds to anything

1315

00:53:24,390 --> 00:53:23,040

else you know that's new money so to

1316

00:53:25,430 --> 00:53:24,400

speak

1317

00:53:27,750 --> 00:53:25,440

and

1318

00:53:29,190 --> 00:53:27,760

moreover we are seeking evidence you

1319

00:53:31,349 --> 00:53:29,200

know that's is

1320

00:53:34,470 --> 00:53:31,359

the natural way that science progresses

1321

00:53:36,630 --> 00:53:34,480

by evidence so i cannot understand why a

1322

00:53:39,750 --> 00:53:36,640

scientist would have a problem with this

1323

00:53:41,589 --> 00:53:39,760

project that is funded by donations that

1324

00:53:42,630 --> 00:53:41,599

were not allocating funds to science

1325

00:53:43,670 --> 00:53:42,640

before

1326

00:53:46,470 --> 00:53:43,680

and

1327

00:53:48,790 --> 00:53:46,480

that is trying to seek evidence to me it

1328

00:53:51,349 --> 00:53:48,800

sounds like a win-win proposition

1329

00:53:54,069 --> 00:53:51,359

nevertheless you know we don't get

1330

00:53:57,270 --> 00:53:54,079

support from uh many people but there

1331

00:53:59,190 --> 00:53:57,280

are uh 70 scientists engaged in the

1332

00:54:01,510 --> 00:53:59,200

project and are very enthusiastic about

1333

00:54:04,470 --> 00:54:01,520

it so my hope is this will break the ice

1334

00:54:07,430 --> 00:54:04,480

and change the way that this subject is

1335

00:54:09,270 --> 00:54:07,440

treated because you know i don't regard

1336

00:54:11,829 --> 00:54:09,280

it as more speculative than the search

1337

00:54:14,069 --> 00:54:11,839

for weakly interacting massive particles

1338

00:54:16,630 --> 00:54:14,079

is the dark matter which hasn't found

1339

00:54:19,030 --> 00:54:16,640

them yet

1340

00:54:21,190 --> 00:54:19,040

so we have a question a raised hand from

1341

00:54:28,069 --> 00:54:21,200

one of our student members so i'm gonna

1342

00:54:31,750 --> 00:54:29,510

hey um

1343

00:54:33,430 --> 00:54:31,760

so i had a comment about einstein he was

1344

00:54:35,510 --> 00:54:33,440

wrong a lot more than three times with

1345

00:54:38,870 --> 00:54:35,520

all the teleparalism and all those but

1346

00:54:40,470 --> 00:54:38,880

um as a question i guess

1347

00:54:41,670 --> 00:54:40,480

it's more a question of tone and

1348

00:54:44,150 --> 00:54:41,680

humbleness than necessarily like

1349

00:54:45,829 --> 00:54:44,160

scientific fact is so you convinced me

1350

00:54:47,190 --> 00:54:45,839

that um

1351  
00:54:48,870 --> 00:54:47,200  
there's very compelling evidence that

1352  
00:54:49,990 --> 00:54:48,880  
there's an anomaly that we can't explain

1353  
00:54:50,829 --> 00:54:50,000  
with you know

1354  
00:54:53,270 --> 00:54:50,839  
any

1355  
00:54:55,270 --> 00:54:53,280  
conceivable current theory we're going

1356  
00:54:57,030 --> 00:54:55,280  
to these very elaborate speculative

1357  
00:54:58,789 --> 00:54:57,040  
hydrogen icebergs to try and explain it

1358  
00:54:59,990 --> 00:54:58,799  
but there's also i think

1359  
00:55:01,109 --> 00:55:00,000  
at least to me there's an equivalent

1360  
00:55:03,910 --> 00:55:01,119  
danger of

1361  
00:55:05,510 --> 00:55:03,920  
generalizing on one anomaly to these

1362  
00:55:07,670 --> 00:55:05,520  
very very large metaphysical

1363  
00:55:09,430 --> 00:55:07,680

implications of there are aliens that

1364

00:55:11,190 --> 00:55:09,440

have obviously a very big impact in the

1365

00:55:12,710 --> 00:55:11,200

public and i guess the question is you

1366

00:55:14,390 --> 00:55:12,720

know

1367

00:55:16,390 --> 00:55:14,400

obviously we have to be very careful

1368

00:55:18,150 --> 00:55:16,400

with the facts and and trust them and

1369

00:55:19,670 --> 00:55:18,160

follow them but how do we

1370

00:55:21,349 --> 00:55:19,680

avoid our own hubris and think just

1371

00:55:22,710 --> 00:55:21,359

because we haven't come up with a

1372

00:55:23,990 --> 00:55:22,720

plausible explanation for this that's

1373

00:55:25,750 --> 00:55:24,000

not there so i guess it's just like the

1374

00:55:26,950 --> 00:55:25,760

tone of how we present this as we search

1375

00:55:29,750 --> 00:55:26,960

for more evidence is kind of what i'm

1376

00:55:32,390 --> 00:55:29,760

interested in well okay so science is

1377

00:55:35,510 --> 00:55:32,400

not about so much the presentation it's

1378

00:55:37,270 --> 00:55:35,520

about reality okay so yeah my my point

1379

00:55:38,870 --> 00:55:37,280

about this object is that it's

1380

00:55:42,069 --> 00:55:38,880

intriguing enough

1381

00:55:43,990 --> 00:55:42,079

to motivate us to get better data

1382

00:55:47,030 --> 00:55:44,000

on future objects that belong to the

1383

00:55:49,030 --> 00:55:47,040

same class and that's all that's all so

1384

00:55:51,109 --> 00:55:49,040

the bottom line from this is get more

1385

00:55:52,870 --> 00:55:51,119

evidence get a high resolution image

1386

00:55:53,750 --> 00:55:52,880

from a spacecraft that

1387

00:55:56,710 --> 00:55:53,760

uh

1388

00:55:58,470 --> 00:55:56,720

flies close to a future object that

1389

00:56:00,950 --> 00:55:58,480

doesn't look like a comet or an asteroid

1390

00:56:02,710 --> 00:56:00,960

similar to omuamua that comes from

1391

00:56:06,309 --> 00:56:02,720

interstellar space and get a high

1392

00:56:11,270 --> 00:56:09,030

let's not assume that it's natural let's

1393

00:56:12,710 --> 00:56:11,280

just say it's very intriguing and by the

1394

00:56:14,309 --> 00:56:12,720

way that's the approach of a kid you

1395

00:56:16,710 --> 00:56:14,319

know a kid sees something unusual it

1396

00:56:19,109 --> 00:56:16,720

says what is it let's find out whereas

1397

00:56:22,150 --> 00:56:19,119

the adult says ah it must be something

1398

00:56:23,829 --> 00:56:22,160

that i've seen before and my point is

1399

00:56:25,670 --> 00:56:23,839

you know we we will never learn

1400

00:56:27,750 --> 00:56:25,680

something new if we approach everything

1401

00:56:30,470 --> 00:56:27,760

that doesn't line up with our

1402

00:56:33,750 --> 00:56:30,480

uh prejudice you know and it reminds me

1403

00:56:37,349 --> 00:56:33,760

of a phd thesis defense that i attended

1404

00:56:39,270 --> 00:56:37,359

at harvard where the student was saying

1405

00:56:40,069 --> 00:56:39,280

this is the predict you know i worked

1406

00:56:41,990 --> 00:56:40,079

for

1407

00:56:44,789 --> 00:56:42,000

several years on the prediction from the

1408

00:56:46,950 --> 00:56:44,799

standard model of cosmology

1409

00:56:49,910 --> 00:56:46,960

with respect to this future

1410

00:56:51,829 --> 00:56:49,920

data okay and i said okay now suppose

1411

00:56:53,670 --> 00:56:51,839

the data doesn't agree with what you

1412

00:56:55,589 --> 00:56:53,680

calculated

1413

00:56:57,750 --> 00:56:55,599

would you conclude would you conclude

1414

00:56:58,470 --> 00:56:57,760

that the standard model is wrong and she

1415

00:57:01,109 --> 00:56:58,480

said

1416

00:57:02,950 --> 00:57:01,119

no it may be that something in my

1417

00:57:04,789 --> 00:57:02,960

assumptions is wrong and i say to myself

1418

00:57:06,710 --> 00:57:04,799

that's not a honest scientific

1419

00:57:08,789 --> 00:57:06,720

discussion

1420

00:57:10,309 --> 00:57:08,799

you know the same happened with a senior

1421

00:57:11,910 --> 00:57:10,319

person that talked about string theory

1422

00:57:14,069 --> 00:57:11,920

he gave a talk talking connected string

1423

00:57:16,789 --> 00:57:14,079

theory to the early universe and i said

1424

00:57:18,710 --> 00:57:16,799

oh that's great now if we find something

1425

00:57:20,549 --> 00:57:18,720

that contradicts your predictions about

1426

00:57:23,030 --> 00:57:20,559

the early universe will that rule out

1427

00:57:25,109 --> 00:57:23,040

string theory and he said no it will

1428

00:57:27,589 --> 00:57:25,119

just rule out the connection that i made

1429

00:57:29,510 --> 00:57:27,599

string theory always be right and that

1430

00:57:31,510 --> 00:57:29,520

me that to me and by the way it keeps

1431

00:57:33,109 --> 00:57:31,520

repeating and also in the context of

1432

00:57:35,829 --> 00:57:33,119

you know people said it's a natural

1433

00:57:38,870 --> 00:57:35,839

object and then a few months later they

1434

00:57:40,549 --> 00:57:38,880

said oh no wait maybe it's a hydrogen

1435

00:57:41,990 --> 00:57:40,559

iceberg maybe it's a nitrogen iceberg

1436

00:57:43,430 --> 00:57:42,000

maybe it's a death bunny these were

1437

00:57:46,789 --> 00:57:43,440

different groups of people i say to

1438

00:57:49,430 --> 00:57:46,799

myself how can it be that a big group of

1439

00:57:51,990 --> 00:57:49,440

leaders on the interpretation of rocks

1440

00:57:54,470 --> 00:57:52,000

would declare it natural before other

1441

00:57:56,950 --> 00:57:54,480

people would say would write full papers

1442

00:57:58,470 --> 00:57:56,960

multiple papers

1443

00:58:01,990 --> 00:57:58,480

so i'm saying the scientific

1444

00:58:04,230 --> 00:58:02,000

deliberation currently is not honest

1445

00:58:06,630 --> 00:58:04,240

that's my basic point

1446

00:58:08,789 --> 00:58:06,640

those mainstream people they want the

1447

00:58:10,470 --> 00:58:08,799

conclusion to hold irrespective of the

1448

00:58:13,430 --> 00:58:10,480

facts and what we need is to get more

1449

00:58:15,109 --> 00:58:13,440

facts more evidence that's all thanks

1450

00:58:17,589 --> 00:58:15,119

yeah thank you paul for your question

1451  
00:58:19,430 --> 00:58:17,599  
this is don crosby donder who is one of

1452  
00:58:21,109 --> 00:58:19,440  
our full members and so i will hand him

1453  
00:58:23,030 --> 00:58:21,119  
the mic

1454  
00:58:25,349 --> 00:58:23,040  
so much professor loeb and i already

1455  
00:58:27,190 --> 00:58:25,359  
know each other online and so this is

1456  
00:58:29,270 --> 00:58:27,200  
not our first acquaintance and i don't

1457  
00:58:31,349 --> 00:58:29,280  
have anything to say except positive

1458  
00:58:33,190 --> 00:58:31,359  
things about professor loeb's talk i

1459  
00:58:36,069 --> 00:58:33,200  
just wanted to point out that the

1460  
00:58:38,390 --> 00:58:36,079  
evidence for extraterrestrial presence

1461  
00:58:41,510 --> 00:58:38,400  
collected by other kinds of instruments

1462  
00:58:44,549 --> 00:58:41,520  
cameras radars and eyewitness testimony

1463  
00:58:46,789 --> 00:58:44,559

goes back at least to 1946 and actually

1464

00:58:49,910 --> 00:58:46,799

i've studied some of that evidence

1465

00:58:51,270 --> 00:58:49,920

in hypothesis testing experiments two of

1466

00:58:53,349 --> 00:58:51,280

which have been published in the journal

1467

00:58:56,069 --> 00:58:53,359

of scientific exploration uh that's all

1468

00:58:58,950 --> 00:58:56,079

i have to say it's just that the uh

1469

00:59:01,430 --> 00:58:58,960

amana evidence is new the ufo evidence

1470

00:59:02,950 --> 00:59:01,440

or so-called ufo evidence is not new and

1471

00:59:04,950 --> 00:59:02,960

a lot of it has been verified thanks

1472

00:59:06,549 --> 00:59:04,960

very much i've enjoyed the talk and what

1473

00:59:08,710 --> 00:59:06,559

i think is really that we need to

1474

00:59:09,990 --> 00:59:08,720

collect more evidence that will convince

1475

00:59:11,589 --> 00:59:10,000

the mainstream of the scientific

1476  
00:59:13,430 --> 00:59:11,599  
community that's my approach basically

1477  
00:59:15,910 --> 00:59:13,440  
with the galileo project so

1478  
00:59:17,829 --> 00:59:15,920  
my goal is really to bring it to the

1479  
00:59:19,349 --> 00:59:17,839  
forefront of science rather than being

1480  
00:59:20,789 --> 00:59:19,359  
ridiculed by scientists which is

1481  
00:59:24,950 --> 00:59:20,799  
inappropriate i completely agree with

1482  
00:59:30,789 --> 00:59:27,750  
okay i'm going to now

1483  
00:59:32,390 --> 00:59:30,799  
pass pass the mic to michael nunn

1484  
00:59:33,910 --> 00:59:32,400  
hello

1485  
00:59:35,670 --> 00:59:33,920  
thank you very much for your talk i

1486  
00:59:37,750 --> 00:59:35,680  
really enjoyed it very much and also

1487  
00:59:41,349 --> 00:59:37,760  
like your attitude towards science and

1488  
00:59:42,589 --> 00:59:41,359

scientists now my question is about

1489

00:59:44,950 --> 00:59:42,599

the

1490

00:59:49,030 --> 00:59:44,960

phenomenology of ufos

1491

00:59:53,510 --> 00:59:49,040

who behave rather weird they move in

1492

00:59:56,470 --> 00:59:53,520

weird ways they may disappear and

1493

00:59:59,030 --> 00:59:56,480

appear again so my question is do you

1494

01:00:00,789 --> 00:59:59,040

know these hyper spatial models of your

1495

01:00:02,630 --> 01:00:00,799

colleague bernard carr who is a

1496

01:00:05,270 --> 01:00:02,640

professor of astronomy and at the

1497

01:00:07,910 --> 01:00:05,280

university in london and might it be

1498

01:00:10,549 --> 01:00:07,920

possible that these objects also can

1499

01:00:13,190 --> 01:00:10,559

travel faster than light maybe using

1500

01:00:15,430 --> 01:00:13,200

these types of physics we don't even

1501  
01:00:17,190 --> 01:00:15,440  
know yet so that we might even be able

1502  
01:00:19,430 --> 01:00:17,200  
to accelerate this

1503  
01:00:21,270 --> 01:00:19,440  
process of checking out our universe and

1504  
01:00:22,549 --> 01:00:21,280  
our neighborhood instead of relying on

1505  
01:00:24,789 --> 01:00:22,559  
these um

1506  
01:00:26,069 --> 01:00:24,799  
rather conventional physical

1507  
01:00:28,069 --> 01:00:26,079  
technologies

1508  
01:00:30,710 --> 01:00:28,079  
yeah i mean it's definitely possible

1509  
01:00:31,829 --> 01:00:30,720  
that we will end up finding that

1510  
01:00:36,069 --> 01:00:31,839  
they are

1511  
01:00:38,309 --> 01:00:36,079  
we do not possess that in fact they they

1512  
01:00:40,470 --> 01:00:38,319  
violate what we know about

1513  
01:00:41,349 --> 01:00:40,480

the standard model of physics

1514

01:00:43,109 --> 01:00:41,359

but

1515

01:00:44,950 --> 01:00:43,119

the way that the galileo project will

1516

01:00:46,950 --> 01:00:44,960

approach it is trying without any

1517

01:00:48,630 --> 01:00:46,960

prejudice without any assumptions

1518

01:00:50,150 --> 01:00:48,640

collecting the data and seeing how they

1519

01:00:52,309 --> 01:00:50,160

move now

1520

01:00:53,910 --> 01:00:52,319

i saw a lot of incorrect statements in

1521

01:00:56,549 --> 01:00:53,920

the you know

1522

01:00:58,630 --> 01:00:56,559

out there of peeping people saying oh

1523

01:00:59,829 --> 01:00:58,640

they move very fast and therefore they

1524

01:01:01,670 --> 01:00:59,839

must be

1525

01:01:03,750 --> 01:01:01,680

uh violating the laws of physics that's

1526

01:01:06,150 --> 01:01:03,760

not true because for example uh

1527

01:01:10,549 --> 01:01:06,160

artillery shells you know they move at

1528

01:01:12,470 --> 01:01:10,559

100 000 g and they have um

1529

01:01:13,349 --> 01:01:12,480

electronic equipment

1530

01:01:15,510 --> 01:01:13,359

so

1531

01:01:16,549 --> 01:01:15,520

we ourself are producing

1532

01:01:17,349 --> 01:01:16,559

um

1533

01:01:19,589 --> 01:01:17,359

you know

1534

01:01:22,549 --> 01:01:19,599

objects that can sustain very high

1535

01:01:24,150 --> 01:01:22,559

accelerations with electronics in them

1536

01:01:26,309 --> 01:01:24,160

it doesn't violate the laws of physics

1537

01:01:27,510 --> 01:01:26,319

but if something moves faster than light

1538

01:01:29,270 --> 01:01:27,520

as you said

1539

01:01:31,750 --> 01:01:29,280

that would violate what we know from

1540

01:01:33,510 --> 01:01:31,760

einstein's theory of special relativity

1541

01:01:35,349 --> 01:01:33,520

and that would be really intriguing so

1542

01:01:37,910 --> 01:01:35,359

the way we approach it with the galileo

1543

01:01:40,549 --> 01:01:37,920

project is not to assume anything just

1544

01:01:42,710 --> 01:01:40,559

monitor the motion of these objects and

1545

01:01:45,109 --> 01:01:42,720

get a high resolution image if if

1546

01:01:47,510 --> 01:01:45,119

possible and and then we can analyze the

1547

01:01:49,190 --> 01:01:47,520

data in an open way so everyone can see

1548

01:01:51,670 --> 01:01:49,200

the data it will not be classified

1549

01:01:53,829 --> 01:01:51,680

because the sky is not classified

1550

01:01:55,990 --> 01:01:53,839

and the first assumption would be let's

1551

01:01:58,789 --> 01:01:56,000

try to explain what we see using the

1552

01:02:01,430 --> 01:01:58,799

standard model of physics if we can't it

1553

01:02:02,950 --> 01:02:01,440

would be even a more major discovery not

1554

01:02:05,270 --> 01:02:02,960

only we will find

1555

01:02:07,829 --> 01:02:05,280

something new about our neighbors you

1556

01:02:10,390 --> 01:02:07,839

know but we will also find something new

1557

01:02:13,190 --> 01:02:10,400

about physics which i should say is of

1558

01:02:15,510 --> 01:02:13,200

greater significance because it would

1559

01:02:17,829 --> 01:02:15,520

imply that we understand reality the

1560

01:02:19,349 --> 01:02:17,839

physical laws of nature

1561

01:02:22,150 --> 01:02:19,359

that should apply everywhere in the

1562

01:02:24,470 --> 01:02:22,160

universe in a different way and

1563

01:02:26,470 --> 01:02:24,480

you know i want to do it in steps at

1564

01:02:28,390 --> 01:02:26,480

first assume that the standard laws of

1565

01:02:30,710 --> 01:02:28,400

physics apply and then if we see a

1566

01:02:32,789 --> 01:02:30,720

violation of them conclusively you know

1567

01:02:36,309 --> 01:02:32,799

without any doubt based on all the data

1568

01:02:38,549 --> 01:02:36,319

we have we will report that definitely

1569

01:02:41,589 --> 01:02:38,559

make sense thank you

1570

01:02:44,390 --> 01:02:41,599

thank you michael uh so we do have a

1571

01:02:46,390 --> 01:02:44,400

winning question

1572

01:02:47,990 --> 01:02:46,400

what is what relationship do you have

1573

01:02:49,750 --> 01:02:48,000

with the study group and do you

1574

01:02:51,430 --> 01:02:49,760

coordinate with such groups well that's

1575

01:02:53,430 --> 01:02:51,440

really interesting that's an excellent

1576

01:02:55,349 --> 01:02:53,440

question because

1577

01:02:56,230 --> 01:02:55,359

what i found well first of all i should

1578

01:02:58,069 --> 01:02:56,240

say

1579

01:03:01,510 --> 01:02:58,079

for 70 years we've been searching for

1580

01:03:03,430 --> 01:03:01,520

radio signals and laser beams

1581

01:03:05,270 --> 01:03:03,440

and we didn't find any

1582

01:03:08,470 --> 01:03:05,280

um and

1583

01:03:10,230 --> 01:03:08,480

uh to me it's like trying to have a fun

1584

01:03:11,750 --> 01:03:10,240

conversation you need the counterpart to

1585

01:03:14,630 --> 01:03:11,760

be active when you are having the

1586

01:03:17,190 --> 01:03:14,640

conversation and uh i think that it may

1587

01:03:19,109 --> 01:03:17,200

be the wrong approach because perhaps

1588

01:03:21,270 --> 01:03:19,119

well for two reasons one

1589

01:03:22,950 --> 01:03:21,280

the civilizations that predated us are

1590

01:03:24,549 --> 01:03:22,960

not around anymore so you can't have a

1591

01:03:26,950 --> 01:03:24,559

conversation you know with an old

1592

01:03:28,150 --> 01:03:26,960

civilization that died by now but

1593

01:03:29,670 --> 01:03:28,160

moreover

1594

01:03:31,510 --> 01:03:29,680

why should they be exactly the same

1595

01:03:33,190 --> 01:03:31,520

technological phase so that we will be

1596

01:03:34,789 --> 01:03:33,200

able to understand their signals you

1597

01:03:37,029 --> 01:03:34,799

know and um

1598

01:03:39,270 --> 01:03:37,039

so um it's possible they're far more

1599

01:03:41,190 --> 01:03:39,280

advanced and we don't really figure out

1600

01:03:43,270 --> 01:03:41,200

that they're actually communicating with

1601  
01:03:45,270 --> 01:03:43,280  
us in ways that we we don't understand

1602  
01:03:47,270 --> 01:03:45,280  
you know and um

1603  
01:03:49,430 --> 01:03:47,280  
so my point is it's a much better

1604  
01:03:52,069 --> 01:03:49,440  
approach to look for objects that were

1605  
01:03:54,390 --> 01:03:52,079  
sent because they survived

1606  
01:03:55,910 --> 01:03:54,400  
billions of years as they travel through

1607  
01:03:59,430 --> 01:03:55,920  
space and that's a completely different

1608  
01:04:01,990 --> 01:03:59,440  
approach that was not searched

1609  
01:04:04,230 --> 01:04:02,000  
as of until the galileo project you know

1610  
01:04:05,829 --> 01:04:04,240  
so we are really embarking on new

1611  
01:04:08,789 --> 01:04:05,839  
territory and of course there are the

1612  
01:04:10,230 --> 01:04:08,799  
uap reports the ufo reports but we are

1613  
01:04:12,630 --> 01:04:10,240

trying to bring it

1614

01:04:13,670 --> 01:04:12,640

to the realm of mainstream science by

1615

01:04:14,710 --> 01:04:13,680

using

1616

01:04:17,029 --> 01:04:14,720

in uh

1617

01:04:19,430 --> 01:04:17,039

telescope systems instruments that are

1618

01:04:21,270 --> 01:04:19,440

state of the art to look at the sky i

1619

01:04:24,309 --> 01:04:21,280

was asked by administrators at harvard

1620

01:04:26,870 --> 01:04:24,319

if it relates to my day job this galileo

1621

01:04:29,510 --> 01:04:26,880

project and i basically said throughout

1622

01:04:31,589 --> 01:04:29,520

the decades that i practiced astronomy i

1623

01:04:33,510 --> 01:04:31,599

was interpreting data collected by

1624

01:04:35,910 --> 01:04:33,520

telescopes and that's what the galileo

1625

01:04:38,069 --> 01:04:35,920

project is trying to do collecting data

1626

01:04:40,870 --> 01:04:38,079

there is no lower limit on the distance

1627

01:04:43,510 --> 01:04:40,880

of objects in astronomy we study the sun

1628

01:04:44,549 --> 01:04:43,520

we study meteors we study asteroids and

1629

01:04:46,470 --> 01:04:44,559

so

1630

01:04:49,510 --> 01:04:46,480

trying to figure out the nature of uap

1631

01:04:51,270 --> 01:04:49,520

with telescopes is part of astronomy so

1632

01:04:53,190 --> 01:04:51,280

the administration at harvard agreed and

1633

01:04:56,150 --> 01:04:53,200

that's part of my day job

1634

01:04:57,109 --> 01:04:56,160

and so i hope that by getting better

1635

01:04:59,990 --> 01:04:57,119

data

1636

01:05:02,549 --> 01:05:00,000

we will either see something unusual or

1637

01:05:03,589 --> 01:05:02,559

not but at any event we'll advance our

1638

01:05:06,470 --> 01:05:03,599

knowledge

1639

01:05:08,470 --> 01:05:06,480

uh in a scientific way and bring it to

1640

01:05:09,750 --> 01:05:08,480

the mainstream

1641

01:05:11,270 --> 01:05:09,760

fantastic