



AVI LOEB

#535

1
00:00:03,600 --> 00:00:08,680
foreign

2
00:01:03,670 --> 00:00:26,170
[Music]

3
00:01:08,750 --> 00:01:06,050
and welcome to the show on Martin Willis

4
00:01:11,450 --> 00:01:08,760
your host and we have our guest Avi Loeb

5
00:01:13,730 --> 00:01:11,460
coming up he is running a little bit uh

6
00:01:16,130 --> 00:01:13,740
a little bit behind he was in another

7
00:01:17,630 --> 00:01:16,140
interview earlier

8
00:01:19,190 --> 00:01:17,640
um and I just got a message from music

9
00:01:22,070 --> 00:01:19,200
running a little bit behind so we have a

10
00:01:24,350 --> 00:01:22,080
little time to kill here and uh I will

11
00:01:26,749 --> 00:01:24,360
ask you people that are listening and

12
00:01:28,969 --> 00:01:26,759
watching live and chat if you want to

13
00:01:31,090 --> 00:01:28,979

throw a question my way you know maybe

14

00:01:34,630 --> 00:01:31,100

we can get a conversation going that way

15

00:01:38,630 --> 00:01:34,640

uh but again avilo uh Harvard

16

00:01:41,149 --> 00:01:38,640

astrophysicists is uh coming up within I

17

00:01:42,950 --> 00:01:41,159

would think within um probably within

18

00:01:45,710 --> 00:01:42,960

five or ten minutes he should be joining

19

00:01:47,569 --> 00:01:45,720

us uh a quick announcement

20

00:01:50,870 --> 00:01:47,579

um the holidays are coming up I got this

21

00:01:53,270 --> 00:01:50,880

email from the Ariel phenomenon the

22

00:01:54,710 --> 00:01:53,280

movie The Randall Nickerson I try to get

23

00:01:58,069 --> 00:01:54,720

him just now to see if he was available

24

00:02:00,109 --> 00:01:58,079

but he's not but uh his uh the aerial

25

00:02:02,569 --> 00:02:00,119

phenomenon movie is going to be

26

00:02:06,550 --> 00:02:02,579

available on Christmas Day

27

00:02:10,669 --> 00:02:06,560

on iTunes Apple TV Google play YouTube

28

00:02:11,630 --> 00:02:10,679

and Amazon Prime Video in the US and the

29

00:02:14,330 --> 00:02:11,640

UK

30

00:02:16,790 --> 00:02:14,340

so also if you go over to the website

31

00:02:18,350 --> 00:02:16,800

his website aerialphenomenon.com I

32

00:02:20,750 --> 00:02:18,360

believe it is

33

00:02:22,610 --> 00:02:20,760

um there's some merch for sale too

34

00:02:26,089 --> 00:02:22,620

t-shirts just in time for Christmas

35

00:02:27,589 --> 00:02:26,099

things like that and uh anyway I really

36

00:02:30,890 --> 00:02:27,599

think it's one of the most beautiful

37

00:02:34,010 --> 00:02:30,900

films made on this subject and it's to

38

00:02:37,369 --> 00:02:34,020

me it's I consider that the top uh the

39

00:02:40,970 --> 00:02:37,379

top case uh as far as being fast

40

00:02:43,850 --> 00:02:40,980

fascinating in my opinion and although

41

00:02:46,430 --> 00:02:43,860

school children uh just seem so credible

42

00:02:48,670 --> 00:02:46,440

and they never really strayed from their

43

00:02:52,190 --> 00:02:48,680

stories I believe whatever happened

44

00:02:55,190 --> 00:02:52,200

whatever it was happened did happen to

45

00:02:56,930 --> 00:02:55,200

those kids and uh Randall Nicholson did

46

00:02:58,970 --> 00:02:56,940

such a beautiful job with the film and I

47

00:03:00,830 --> 00:02:58,980

I know a lot of people that pay

48

00:03:03,470 --> 00:03:00,840

attention to this topic have already

49

00:03:05,229 --> 00:03:03,480

watched it I've watched it a couple of

50

00:03:08,270 --> 00:03:05,239

times maybe three I think at this point

51
00:03:11,570 --> 00:03:08,280
and I really was looking forward to

52
00:03:13,970 --> 00:03:11,580
seeing it in the theater when I had

53
00:03:16,790 --> 00:03:13,980
ended up having to have surgery and and

54
00:03:18,050 --> 00:03:16,800
missed that uh that big event when that

55
00:03:19,729 --> 00:03:18,060
happened

56
00:03:22,130 --> 00:03:19,739
um and uh I think it was Western

57
00:03:25,009 --> 00:03:22,140
Massachusetts

58
00:03:26,930 --> 00:03:25,019
um new Northampton Mass is when that uh

59
00:03:29,570 --> 00:03:26,940
I can't remember when the date was but I

60
00:03:31,910 --> 00:03:29,580
was out of commission and anyway our

61
00:03:35,449 --> 00:03:31,920
blog this week by Charles Lear is Hayden

62
00:03:37,850 --> 00:03:35,459
Hughes and the international UFO Bureau

63
00:03:40,729 --> 00:03:37,860

so let me take a look at chat here see

64

00:03:40,739 --> 00:03:43,190

um

65

00:03:49,970 --> 00:03:45,009

greetings everyone

66

00:03:52,430 --> 00:03:49,980

and let's see uh no questions yet but if

67

00:03:55,369 --> 00:03:52,440

anyone has a question see if anyone put

68

00:03:58,910 --> 00:03:55,379

anything in here I see Bobby Mary Grace

69

00:04:01,309 --> 00:03:58,920

hi hello hello and uh

70

00:04:05,089 --> 00:04:01,319

all good to have you all in here Cali

71

00:04:08,149 --> 00:04:05,099

Kidd uh here's a question

72

00:04:13,550 --> 00:04:10,850

uh so Martin how do you feel about the

73

00:04:17,270 --> 00:04:13,560

possibility of ammonia-based

74

00:04:19,729 --> 00:04:17,280

uh an ammonia-based creature

75

00:04:21,730 --> 00:04:19,739

from the documentary oh you're talking

76

00:04:24,770 --> 00:04:21,740

about James Fox

77

00:04:27,770 --> 00:04:24,780

documentary uh you know

78

00:04:29,629 --> 00:04:27,780

I don't know about that if that would be

79

00:04:31,969 --> 00:04:29,639

a type of building block that would work

80

00:04:34,730 --> 00:04:31,979

I know they they speculate that there

81

00:04:39,230 --> 00:04:34,740

could be silken like a silken based

82

00:04:43,550 --> 00:04:39,240

besides carbon-based uh life why that

83

00:04:46,610 --> 00:04:43,560

that being had such an odor uh

84

00:04:48,650 --> 00:04:46,620

I don't know what the the makeup of that

85

00:04:51,170 --> 00:04:48,660

was and it would be really interesting

86

00:04:54,469 --> 00:04:51,180

to know and to think that there's

87

00:04:55,790 --> 00:04:54,479

possibly some information out there in

88

00:04:59,870 --> 00:04:55,800

Brazil about

89

00:05:03,230 --> 00:04:59,880

uh when they did the autopsy on whatever

90

00:05:06,890 --> 00:05:03,240

the supposed autopsy I don't know 100

91

00:05:09,590 --> 00:05:06,900

sure that any of this you know can be

92

00:05:12,890 --> 00:05:09,600

documented or not but anyway

93

00:05:16,370 --> 00:05:12,900

um it was to me I think it was a a very

94

00:05:19,010 --> 00:05:16,380

good case and that's called moment of

95

00:05:20,689 --> 00:05:19,020

contact James Fox movie

96

00:05:23,810 --> 00:05:20,699

and if you haven't watched that it's

97

00:05:25,790 --> 00:05:23,820

another great one here here's a now I

98

00:05:27,770 --> 00:05:25,800

just uh hi Martin any thoughts on the

99

00:05:29,990 --> 00:05:27,780

nuclear fusion breakthrough announced

100

00:05:32,390 --> 00:05:30,000

today I heard that was announced today

101
00:05:34,430 --> 00:05:32,400
and I'm really really excited to read

102
00:05:37,670 --> 00:05:34,440
about it um I've been traveling all day

103
00:05:39,710 --> 00:05:37,680
as you can see I'm in a hotel room and I

104
00:05:41,930 --> 00:05:39,720
I had that article sent to me and I

105
00:05:44,390 --> 00:05:41,940
can't wait to read that it's very

106
00:05:47,629 --> 00:05:44,400
exciting if it's a breakthrough

107
00:05:49,430 --> 00:05:47,639
because that would certainly solve a lot

108
00:05:50,990 --> 00:05:49,440
of problems that we have

109
00:05:53,749 --> 00:05:51,000
and

110
00:05:57,890 --> 00:05:53,759
here's another question here have you

111
00:05:59,990 --> 00:05:57,900
seen David Pilates new UFO 4-1-1 movie I

112
00:06:03,469 --> 00:06:00,000
have not now I've met him a few years

113
00:06:06,650 --> 00:06:03,479

ago down in Cherry Hill down in New

114

00:06:10,010 --> 00:06:06,660

Jersey and I know that he used to really

115

00:06:12,170 --> 00:06:10,020

be into the UFO topic but he was staring

116

00:06:14,870 --> 00:06:12,180

completely away from it when he was

117

00:06:17,510 --> 00:06:14,880

doing those four one one movies and

118

00:06:19,610 --> 00:06:17,520

books I mean he did that one movie and

119

00:06:22,249 --> 00:06:19,620

and some books

120

00:06:25,249 --> 00:06:22,259

um so I knew that he was into the UFO

121

00:06:27,350 --> 00:06:25,259

topic and I had a private conversation

122

00:06:29,749 --> 00:06:27,360

with him and asked what he thought about

123

00:06:31,850 --> 00:06:29,759

that aspect of it so

124

00:06:33,770 --> 00:06:31,860

um he did not want to be on this show he

125

00:06:36,170 --> 00:06:33,780

wanted to kind of distance himself from

126

00:06:37,249 --> 00:06:36,180

the UFO but it looks like if he has this

127

00:06:39,290 --> 00:06:37,259

movie out

128

00:06:40,550 --> 00:06:39,300

then uh looks like it's time for me to

129

00:06:42,590 --> 00:06:40,560

get in touch with them and see if I can

130

00:06:44,930 --> 00:06:42,600

get them on as a guest I have not seen

131

00:06:47,570 --> 00:06:44,940

it or I didn't even know about it

132

00:06:48,890 --> 00:06:47,580

but uh thank you for posting that and

133

00:06:50,450 --> 00:06:48,900

thank you everyone for posting these

134

00:06:52,610 --> 00:06:50,460

questions you're keeping me going while

135

00:06:55,129 --> 00:06:52,620

I'm waiting for

136

00:06:57,590 --> 00:06:55,139

um Avi Loeb to come on

137

00:07:00,770 --> 00:06:57,600

here's another one here

138

00:07:03,110 --> 00:07:00,780

uh Martin what is your view on the lack

139

00:07:06,950 --> 00:07:03,120

of Promise UAP report by our government

140

00:07:08,689 --> 00:07:06,960

lack of promise you would uh I don't

141

00:07:11,150 --> 00:07:08,699

know what's going on I know that right

142

00:07:14,150 --> 00:07:11,160

around Halloween time we were supposed

143

00:07:16,430 --> 00:07:14,160

to get another report I I have not

144

00:07:19,490 --> 00:07:16,440

really heard much of what is going on

145

00:07:22,430 --> 00:07:19,500

with that and information I would like

146

00:07:26,689 --> 00:07:22,440

to know more about I know that they're

147

00:07:29,390 --> 00:07:26,699

they're supposed to report publicly so

148

00:07:31,370 --> 00:07:29,400

um I know I I do believe I there was

149

00:07:33,770 --> 00:07:31,380

something about their thinking or

150

00:07:37,550 --> 00:07:33,780

they're trying to point the finger uh

151

00:07:39,170 --> 00:07:37,560

that these are drones uh a lot of a lot

152

00:07:40,730 --> 00:07:39,180

of these things are drones but I don't

153

00:07:42,830 --> 00:07:40,740

know how far they're going to be able to

154

00:07:45,589 --> 00:07:42,840

get with that with all the other cases

155

00:07:50,150 --> 00:07:45,599

and I think 2023

156

00:07:53,210 --> 00:07:50,160

should be very promising as far as you

157

00:07:54,469 --> 00:07:53,220

know the uh investigations that's going

158

00:07:56,749 --> 00:07:54,479

to go on because they're going to go all

159

00:07:59,450 --> 00:07:56,759

the way back to the 1940s

160

00:08:01,189 --> 00:07:59,460

which is fascinating there's so many as

161

00:08:03,589 --> 00:08:01,199

you know anyone that follows this topic

162

00:08:06,589 --> 00:08:03,599

knows how much great information there

163

00:08:09,409 --> 00:08:06,599

was back in the 19 you know starting in

164

00:08:12,409 --> 00:08:09,419

the 1940s forward you know a lot of

165

00:08:14,570 --> 00:08:12,419

people will say well you know these

166

00:08:16,969 --> 00:08:14,580

could be secret you know government

167

00:08:20,270 --> 00:08:16,979

programs and all that but they kind of

168

00:08:22,309 --> 00:08:20,280

discount all the fact that these have

169

00:08:26,510 --> 00:08:22,319

been seen for

170

00:08:28,969 --> 00:08:26,520

you know decades and decades uh uh doing

171

00:08:30,589 --> 00:08:28,979

all these unusual Maneuvers that we

172

00:08:32,690 --> 00:08:30,599

can't explain

173

00:08:37,250 --> 00:08:32,700

I

174

00:08:41,149 --> 00:08:37,260

sightings but our guest Avi Loeb has

175

00:08:42,589 --> 00:08:41,159

shown up he's here Avi welcome

176

00:08:45,889 --> 00:08:42,599

thanks for having me it's a great

177

00:08:47,690 --> 00:08:45,899

pleasure to join you yes I'm so glad you

178

00:08:49,370 --> 00:08:47,700

you showed up I was getting a little bit

179

00:08:50,930 --> 00:08:49,380

nervous and kind of running out of

180

00:08:53,630 --> 00:08:50,940

things to talk about but everyone was

181

00:08:57,050 --> 00:08:53,640

gracious enough to post some nice

182

00:09:00,110 --> 00:08:57,060

questions up for me so welcome welcome

183

00:09:04,070 --> 00:09:00,120

back you're you're it's extremely busy

184

00:09:06,170 --> 00:09:04,080

guy and uh I I am always impressed with

185

00:09:08,090 --> 00:09:06,180

the well first of all I'm always

186

00:09:10,430 --> 00:09:08,100

impressed that you answer my email right

187

00:09:12,949 --> 00:09:10,440

away I mean you must get a thousand

188

00:09:15,769 --> 00:09:12,959

emails a day or something like that

189

00:09:18,170 --> 00:09:15,779

yeah well today was particularly busy

190

00:09:20,269 --> 00:09:18,180

because I was going over the final draft

191

00:09:24,050 --> 00:09:20,279

of my new book that is supposed to come

192

00:09:27,590 --> 00:09:24,060

out in August 2023 at the end of August

193

00:09:29,930 --> 00:09:27,600

and it's called Interstellar and uh it

194

00:09:31,730 --> 00:09:29,940

should be interesting and I I just

195

00:09:34,610 --> 00:09:31,740

finished going over it

196

00:09:37,009 --> 00:09:34,620

wow so you with everything you do you

197

00:09:39,889 --> 00:09:37,019

find time to write a book as well

198

00:09:42,590 --> 00:09:39,899

well that's very important it's sort of

199

00:09:45,949 --> 00:09:42,600

like a diary summarizing my thoughts

200

00:09:49,070 --> 00:09:45,959

about the past and the future and uh

201

00:09:50,030 --> 00:09:49,080

it's not so much about me as as it is

202

00:09:52,430 --> 00:09:50,040

about

203

00:09:54,530 --> 00:09:52,440

uh what I find most important these days

204

00:09:59,210 --> 00:09:54,540

you know and I reached a point in my

205

00:10:01,610 --> 00:09:59,220

life where I care less about my personal

206

00:10:04,370 --> 00:10:01,620

um faith and what happens to me and more

207

00:10:07,150 --> 00:10:04,380

about what will happen to humanity and

208

00:10:09,889 --> 00:10:07,160

what the future may hold and how can we

209

00:10:12,290 --> 00:10:09,899

uh make the future better than the past

210

00:10:14,449 --> 00:10:12,300

and that's pretty much what my book is

211

00:10:17,630 --> 00:10:14,459

about wow

212

00:10:20,329 --> 00:10:17,640

that's really great I'm going to

213

00:10:22,790 --> 00:10:20,339

put up right here just so I wanted to

214

00:10:26,090 --> 00:10:22,800

put up your your articles that you write

215

00:10:28,850 --> 00:10:26,100

because again here you are writing all

216

00:10:31,070 --> 00:10:28,860

of these articles it's just amazing and

217

00:10:32,570 --> 00:10:31,080

I've skimmed through a couple of them

218

00:10:35,090 --> 00:10:32,580

and and um

219

00:10:36,650 --> 00:10:35,100

just I'm very very impressed because you

220

00:10:39,949 --> 00:10:36,660

look at these it says almost like every

221

00:10:41,930 --> 00:10:39,959

day right and the only reason today is

222

00:10:44,050 --> 00:10:41,940

the article will be a little delayed

223

00:10:46,630 --> 00:10:44,060

I'll write it after we speak is because

224

00:10:49,370 --> 00:10:46,640

I was engaged with the new book

225

00:10:51,290 --> 00:10:49,380

Interstellar that's the title and it's

226

00:10:55,550 --> 00:10:51,300

Harper Collins it's already on the

227

00:10:57,410 --> 00:10:55,560

website uh today's news I I had already

228

00:10:59,470 --> 00:10:57,420

two interviews in the morning about it

229

00:11:02,269 --> 00:10:59,480

is the announcement of

230

00:11:05,090 --> 00:11:02,279

ignition at the nuclear ignition

231

00:11:08,350 --> 00:11:05,100

facility using lasers to compress a

232

00:11:10,970 --> 00:11:08,360

pellet with hydrogen

233

00:11:12,650 --> 00:11:10,980

and they demonstrated Fusion is possible

234

00:11:15,290 --> 00:11:12,660

in the lab and they created the small

235

00:11:17,630 --> 00:11:15,300

star a tiny little star for a short

236

00:11:19,670 --> 00:11:17,640

period of time and that's an

237

00:11:21,949 --> 00:11:19,680

accomplishment and it's sort of an

238

00:11:23,110 --> 00:11:21,959

imitation of what nature did for many

239

00:11:26,269 --> 00:11:23,120

many

240

00:11:28,370 --> 00:11:26,279

billions of years which is Stars you

241

00:11:33,110 --> 00:11:28,380

know at the center of a star you get the

242

00:11:35,449 --> 00:11:33,120

nuclear fusion of the same nature and uh

243

00:11:37,610 --> 00:11:35,459

the only difference is that a star like

244

00:11:40,009 --> 00:11:37,620

the sun is held by gravity and so the

245

00:11:42,530 --> 00:11:40,019

nuclear fuel reaches very high

246

00:11:46,190 --> 00:11:42,540

temperatures but doesn't explode doesn't

247

00:11:48,410 --> 00:11:46,200

run away because gravity binds it for

248

00:11:50,269 --> 00:11:48,420

that you need a very massive object in

249

00:11:52,910 --> 00:11:50,279

our Laboratories gravity is completely

250

00:11:55,970 --> 00:11:52,920

irrelevant and so we need some other way

251
00:11:57,610 --> 00:11:55,980
of confining the hot gas that is you

252
00:12:00,710 --> 00:11:57,620
know hundreds of millions of degrees

253
00:12:03,910 --> 00:12:00,720
that is fusing and the way they

254
00:12:06,470 --> 00:12:03,920
accomplish that is with laser beams

255
00:12:09,230 --> 00:12:06,480
basically generating x-rays that

256
00:12:12,829 --> 00:12:09,240
compress a pellet and it reached the

257
00:12:14,990 --> 00:12:12,839
ignition and that was a major fit of

258
00:12:17,870 --> 00:12:15,000
engineering I mean it's not new physics

259
00:12:19,930 --> 00:12:17,880
it's just imitating nature just the way

260
00:12:22,550 --> 00:12:19,940
that the Wright brothers

261
00:12:25,130 --> 00:12:22,560
were able to imitate Birds you know

262
00:12:29,389 --> 00:12:25,140
humans saw birds for so many centuries

263
00:12:30,829 --> 00:12:29,399

and uh 100 about a century ago in 1905

264

00:12:32,630 --> 00:12:30,839

the Wright brothers demonstrated that

265

00:12:34,610 --> 00:12:32,640

humans can do it as well

266

00:12:37,250 --> 00:12:34,620

so what is this what do you think this

267

00:12:40,250 --> 00:12:37,260

means where where do you think this can

268

00:12:43,129 --> 00:12:40,260

go I mean there has been talk about this

269

00:12:44,750 --> 00:12:43,139

in Cold Fusion that is that a that's a

270

00:12:47,629 --> 00:12:44,760

whole different thing isn't it yeah I

271

00:12:50,930 --> 00:12:47,639

know this one is hot Fusion yeah um cold

272

00:12:55,370 --> 00:12:50,940

fusion was not demonstrated to work

273

00:12:58,990 --> 00:12:55,380

um and the original experiments um were

274

00:13:01,490 --> 00:12:59,000

um repeated and did not produce results

275

00:13:03,949 --> 00:13:01,500

similar to those claimed originally so

276

00:13:07,310 --> 00:13:03,959

we don't know if qualifusion is possible

277

00:13:09,710 --> 00:13:07,320

but hot Fusion has been attempted for

278

00:13:12,470 --> 00:13:09,720

many decades and the issue is really how

279

00:13:15,170 --> 00:13:12,480

to confine the hot gas at hundreds of

280

00:13:17,030 --> 00:13:15,180

millions of degrees uh and the one

281

00:13:18,949 --> 00:13:17,040

approach that was very popular is using

282

00:13:21,410 --> 00:13:18,959

magnetic fields very strong magnetic

283

00:13:24,170 --> 00:13:21,420

fields and the biggest demonstration of

284

00:13:27,710 --> 00:13:24,180

that is the eater experiment in Euro but

285

00:13:29,990 --> 00:13:27,720

that's a gigantic facility and we

286

00:13:32,569 --> 00:13:30,000

haven't reached the Milestone of

287

00:13:36,829 --> 00:13:32,579

ignition there the approach taken

288

00:13:39,590 --> 00:13:36,839

Livermore that was announced today in

289

00:13:41,690 --> 00:13:39,600

terms of being successful was to use a

290

00:13:45,350 --> 00:13:41,700

lot of laser beams very powerful laser

291

00:13:47,750 --> 00:13:45,360

beams that shine into a cavity inside of

292

00:13:50,030 --> 00:13:47,760

which there is a pellet and the X-ray is

293

00:13:52,509 --> 00:13:50,040

generated as they interact with the

294

00:13:55,490 --> 00:13:52,519

walls all these laser beams

295

00:13:57,949 --> 00:13:55,500

they compress the pellet to very high

296

00:14:00,710 --> 00:13:57,959

temperatures and densities such that it

297

00:14:02,629 --> 00:14:00,720

ignites and the challenge in that method

298

00:14:06,350 --> 00:14:02,639

is called the natural confinement the

299

00:14:09,590 --> 00:14:06,360

challenge is to get a uniform collapse

300

00:14:12,110 --> 00:14:09,600

contraction of this pellet and it's very

301

00:14:14,210 --> 00:14:12,120

easy for it to collapse along one axis

302

00:14:15,650 --> 00:14:14,220

and then it just becomes a pancake and

303

00:14:18,470 --> 00:14:15,660

you don't get the high temperatures and

304

00:14:21,949 --> 00:14:18,480

densities so they managed to accomplish

305

00:14:23,509 --> 00:14:21,959

that that's a major achievement and but

306

00:14:26,629 --> 00:14:23,519

it's not clear whether it will become

307

00:14:29,150 --> 00:14:26,639

practical for two reasons one and you

308

00:14:31,150 --> 00:14:29,160

have to replenish the pellet so it's a

309

00:14:33,530 --> 00:14:31,160

very sort of um

310

00:14:36,769 --> 00:14:33,540

it's sort of like an engine that

311

00:14:39,230 --> 00:14:36,779

operates on Tiny explosions you can

312

00:14:43,189 --> 00:14:39,240

think of it as a tiny nuclear explosion

313

00:14:46,670 --> 00:14:43,199

and fusion explosion so then you need to

314

00:14:48,769 --> 00:14:46,680

replace the pellet every so often and in

315

00:14:52,250 --> 00:14:48,779

order to gain enough energy that can

316

00:14:54,829 --> 00:14:52,260

power a city but then in addition you

317

00:14:56,990 --> 00:14:54,839

have to extract the energy from the

318

00:15:00,350 --> 00:14:57,000

system and the energy comes out in very

319

00:15:03,129 --> 00:15:00,360

energetic neutrons and it's not obvious

320

00:15:06,970 --> 00:15:03,139

that the engineering of how to

321

00:15:10,129 --> 00:15:06,980

extract their energy is so simple so

322

00:15:12,889 --> 00:15:10,139

I I'm not much more optimistic that

323

00:15:16,189 --> 00:15:12,899

nuclear fusion will become practical it

324

00:15:18,650 --> 00:15:16,199

will take decades it's just a major fit

325

00:15:21,290 --> 00:15:18,660

in terms of humans being able to imitate

326

00:15:24,110 --> 00:15:21,300

nature that's that's the significance of

327

00:15:25,970 --> 00:15:24,120

it yeah that is that is and it would be

328

00:15:27,470 --> 00:15:25,980

great though if

329

00:15:30,590 --> 00:15:27,480

um I understand that there wouldn't be

330

00:15:32,269 --> 00:15:30,600

the Hazardous Waste like there is with

331

00:15:35,210 --> 00:15:32,279

nuclear power if they could figure this

332

00:15:37,250 --> 00:15:35,220

out right right exactly it could happen

333

00:15:39,829 --> 00:15:37,260

on the walls depending on how you absorb

334

00:15:42,910 --> 00:15:39,839

the neutrons but then indeed the

335

00:15:46,790 --> 00:15:42,920

material the fuel itself is not

336

00:15:49,850 --> 00:15:46,800

producing uh Radioactive debris that

337

00:15:52,069 --> 00:15:49,860

could cause problems

338

00:15:54,829 --> 00:15:52,079

um I should say that fission is known to

339

00:15:58,370 --> 00:15:54,839

work nuclear reactors work and it could

340

00:16:00,170 --> 00:15:58,380

be uh the the best source of clean

341

00:16:03,350 --> 00:16:00,180

energy in the future irrespective what

342

00:16:08,170 --> 00:16:03,360

happens with with Fusion if we uh build

343

00:16:12,769 --> 00:16:08,180

a safe reactors which is a possible way

344

00:16:18,230 --> 00:16:12,779

for us to maintain you know our

345

00:16:21,290 --> 00:16:18,240

long-term energy needs um so um I won't

346

00:16:25,250 --> 00:16:21,300

say that Fusion is a must for our

347

00:16:28,129 --> 00:16:25,260

civilization to get its energy in the

348

00:16:29,990 --> 00:16:28,139

long-term future and we we could get the

349

00:16:31,910 --> 00:16:30,000

best source of clean energy out of

350

00:16:34,310 --> 00:16:31,920

nuclear reactors that based on fission

351
00:16:37,189 --> 00:16:34,320
and uh it's just a matter of engineering

352
00:16:41,210 --> 00:16:37,199
it uh so that we prevent any

353
00:16:43,850 --> 00:16:41,220
catastrophes right right and uh yeah

354
00:16:46,129 --> 00:16:43,860
we'll see how that goes yeah I had

355
00:16:49,610 --> 00:16:46,139
there's been hope for cold fusion I know

356
00:16:51,590 --> 00:16:49,620
there's there's a uh a private company

357
00:16:53,509 --> 00:16:51,600
in Washington state that thinks that

358
00:16:55,310 --> 00:16:53,519
they're going to be able to crack that

359
00:16:57,650 --> 00:16:55,320
problem and I don't know I mean they are

360
00:16:59,629 --> 00:16:57,660
working on it and they are they are well

361
00:17:01,550 --> 00:16:59,639
funded from what I understand and that

362
00:17:04,730 --> 00:17:01,560
would be really something if yeah I mean

363
00:17:07,669 --> 00:17:04,740

all together uh any such

364

00:17:10,429 --> 00:17:07,679

a breakthrough would would help perhaps

365

00:17:13,370 --> 00:17:10,439

to venture into space because as of now

366

00:17:16,850 --> 00:17:13,380

all the spacecraft we launched were

367

00:17:20,329 --> 00:17:16,860

based on chemical propellants and right

368

00:17:23,630 --> 00:17:20,339

um they produce much less energy by a

369

00:17:27,549 --> 00:17:23,640

factor of almost a million uh per unit

370

00:17:32,150 --> 00:17:27,559

mass of fuel so so if we are able to

371

00:17:35,029 --> 00:17:32,160

manufacture relatively small and either

372

00:17:37,730 --> 00:17:35,039

Fusion or fission reactors that can be

373

00:17:42,049 --> 00:17:37,740

used as engines for spacecraft that

374

00:17:45,529 --> 00:17:42,059

would be amazing uh but uh as of now the

375

00:17:47,029 --> 00:17:45,539

limit of all of on the terminal speed of

376

00:17:51,770 --> 00:17:47,039

all the spacecraft that we've launched

377

00:17:53,409 --> 00:17:51,780

since Sputnik until uh no Horizons all

378

00:17:56,210 --> 00:17:53,419

of them

379

00:17:58,010 --> 00:17:56,220

reached tens of kilometers per second is

380

00:18:00,049 --> 00:17:58,020

the terminal speed and that's the

381

00:18:01,909 --> 00:18:00,059

tyranny of the rocket equation the

382

00:18:05,029 --> 00:18:01,919

problem is they carry their own Fuel and

383

00:18:06,890 --> 00:18:05,039

they cannot they cannot reach speeds

384

00:18:10,190 --> 00:18:06,900

that exceed by more than one order of

385

00:18:12,350 --> 00:18:10,200

magnitude or so the exhaust speed of the

386

00:18:14,270 --> 00:18:12,360

gas is coming out of their exhaust

387

00:18:16,430 --> 00:18:14,280

because they have to carry the fuel so

388

00:18:19,130 --> 00:18:16,440

the rocket equation doesn't allow you to

389

00:18:20,630 --> 00:18:19,140

reach very high speeds just because of

390

00:18:23,630 --> 00:18:20,640

the exhaust speed of chemical

391

00:18:26,390 --> 00:18:23,640

propellants but with nuclear you can

392

00:18:29,150 --> 00:18:26,400

reach much higher exhaust speeds

393

00:18:30,830 --> 00:18:29,160

now is there any further Advance has

394

00:18:33,049 --> 00:18:30,840

there been any further advancement on

395

00:18:35,029 --> 00:18:33,059

the star shot that you were involved in

396

00:18:37,850 --> 00:18:35,039

right so that's a completely different

397

00:18:42,529 --> 00:18:37,860

approach where you say uh instead of

398

00:18:45,230 --> 00:18:42,539

carrying the fuel the the the spacecraft

399

00:18:46,610 --> 00:18:45,240

is being pushed by some external force

400

00:18:50,270 --> 00:18:46,620

and in this case

401
00:18:53,150 --> 00:18:50,280
it's light the beam of light and it is

402
00:18:56,090 --> 00:18:53,160
to have a lightweight sale just like the

403
00:18:59,270 --> 00:18:56,100
sale of a boat which is uh being pushed

404
00:19:02,210 --> 00:18:59,280
by reflecting light and we were thinking

405
00:19:05,390 --> 00:19:02,220
about a very powerful laser shining at

406
00:19:09,650 --> 00:19:05,400
the sale the size of a person that

407
00:19:12,110 --> 00:19:09,660
weighs roughly a gram very thin and then

408
00:19:13,850 --> 00:19:12,120
pushes it over a few minutes to a fifth

409
00:19:14,830 --> 00:19:13,860
of the speed of light and then you can

410
00:19:17,150 --> 00:19:14,840
attach

411
00:19:20,990 --> 00:19:17,160
Electronics to that sale that's the

412
00:19:24,230 --> 00:19:21,000
Starship concept and we're working on

413
00:19:26,630 --> 00:19:24,240

various components of this and we don't

414

00:19:30,169 --> 00:19:26,640

we still don't see a show stopper but

415

00:19:33,890 --> 00:19:30,179

it's very challenging so uh building uh

416

00:19:35,690 --> 00:19:33,900

the lasers and also making the sale you

417

00:19:38,810 --> 00:19:35,700

know that it's all possible with

418

00:19:41,029 --> 00:19:38,820

existing understanding of how these

419

00:19:43,789 --> 00:19:41,039

things can be made but uh we are not

420

00:19:45,770 --> 00:19:43,799

there yet we are working on it

421

00:19:47,990 --> 00:19:45,780

now would say there was a Russian

422

00:19:51,529 --> 00:19:48,000

gentleman involved in that is he is he

423

00:19:54,409 --> 00:19:51,539

still involved in that well he's uh he's

424

00:19:56,510 --> 00:19:54,419

not a he's not Russian citizen anymore

425

00:20:00,049 --> 00:19:56,520

he is

426

00:20:02,570 --> 00:20:00,059

um yeah he um yeah he's he's an

427

00:20:06,230 --> 00:20:02,580

entrepreneur from Silicon Valley and the

428

00:20:09,110 --> 00:20:06,240

physicist his name is Yuri Miller and uh

429

00:20:13,010 --> 00:20:09,120

yeah he he still funds this as well as

430

00:20:14,090 --> 00:20:13,020

other initiatives such as searching for

431

00:20:17,510 --> 00:20:14,100

um

432

00:20:19,669 --> 00:20:17,520

signals from extraterrestrial

433

00:20:22,190 --> 00:20:19,679

civilizations that that's called the

434

00:20:24,529 --> 00:20:22,200

Breakthrough uh listen

435

00:20:26,270 --> 00:20:24,539

um the other one the other initiative is

436

00:20:29,990 --> 00:20:26,280

breakthrough Starship

437

00:20:32,270 --> 00:20:30,000

mm-hmm interesting now uh we're going to

438

00:20:34,490 --> 00:20:32,280

talk in a minute about I would like to

439

00:20:36,230 --> 00:20:34,500

talk about this possible or this

440

00:20:38,210 --> 00:20:36,240

excursion

441

00:20:40,310 --> 00:20:38,220

um or whatever you would like to call it

442

00:20:41,990 --> 00:20:40,320

uh right off of the coast of Papua New

443

00:20:44,690 --> 00:20:42,000

Guinea but

444

00:20:46,730 --> 00:20:44,700

um but before that I I guess I'd like to

445

00:20:49,669 --> 00:20:46,740

ask you

446

00:20:52,490 --> 00:20:49,679

um you have gotten so much publicity out

447

00:20:54,830 --> 00:20:52,500

of you know talking about amuamua and

448

00:20:57,950 --> 00:20:54,840

and all that over the last few years

449

00:20:59,750 --> 00:20:57,960

since you were on this show and has the

450

00:21:00,830 --> 00:20:59,760

feedback still been positive I know

451
00:21:04,250 --> 00:21:00,840
there were a lot of people actually

452
00:21:06,650 --> 00:21:04,260
helping fund the Galileo project how is

453
00:21:10,250 --> 00:21:06,660
all that going well my book came out

454
00:21:13,370 --> 00:21:10,260
less than two years ago and then I had

455
00:21:17,210 --> 00:21:13,380
about 2 000 interviews and appearances

456
00:21:19,610 --> 00:21:17,220
and yeah all the media outlets and the

457
00:21:22,909 --> 00:21:19,620
book was translated to 25 languages it

458
00:21:24,710 --> 00:21:22,919
became a bestseller just to give you uh

459
00:21:28,390 --> 00:21:24,720
it became bestseller in many countries

460
00:21:32,210 --> 00:21:28,400
but just to give an an impression I was

461
00:21:35,270 --> 00:21:32,220
in two public forums last month and one

462
00:21:37,490 --> 00:21:35,280
of them an iranian-born entrepreneur

463
00:21:39,890 --> 00:21:37,500

came to me and said can I have a selfie

464

00:21:41,230 --> 00:21:39,900

with you and I said of course and then

465

00:21:43,909 --> 00:21:41,240

the following morning

466

00:21:45,409 --> 00:21:43,919

she saw me and and said that did you

467

00:21:48,049 --> 00:21:45,419

know that you have hundreds of women

468

00:21:51,110 --> 00:21:48,059

scientists in Iran that are following

469

00:21:53,090 --> 00:21:51,120

your work and I said I never knew about

470

00:21:55,190 --> 00:21:53,100

it because she posted it in Instagram

471

00:21:58,310 --> 00:21:55,200

and she got immediately messages about

472

00:22:00,950 --> 00:21:58,320

it so it looks like all over the world I

473

00:22:02,890 --> 00:22:00,960

mean that what that shows is that this

474

00:22:06,049 --> 00:22:02,900

subject of the search for

475

00:22:08,270 --> 00:22:06,059

extraterrestrial intelligence unifies

476

00:22:10,909 --> 00:22:08,280

um everyone irrespective of national

477

00:22:15,470 --> 00:22:10,919

borders I was born in Israel these are

478

00:22:18,130 --> 00:22:15,480

women from Iran uh there is nothing

479

00:22:22,549 --> 00:22:18,140

um I mean it brings people together and

480

00:22:24,409 --> 00:22:22,559

I think the more we research the subject

481

00:22:27,350 --> 00:22:24,419

the more we would find there is some

482

00:22:29,930 --> 00:22:27,360

low-hanging fruit because this path that

483

00:22:32,990 --> 00:22:29,940

we are taking was not taken uh

484

00:22:35,090 --> 00:22:33,000

the reason uh it's very different from

485

00:22:36,710 --> 00:22:35,100

the search for intelligence in the past

486

00:22:39,470 --> 00:22:36,720

is that we were looking for radio

487

00:22:41,930 --> 00:22:39,480

signals or or laser signals and yeah

488

00:22:43,970 --> 00:22:41,940

this is just like waiting for a phone

489

00:22:47,270 --> 00:22:43,980

call at home

490

00:22:49,850 --> 00:22:47,280

um for that you need whoever calls you

491

00:22:52,970 --> 00:22:49,860

to be active at the time that you are

492

00:22:55,490 --> 00:22:52,980

waiting uh but there is a completely

493

00:22:57,230 --> 00:22:55,500

different approach which is to just

494

00:22:59,930 --> 00:22:57,240

check your mailbox if there are any

495

00:23:02,090 --> 00:22:59,940

packages that accumulated over time the

496

00:23:03,770 --> 00:23:02,100

sender may be dead by now but the

497

00:23:05,149 --> 00:23:03,780

packages keep accumulating in your

498

00:23:08,090 --> 00:23:05,159

mailbox

499

00:23:10,190 --> 00:23:08,100

um over the years and that we have never

500

00:23:12,049 --> 00:23:10,200

done only over the past decade we had

501
00:23:13,789 --> 00:23:12,059
the instruments that allow us to detect

502
00:23:17,210 --> 00:23:13,799
objects from outside the solar system

503
00:23:19,789 --> 00:23:17,220
and we found four of them two of which

504
00:23:22,130 --> 00:23:19,799
are meteors that we will talk about in a

505
00:23:24,890 --> 00:23:22,140
minute that I discovered with my student

506
00:23:26,750 --> 00:23:24,900
Amir siraj that came from outside the

507
00:23:29,870 --> 00:23:26,760
solar system there were roughly half a

508
00:23:32,990 --> 00:23:29,880
meter in size and the third was omuamua

509
00:23:38,330 --> 00:23:33,000
that my book is dedicated to that and

510
00:23:42,110 --> 00:23:38,340
all three uh from 2014 to 2017 all three

511
00:23:44,570 --> 00:23:42,120
were uh outliers they didn't resemble

512
00:23:46,870 --> 00:23:44,580
the familiar rocks space rocks that

513
00:23:49,909 --> 00:23:46,880

we've seen before from the solar system

514

00:23:52,669 --> 00:23:49,919

uh the meteors because of their material

515

00:23:55,669 --> 00:23:52,679

strength they were the toughest that

516

00:23:56,950 --> 00:23:55,679

were were even ever spotted among all

517

00:24:00,070 --> 00:23:56,960

meteors

518

00:24:03,649 --> 00:24:00,080

out of 270 that the US government

519

00:24:05,930 --> 00:24:03,659

detected uh and and more was unusual

520

00:24:07,610 --> 00:24:05,940

because of its shape it was most likely

521

00:24:10,190 --> 00:24:07,620

pancake black and then it was pushed

522

00:24:13,430 --> 00:24:10,200

away from the Sun by without showing any

523

00:24:17,630 --> 00:24:13,440

cometary evaporation no rocket effect

524

00:24:19,850 --> 00:24:17,640

and so it was anomalous and uh what I'm

525

00:24:21,890 --> 00:24:19,860

saying is if the first three objects are

526

00:24:24,230 --> 00:24:21,900

unusual then we are missing something

527

00:24:26,750 --> 00:24:24,240

about what comes from outside the solar

528

00:24:29,330 --> 00:24:26,760

system the fourth the fourth one was

529

00:24:32,169 --> 00:24:29,340

just like a comet it's it's called

530

00:24:34,490 --> 00:24:32,179

boriso after the

531

00:24:37,909 --> 00:24:34,500

astronomer amateur astronomer who

532

00:24:39,950 --> 00:24:37,919

discovered it so all together this is a

533

00:24:42,350 --> 00:24:39,960

new frontier and we haven't tried

534

00:24:44,570 --> 00:24:42,360

checking our mailbox and the fact that

535

00:24:47,149 --> 00:24:44,580

we found these unusual packages tells us

536

00:24:50,390 --> 00:24:47,159

maybe there is something out there that

537

00:24:52,310 --> 00:24:50,400

we haven't figured out and so we are

538

00:24:54,669 --> 00:24:52,320

planning an expedition to scoop the

539

00:24:57,529 --> 00:24:54,679

ocean floor where the first meteor

540

00:24:59,270 --> 00:24:57,539

exploded and it disintegrates in the

541

00:25:01,970 --> 00:24:59,280

lower atmosphere of the earth and it was

542

00:25:04,730 --> 00:25:01,980

tougher than iron so we want to find out

543

00:25:07,370 --> 00:25:04,740

whether it was natural in origin or

544

00:25:10,010 --> 00:25:07,380

maybe a spacecraft maybe artificial and

545

00:25:12,470 --> 00:25:10,020

we're planning an expedition I was

546

00:25:15,230 --> 00:25:12,480

funded at the one and a half million

547

00:25:19,310 --> 00:25:15,240

dollars for that and and we will do it

548

00:25:21,169 --> 00:25:19,320

before summer 2023 within six months uh

549

00:25:24,409 --> 00:25:21,179

and um you know you asked me about

550

00:25:26,390 --> 00:25:24,419

funding basically my book brought a lot

551
00:25:28,070 --> 00:25:26,400
of interesting people to the porch of my

552
00:25:31,070 --> 00:25:28,080
home during the pandemic they just

553
00:25:33,169 --> 00:25:31,080
showed up a lot of very wealthy

554
00:25:34,730 --> 00:25:33,179
individuals that gave me a few million

555
00:25:36,890 --> 00:25:34,740
dollars that allowed me to establish the

556
00:25:39,049 --> 00:25:36,900
Galileo project that we have a hundred

557
00:25:42,049 --> 00:25:39,059
people involved and we are starting to

558
00:25:45,470 --> 00:25:42,059
get data uh from instruments that we put

559
00:25:47,990 --> 00:25:45,480
together scientifically and then in the

560
00:25:49,970 --> 00:25:48,000
coming months we'll analyze this data

561
00:25:51,649 --> 00:25:49,980
we'll build copies of the first system

562
00:25:53,870 --> 00:25:51,659
that seems to work

563
00:25:57,470 --> 00:25:53,880

we are basically taking a video of the

564

00:26:00,250 --> 00:25:57,480

sky in the infrared Optical radio and

565

00:26:02,990 --> 00:26:00,260

audio and that was never done before

566

00:26:04,669 --> 00:26:03,000

with a suite of instruments that we have

567

00:26:06,110 --> 00:26:04,679

full control over that we fully

568

00:26:08,870 --> 00:26:06,120

understand

569

00:26:11,750 --> 00:26:08,880

and well well the information is that

570

00:26:14,390 --> 00:26:11,760

going to be publicly available yeah so

571

00:26:16,669 --> 00:26:14,400

there will be an early period where we

572

00:26:19,010 --> 00:26:16,679

will make sure that the data is not

573

00:26:21,590 --> 00:26:19,020

contaminated with some malfunction of

574

00:26:23,570 --> 00:26:21,600

instruments or things we don't fully

575

00:26:26,990 --> 00:26:23,580

understand and then of course we will

576

00:26:28,970 --> 00:26:27,000

release it make it open uh and also

577

00:26:31,010 --> 00:26:28,980

report about it in scientific papers

578

00:26:32,330 --> 00:26:31,020

that will be submitted to peer-reviewed

579

00:26:35,210 --> 00:26:32,340

journals

580

00:26:38,510 --> 00:26:35,220

that's great that's great now so on this

581

00:26:40,789 --> 00:26:38,520

excursion how do you propose that you're

582

00:26:43,310 --> 00:26:40,799

going to is it through instruments that

583

00:26:45,769 --> 00:26:43,320

you're going to be able to detect the

584

00:26:47,870 --> 00:26:45,779

fragments if that's what they are on the

585

00:26:49,730 --> 00:26:47,880

ocean floor how do you plan to do that

586

00:26:53,390 --> 00:26:49,740

yeah we're starting to build a Machinery

587

00:26:56,350 --> 00:26:53,400

it will have a sled with magnets on it

588

00:26:59,750 --> 00:26:56,360

so that if there is any uh

589

00:27:01,909 --> 00:26:59,760

magnetic I mean ferromagnetic material

590

00:27:04,370 --> 00:27:01,919

like iron or

591

00:27:07,669 --> 00:27:04,380

other metals that are attracted to to

592

00:27:10,450 --> 00:27:07,679

the magnets we will separate it from the

593

00:27:12,769 --> 00:27:10,460

Mac that is on the ocean floor the ooze

594

00:27:15,769 --> 00:27:12,779

and then

595

00:27:18,110 --> 00:27:15,779

um in addition if it's not magnetic the

596

00:27:20,110 --> 00:27:18,120

fragments from the meteor we actually

597

00:27:22,789 --> 00:27:20,120

wrote a scientific paper just a week ago

598

00:27:24,769 --> 00:27:22,799

where we calculated the distribution of

599

00:27:28,010 --> 00:27:24,779

fragment sizes that we expect if it's

600

00:27:30,669 --> 00:27:28,020

made of iron or if it's made of steel

601
00:27:34,630 --> 00:27:30,679
for example if it's artificial in origin

602
00:27:38,210 --> 00:27:34,640
and we should be able to find the pieces

603
00:27:41,090 --> 00:27:38,220
uh most of them of order a millimeter or

604
00:27:42,830 --> 00:27:41,100
less but some of them could be if

605
00:27:45,710 --> 00:27:42,840
especially if it's very tough material

606
00:27:48,649 --> 00:27:45,720
like still some of them could be

607
00:27:51,950 --> 00:27:48,659
centimeters in size and I already

608
00:27:53,990 --> 00:27:51,960
promised the Paula Antonelli the curator

609
00:27:56,690 --> 00:27:54,000
of the Museum of Modern Art in New York

610
00:27:59,990 --> 00:27:56,700
City that if we find any Gadget I'll

611
00:28:02,029 --> 00:28:00,000
bring it for display because for us it

612
00:28:05,630 --> 00:28:02,039
would represent modernity even though

613
00:28:07,210 --> 00:28:05,640

the senders might think of it as ancient

614

00:28:09,409 --> 00:28:07,220

history

615

00:28:11,149 --> 00:28:09,419

boy wouldn't that be something everyone

616

00:28:13,669 --> 00:28:11,159

would want to come see that that's for

617

00:28:15,590 --> 00:28:13,679

sure well let's uh hope we find

618

00:28:18,590 --> 00:28:15,600

something it's it's a very challenging

619

00:28:21,590 --> 00:28:18,600

Mission the the ocean floor is a mile

620

00:28:24,890 --> 00:28:21,600

deep and we plan to spend a couple of

621

00:28:26,690 --> 00:28:24,900

weeks there but the Galileo project as a

622

00:28:29,570 --> 00:28:26,700

whole I mean this is just one branch of

623

00:28:31,370 --> 00:28:29,580

it looking for fragments of interstellar

624

00:28:33,649 --> 00:28:31,380

meteors the second is looking at

625

00:28:35,870 --> 00:28:33,659

unidentified aerial phenomena that the

626
00:28:38,149 --> 00:28:35,880
government reported about and we are

627
00:28:41,330 --> 00:28:38,159
planning to get the data and then the

628
00:28:45,130 --> 00:28:41,340
third one would be to come close or

629
00:28:47,570 --> 00:28:45,140
Rendezvous or if you want date the next

630
00:28:49,010 --> 00:28:47,580
the next object that looks unusual and

631
00:28:51,590 --> 00:28:49,020
doesn't collide with the Earth like

632
00:28:54,590 --> 00:28:51,600
meteors doesn't come close but we might

633
00:28:58,070 --> 00:28:54,600
emit it along its path and take a high

634
00:29:00,649 --> 00:28:58,080
resolution image of it and for that we

635
00:29:02,870 --> 00:29:00,659
are designing the mission the space

636
00:29:05,149 --> 00:29:02,880
mission that would be needed that's a

637
00:29:08,870 --> 00:29:05,159
very expensive Mission it would cost

638
00:29:11,810 --> 00:29:08,880

about a billion dollars uh and to find

639

00:29:14,570 --> 00:29:11,820

candidates that we want to date we have

640

00:29:16,549 --> 00:29:14,580

a dating app which is the Vera Rubin

641

00:29:19,549 --> 00:29:16,559

observatory in Chile that will start

642

00:29:21,590 --> 00:29:19,559

operations in about a year and then will

643

00:29:23,389 --> 00:29:21,600

provide us with candidates and we will

644

00:29:25,850 --> 00:29:23,399

choose I mean most of the time we will

645

00:29:27,710 --> 00:29:25,860

swipe to the left because it's a very

646

00:29:30,590 --> 00:29:27,720

expensive date

647

00:29:34,909 --> 00:29:30,600

it sure sounds like it wow

648

00:29:37,190 --> 00:29:34,919

um so before we get going here someone

649

00:29:40,010 --> 00:29:37,200

um was asking they're involved in like

650

00:29:42,710 --> 00:29:40,020

this uh star star watch I'm sorry meteor

651
00:29:44,210 --> 00:29:42,720
the media watch tonight and they wanted

652
00:29:46,029 --> 00:29:44,220
to know

653
00:29:49,250 --> 00:29:46,039
um if

654
00:29:51,350 --> 00:29:49,260
scientists are paying attention or

655
00:29:54,769 --> 00:29:51,360
um astronomers are paying attention to

656
00:29:58,010 --> 00:29:54,779
where amuamua is now can you calculate

657
00:30:01,789 --> 00:29:58,020
how far away this thing is you roughly

658
00:30:04,970 --> 00:30:01,799
so the problem is that the by now it's

659
00:30:07,250 --> 00:30:04,980
uh 10 million times fainter than it was

660
00:30:10,490 --> 00:30:07,260
close to Earth so it's impossible to

661
00:30:13,789 --> 00:30:10,500
detect it with existing telescopes

662
00:30:15,830 --> 00:30:13,799
um and moreover the trajectory was not

663
00:30:20,090 --> 00:30:15,840

known to a high enough Precision for us

664

00:30:22,190 --> 00:30:20,100

to chase it or to even look for it at

665

00:30:25,190 --> 00:30:22,200

this time if you wanted to send the

666

00:30:27,049 --> 00:30:25,200

spacecraft that will try to find it it

667

00:30:29,870 --> 00:30:27,059

would have to be equipped with a huge

668

00:30:32,090 --> 00:30:29,880

telescope just to First spot where it is

669

00:30:34,370 --> 00:30:32,100

because we don't know the trajectory

670

00:30:36,710 --> 00:30:34,380

well enough to figure out where it is

671

00:30:38,990 --> 00:30:36,720

right now so uh it's completely

672

00:30:41,690 --> 00:30:39,000

impractical but instead of you know it's

673

00:30:43,370 --> 00:30:41,700

just like going on a date and liking a

674

00:30:45,049 --> 00:30:43,380

person but they're not having the the

675

00:30:47,210 --> 00:30:45,059

phone number of that person so you can't

676
00:30:49,310 --> 00:30:47,220
really get in touch but what the

677
00:30:52,010 --> 00:30:49,320
approach the healthy approach my advice

678
00:30:54,049 --> 00:30:52,020
is if you have such an experience you

679
00:30:56,810 --> 00:30:54,059
better date more people with the hope

680
00:30:59,029 --> 00:30:56,820
that one of them will resemble that very

681
00:31:00,769 --> 00:30:59,039
fortunate date you had and so that's

682
00:31:04,190 --> 00:31:00,779
what we are planning to do look for more

683
00:31:06,230 --> 00:31:04,200
objects like it yeah but what you were

684
00:31:08,690 --> 00:31:06,240
able to calculate a speed at one time

685
00:31:11,750 --> 00:31:08,700
weren't you oh of course no when it came

686
00:31:13,490 --> 00:31:11,760
close to Earth we know know the speed

687
00:31:16,190 --> 00:31:13,500
and the direction it was moving and not

688
00:31:18,529 --> 00:31:16,200

only that we could tell that it's

689

00:31:20,810 --> 00:31:18,539

accelerating in a way that is not fully

690

00:31:23,090 --> 00:31:20,820

consistent with the Sun's gravity so

691

00:31:25,610 --> 00:31:23,100

there was a force acting on it pushing

692

00:31:28,070 --> 00:31:25,620

it away from the sun and it was not

693

00:31:30,289 --> 00:31:28,080

clear what this force is because there

694

00:31:32,330 --> 00:31:30,299

was no rocket effect from cometary

695

00:31:35,389 --> 00:31:32,340

evaporation and

696

00:31:38,510 --> 00:31:35,399

um so I suggested it's the reflection of

697

00:31:40,310 --> 00:31:38,520

sunlight just like the salt the solar

698

00:31:42,529 --> 00:31:40,320

sails that we were talking about before

699

00:31:45,590 --> 00:31:42,539

with the laser except here is the

700

00:31:48,470 --> 00:31:45,600

sunlight and then

701
00:31:50,810 --> 00:31:48,480
um actually three years later in

702
00:31:53,930 --> 00:31:50,820
September 2020 there was another object

703
00:31:56,690 --> 00:31:53,940
that was discovered which exhibited the

704
00:31:58,730 --> 00:31:56,700
same qualities as someone white didn't

705
00:32:01,669 --> 00:31:58,740
have a cometary tale and it was pushed

706
00:32:03,350 --> 00:32:01,679
by reflecting sunlight but a few weeks

707
00:32:05,870 --> 00:32:03,360
after it was discovered it was given the

708
00:32:07,970 --> 00:32:05,880
name 2020 so

709
00:32:11,149 --> 00:32:07,980
but it was discovered by the same

710
00:32:13,430 --> 00:32:11,159
telescope in Hawaii panzars and the

711
00:32:16,010 --> 00:32:13,440
astronomers realized oh it's actually

712
00:32:18,049 --> 00:32:16,020
base if you just extrapolate the

713
00:32:22,029 --> 00:32:18,059

trajectory back in time it came from

714

00:32:26,090 --> 00:32:22,039

Earth uh in 1966 it's a rocket booster

715

00:32:29,090 --> 00:32:26,100

uh that was called lunar surveyor that

716

00:32:31,490 --> 00:32:29,100

was sent by NASA and

717

00:32:35,149 --> 00:32:31,500

um and later on they verified that

718

00:32:37,730 --> 00:32:35,159

indeed it's made of stainless steel so

719

00:32:39,769 --> 00:32:37,740

obviously no commentary tale and

720

00:32:43,010 --> 00:32:39,779

moreover the the walls were thin enough

721

00:32:46,190 --> 00:32:43,020

for it to be to be pushed by reflecting

722

00:32:48,470 --> 00:32:46,200

sunlight so here is an example for an

723

00:32:50,990 --> 00:32:48,480

artificial object that is pushed by

724

00:32:53,090 --> 00:32:51,000

sunlight not on purpose it was not

725

00:32:56,029 --> 00:32:53,100

designed to be a sale but it was thin

726

00:32:58,810 --> 00:32:56,039

enough it had a large enough area for

727

00:33:01,250 --> 00:32:58,820

its mass and

728

00:33:03,950 --> 00:33:01,260

so we know that it's artificial because

729

00:33:05,990 --> 00:33:03,960

we produced it the question is who

730

00:33:09,169 --> 00:33:06,000

produced

731

00:33:10,909 --> 00:33:09,179

right but we have uh we have space junk

732

00:33:13,430 --> 00:33:10,919

all over the place don't we

733

00:33:14,409 --> 00:33:13,440

it's going oh yeah closer to Earth of

734

00:33:16,850 --> 00:33:14,419

course

735

00:33:20,029 --> 00:33:16,860

so what happens every now and then is

736

00:33:21,470 --> 00:33:20,039

that one of these objects you know as a

737

00:33:24,190 --> 00:33:21,480

result of friction with the upper

738

00:33:27,230 --> 00:33:24,200

atmosphere Falls in and burns up and

739

00:33:30,110 --> 00:33:27,240

that we also see and so there is a lot

740

00:33:32,870 --> 00:33:30,120

of junk uh but this one the book the

741

00:33:35,570 --> 00:33:32,880

rocket booster was launched well beyond

742

00:33:38,389 --> 00:33:35,580

the atmosphere of Earth and at first it

743

00:33:41,269 --> 00:33:38,399

was not recognized as such as our own

744

00:33:44,210 --> 00:33:41,279

creation so but it just demonstrates

745

00:33:48,610 --> 00:33:44,220

that being pushed by sunlight

746

00:33:50,990 --> 00:33:48,620

uh occurs also for our own

747

00:33:52,850 --> 00:33:51,000

products you know and

748

00:33:56,029 --> 00:33:52,860

um therefore you know it could be that

749

00:33:59,210 --> 00:33:56,039

Omar was not a light sail just like 2020

750

00:34:01,789 --> 00:33:59,220

or so was not a light sail and uh maybe

751

00:34:04,730 --> 00:34:01,799

I'm always just a surface layer of

752

00:34:05,870 --> 00:34:04,740

something else or who knows what its

753

00:34:07,730 --> 00:34:05,880

purpose was

754

00:34:09,169 --> 00:34:07,740

yes and we talked about when you were on

755

00:34:12,169 --> 00:34:09,179

the show before we talked about this

756

00:34:14,810 --> 00:34:12,179

that it was a artist the artist's

757

00:34:16,909 --> 00:34:14,820

conception of the piece was like a

758

00:34:20,349 --> 00:34:16,919

cigar-shaped rock but that's not

759

00:34:22,849 --> 00:34:20,359

not what was really it was not thought

760

00:34:25,430 --> 00:34:22,859

yeah because when

761

00:34:27,770 --> 00:34:25,440

astronomers analyze the data and by the

762

00:34:30,589 --> 00:34:27,780

way this is all scientific data with

763

00:34:34,570 --> 00:34:30,599

very high Precision so when they try to

764

00:34:38,690 --> 00:34:34,580

model the shape of it uh the the best

765

00:34:41,389 --> 00:34:38,700

fit was obtained at the 90 confidence uh

766

00:34:44,149 --> 00:34:41,399

to that of a pancake a flat object and

767

00:34:46,310 --> 00:34:44,159

not a cigar shape now even a flat object

768

00:34:48,409 --> 00:34:46,320

if you imagine a piece of paper when

769

00:34:50,389 --> 00:34:48,419

projected on the sky you know it may

770

00:34:54,829 --> 00:34:50,399

look like a cigar because you see it

771

00:34:57,050 --> 00:34:54,839

sideways right and that's the reason uh

772

00:34:59,109 --> 00:34:57,060

I mean that that initially people argued

773

00:35:02,089 --> 00:34:59,119

is a cigar because

774

00:35:03,770 --> 00:35:02,099

uh projected on the sky it may look like

775

00:35:05,990 --> 00:35:03,780

that

776

00:35:07,510 --> 00:35:06,000

right here's a question going back to

777

00:35:13,010 --> 00:35:07,520

the 2014

778

00:35:15,050 --> 00:35:13,020

uh media off of uh Papua New Guinea so

779

00:35:17,569 --> 00:35:15,060

Bobby wanted to know how was the

780

00:35:20,329 --> 00:35:17,579

hardness of the media determined okay

781

00:35:22,730 --> 00:35:20,339

that's an excellent question uh so what

782

00:35:23,530 --> 00:35:22,740

happened is I was invited for an

783

00:35:26,710 --> 00:35:23,540

interview

784

00:35:29,569 --> 00:35:26,720

on a different meteor

785

00:35:32,870 --> 00:35:29,579

and I wanted to learn a little more

786

00:35:35,630 --> 00:35:32,880

about meteors I went online and I I

787

00:35:37,849 --> 00:35:35,640

realized there is a catalog of meteors

788

00:35:40,010 --> 00:35:37,859

that the U.S government compiled as they

789

00:35:42,050 --> 00:35:40,020

are monitoring the atmosphere for

790

00:35:45,109 --> 00:35:42,060

ballistic missiles you know the for

791

00:35:47,810 --> 00:35:45,119

national security purposes and uh and

792

00:35:51,050 --> 00:35:47,820

then I found this catalog so I asked my

793

00:35:53,450 --> 00:35:51,060

student to check uh whether the fastest

794

00:35:55,490 --> 00:35:53,460

moving meteors could have originated

795

00:35:58,390 --> 00:35:55,500

from outside the solar system if they

796

00:36:02,270 --> 00:35:58,400

move fast enough they are not bound

797

00:36:04,370 --> 00:36:02,280

to the Sun's gravity and we found that

798

00:36:07,069 --> 00:36:04,380

the fastest one is actually a head-on

799

00:36:09,109 --> 00:36:07,079

collision with the Earth so it was fast

800

00:36:10,910 --> 00:36:09,119

relative to the Earth just by chance

801
00:36:13,609 --> 00:36:10,920
because it was moving opposite to the

802
00:36:17,750 --> 00:36:13,619
Earth Direction but this second fastest

803
00:36:19,730 --> 00:36:17,760
is the one from January 8 2014 and that

804
00:36:21,829 --> 00:36:19,740
came from the side and it was actually

805
00:36:23,230 --> 00:36:21,839
moving really fast relative to the Sun

806
00:36:26,150 --> 00:36:23,240
and

807
00:36:29,210 --> 00:36:26,160
it was detected by government sensors

808
00:36:34,130 --> 00:36:29,220
when it exploded about 19 kilometers

809
00:36:35,930 --> 00:36:34,140
above the ocean surface and so we wrote

810
00:36:37,849 --> 00:36:35,940
the paper about it saying this is

811
00:36:40,370 --> 00:36:37,859
actually the first Interstellar object

812
00:36:44,750 --> 00:36:40,380
ever discovered because it dates back to

813
00:36:47,990 --> 00:36:44,760

2014 almost four years before omomo was

814

00:36:50,450 --> 00:36:48,000

discovered but the paper was rejected by

815

00:36:52,010 --> 00:36:50,460

the reviewers because they argued we

816

00:36:54,829 --> 00:36:52,020

don't believe the US government we don't

817

00:36:56,569 --> 00:36:54,839

have the uncertainties and perhaps they

818

00:36:58,609 --> 00:36:56,579

are large and of course the US

819

00:37:00,550 --> 00:36:58,619

government didn't disclose the

820

00:37:03,230 --> 00:37:00,560

uncertainties in the measurement because

821

00:37:06,349 --> 00:37:03,240

they don't want adversaries to be aware

822

00:37:08,270 --> 00:37:06,359

of the quality of the data and but they

823

00:37:10,310 --> 00:37:08,280

need to know if a ballistic missile will

824

00:37:12,890 --> 00:37:10,320

hit Boston or Washington you know they

825

00:37:15,290 --> 00:37:12,900

need to know that so I was pretty

826

00:37:19,849 --> 00:37:15,300

confident but then it took me three

827

00:37:21,530 --> 00:37:19,859

years to reach um out to people beyond

828

00:37:22,609 --> 00:37:21,540

the National Security Fence and

829

00:37:25,910 --> 00:37:22,619

eventually

830

00:37:28,190 --> 00:37:25,920

there was a letter written by the U.S

831

00:37:31,790 --> 00:37:28,200

space command under the Department of

832

00:37:35,990 --> 00:37:31,800

Defense to NASA in which it was

833

00:37:38,870 --> 00:37:36,000

confirmed that the 99.99 confidence that

834

00:37:40,490 --> 00:37:38,880

indeed this meteor came from outside the

835

00:37:42,349 --> 00:37:40,500

solar system that the uncertainties were

836

00:37:46,250 --> 00:37:42,359

really small

837

00:37:48,170 --> 00:37:46,260

um and um at that point our paper I mean

838

00:37:50,390 --> 00:37:48,180

we resubmitted it and it was accepted

839

00:37:52,790 --> 00:37:50,400

for publication in the astrophysical

840

00:37:54,890 --> 00:37:52,800

journal and then we looked back at the

841

00:37:58,370 --> 00:37:54,900

catalog we found another meteor

842

00:38:00,250 --> 00:37:58,380

uh roughly a meter in size this one um

843

00:38:03,050 --> 00:38:00,260

not far from Portugal

844

00:38:05,150 --> 00:38:03,060

and we plan to go on an expedition to

845

00:38:09,170 --> 00:38:05,160

find this one next after the first one

846

00:38:12,589 --> 00:38:09,180

uh both of them are the toughest in the

847

00:38:15,170 --> 00:38:12,599

catalog uh and how do we know that okay

848

00:38:17,030 --> 00:38:15,180

so here I get to the answer we know that

849

00:38:19,550 --> 00:38:17,040

because the government also released the

850

00:38:22,490 --> 00:38:19,560

the light curve of the explosion the

851
00:38:25,849 --> 00:38:22,500
amount of light they generated and the

852
00:38:27,770 --> 00:38:25,859
the flares and from the location in the

853
00:38:28,609 --> 00:38:27,780
atmosphere where the explosion took

854
00:38:33,050 --> 00:38:28,619
place

855
00:38:36,109 --> 00:38:33,060
uh we could tell the stress that the air

856
00:38:38,690 --> 00:38:36,119
exerted on these objects so as they move

857
00:38:40,910 --> 00:38:38,700
through the air there is a certain um

858
00:38:43,430 --> 00:38:40,920
what is called Ram pressure a certain

859
00:38:47,510 --> 00:38:43,440
stress that the material

860
00:38:49,730 --> 00:38:47,520
um feels um and they survived all the

861
00:38:52,430 --> 00:38:49,740
way down to the lower atmosphere of the

862
00:38:54,349 --> 00:38:52,440
Earth at very high speed and that means

863
00:38:58,010 --> 00:38:54,359

I mean since the atmosphere is very

864

00:39:00,650 --> 00:38:58,020

dense down uh in it we could calculate

865

00:39:03,710 --> 00:39:00,660

what is the necessary material strength

866

00:39:06,349 --> 00:39:03,720

to withstand that kind of a stress or

867

00:39:09,530 --> 00:39:06,359

pressure that the air exerts and we

868

00:39:13,190 --> 00:39:09,540

found that is larger than the material

869

00:39:16,450 --> 00:39:13,200

strength of iron okay and uh these

870

00:39:19,730 --> 00:39:16,460

objects were tougher than all 270 other

871

00:39:21,550 --> 00:39:19,740

space rocks in the same catalog of the

872

00:39:25,010 --> 00:39:21,560

government they are the toughest ever

873

00:39:27,410 --> 00:39:25,020

and the chance of drawing them out of

874

00:39:30,829 --> 00:39:27,420

the distribution of material strength

875

00:39:33,770 --> 00:39:30,839

for for solar system rocks is less than

876

00:39:37,750 --> 00:39:33,780

one in ten thousand so that means that

877

00:39:40,849 --> 00:39:37,760

if they originate from a natural origin

878

00:39:43,609 --> 00:39:40,859

their parent system has to be different

879

00:39:46,010 --> 00:39:43,619

than the solar system and you know it

880

00:39:50,990 --> 00:39:46,020

could be that for example an exploding

881

00:39:54,470 --> 00:39:51,000

star ejects bullets or small rocks that

882

00:39:57,790 --> 00:39:54,480

are very tough it's possible we don't

883

00:40:01,130 --> 00:39:57,800

know so the point is whatever we find

884

00:40:02,569 --> 00:40:01,140

down at the bottom of the ocean would

885

00:40:04,430 --> 00:40:02,579

teach us something important because

886

00:40:08,030 --> 00:40:04,440

apparently these objects are tougher

887

00:40:10,069 --> 00:40:08,040

than solar system rocks and then let's

888

00:40:13,910 --> 00:40:10,079

see what we find it's possible also that

889

00:40:16,550 --> 00:40:13,920

there were are made of artificial Alloys

890

00:40:18,410 --> 00:40:16,560

that nature doesn't put together and

891

00:40:21,470 --> 00:40:18,420

that that will be even more exciting if

892

00:40:24,109 --> 00:40:21,480

we find it but um someone had a question

893

00:40:27,290 --> 00:40:24,119

here David Jones He said what if it's

894

00:40:29,829 --> 00:40:27,300

made of a non-magnetic material like if

895

00:40:32,870 --> 00:40:29,839

it's artificial yeah

896

00:40:35,990 --> 00:40:32,880

that's an excellent question and so we

897

00:40:38,089 --> 00:40:36,000

have a plan B in case it's not attracted

898

00:40:39,710 --> 00:40:38,099

to the magnet all the fragments that we

899

00:40:43,430 --> 00:40:39,720

are looking for

900

00:40:46,430 --> 00:40:43,440

um in that case we have a mesh net

901
00:40:50,390 --> 00:40:46,440
behind it that we will

902
00:40:54,290 --> 00:40:50,400
um collect fragments with if they're big

903
00:40:56,690 --> 00:40:54,300
enough so uh we will filter out the

904
00:40:59,569 --> 00:40:56,700
Abundant Mark that is on the ocean floor

905
00:41:02,030 --> 00:40:59,579
and uh just collect anything bigger than

906
00:41:05,930 --> 00:41:02,040
a certain size with a mesh net so that

907
00:41:07,250 --> 00:41:05,940
that's our plan to use in addition to

908
00:41:09,530 --> 00:41:07,260
the magnets

909
00:41:13,250 --> 00:41:09,540
I see and

910
00:41:14,690 --> 00:41:13,260
are we talking like a major square mile

911
00:41:16,910 --> 00:41:14,700
section that you're going to be

912
00:41:19,970 --> 00:41:16,920
searching I mean how do you know where

913
00:41:24,530 --> 00:41:19,980

to search well we know the coordinates

914

00:41:27,950 --> 00:41:24,540

of where uh the meteor exploded uh and

915

00:41:30,849 --> 00:41:27,960

then we calculate so given a fragment

916

00:41:34,310 --> 00:41:30,859

size distribution the small fragments

917

00:41:36,470 --> 00:41:34,320

they have a large surface area for their

918

00:41:39,890 --> 00:41:36,480

mass and so they suffer a lot of

919

00:41:42,170 --> 00:41:39,900

friction with the air and they basically

920

00:41:45,349 --> 00:41:42,180

rain down straight from the explosion

921

00:41:47,510 --> 00:41:45,359

location Point okay so they rain down as

922

00:41:49,190 --> 00:41:47,520

hot rain because the amount of energy

923

00:41:52,730 --> 00:41:49,200

released was a few percent of the

924

00:41:56,030 --> 00:41:52,740

Hiroshima atomic bomb okay so

925

00:41:58,250 --> 00:41:56,040

um what you end up is melting any solid

926
00:42:01,490 --> 00:41:58,260
material irrespective of the composition

927
00:42:04,190 --> 00:42:01,500
and you end up with droplets uh so

928
00:42:05,870 --> 00:42:04,200
that's like very hot rain coming down

929
00:42:08,270 --> 00:42:05,880
and if you had an umbrella it wouldn't

930
00:42:11,450 --> 00:42:08,280
protect you because it's hot uh and then

931
00:42:14,510 --> 00:42:11,460
as it rains on the ocean steam comes up

932
00:42:18,470 --> 00:42:14,520
uh and then these fragments settle down

933
00:42:22,190 --> 00:42:18,480
so the small fragments would appear just

934
00:42:25,490 --> 00:42:22,200
down from the explosion point and then

935
00:42:27,290 --> 00:42:25,500
the bigger fragments continue along the

936
00:42:30,589 --> 00:42:27,300
path of the meteor because they have

937
00:42:32,930 --> 00:42:30,599
less friction with the air and then the

938
00:42:36,410 --> 00:42:32,940

biggest chunks of course follow the path

939

00:42:40,910 --> 00:42:36,420

of the original path of the meteor and

940

00:42:42,770 --> 00:42:40,920

so we plan to basically find this strip

941

00:42:45,170 --> 00:42:42,780

along which the fragments are

942

00:42:47,630 --> 00:42:45,180

distributed with small fragments first

943

00:42:48,490 --> 00:42:47,640

and then larger fragments along the path

944

00:42:55,310 --> 00:42:48,500

and

945

00:42:57,170 --> 00:42:55,320

right now 10 kilometers so it's a

946

00:42:59,470 --> 00:42:57,180

relatively big area that you know

947

00:43:02,210 --> 00:42:59,480

several miles that we will have to

948

00:43:05,150 --> 00:43:02,220

survey and it's just like mowing the

949

00:43:07,309 --> 00:43:05,160

lawn we will go back and forth and we

950

00:43:10,130 --> 00:43:07,319

don't need to go deep there is not much

951
00:43:12,230 --> 00:43:10,140
activity on the ocean floor

952
00:43:16,190 --> 00:43:12,240
so we should see what we find it's an

953
00:43:18,650 --> 00:43:16,200
adventure and definitely worth doing and

954
00:43:21,050 --> 00:43:18,660
we're fully funded for it that's

955
00:43:23,569 --> 00:43:21,060
wonderful about how far off of the

956
00:43:25,550 --> 00:43:23,579
Earth's surface were was this particular

957
00:43:29,569 --> 00:43:25,560
explosion

958
00:43:33,010 --> 00:43:29,579
Oh you mean from a land yeah from no how

959
00:43:36,109 --> 00:43:33,020
far up in the air oh yeah it was

960
00:43:40,790 --> 00:43:36,119
18.7 kilometers up above the ocean

961
00:43:44,510 --> 00:43:40,800
surface yes I see wow so um It's

962
00:43:47,030 --> 00:43:44,520
relatively low given that the you know

963
00:43:49,970 --> 00:43:47,040

this is a in the lower atmosphere of the

964

00:43:51,890 --> 00:43:49,980

Earth where the density is on is is not

965

00:43:54,230 --> 00:43:51,900

very far from what we find

966

00:43:56,270 --> 00:43:54,240

uh at sea level you know it's just a few

967

00:43:58,849 --> 00:43:56,280

times lower so

968

00:44:01,370 --> 00:43:58,859

um if it were made of stone for example

969

00:44:03,829 --> 00:44:01,380

it would have exploded much higher up

970

00:44:06,170 --> 00:44:03,839

because it was moving at 45 kilometers

971

00:44:08,569 --> 00:44:06,180

per second a very high speed the Escape

972

00:44:11,270 --> 00:44:08,579

speed from the earth is 11 kilometers

973

00:44:15,230 --> 00:44:11,280

per second that's what you need

974

00:44:17,750 --> 00:44:15,240

um uh any rocket that you launch beyond

975

00:44:20,750 --> 00:44:17,760

the gravitational pull of Earth that's

976

00:44:23,089 --> 00:44:20,760

the kind of speed it needs to reach at

977

00:44:25,250 --> 00:44:23,099

least 11 kilometers per second right

978

00:44:26,690 --> 00:44:25,260

right this is an interesting question

979

00:44:28,910 --> 00:44:26,700

someone put up there what is your

980

00:44:30,829 --> 00:44:28,920

opinion of the work of John Mack of

981

00:44:34,190 --> 00:44:30,839

Harvard and I guess I want to ask you

982

00:44:36,410 --> 00:44:34,200

has there been any parallels as far as

983

00:44:38,750 --> 00:44:36,420

what you have been doing to what John

984

00:44:42,170 --> 00:44:38,760

Mack did I I don't know if you've looked

985

00:44:44,210 --> 00:44:42,180

into that at all well no there is no

986

00:44:47,690 --> 00:44:44,220

overlap because he was interested in

987

00:44:49,910 --> 00:44:47,700

people and humans are not scientific

988

00:44:52,730 --> 00:44:49,920

instruments for physicists I'm a

989

00:44:55,370 --> 00:44:52,740

physicist I'm an astrophysicist uh you

990

00:44:58,250 --> 00:44:55,380

can't write a scientific paper in

991

00:45:01,130 --> 00:44:58,260

physics saying this person told me that

992

00:45:02,569 --> 00:45:01,140

okay you cannot do that there is no and

993

00:45:05,089 --> 00:45:02,579

there is a good reason for this

994

00:45:06,950 --> 00:45:05,099

tradition because people very often have

995

00:45:09,550 --> 00:45:06,960

hallucinations I mean they are sincere

996

00:45:15,109 --> 00:45:09,560

they tell you that they

997

00:45:17,150 --> 00:45:15,119

felt or or had some uh experiences they

998

00:45:20,569 --> 00:45:17,160

are sincere about it I have no doubt but

999

00:45:23,750 --> 00:45:20,579

humans can easily be fooled and we know

1000

00:45:26,870 --> 00:45:23,760

that when people take recreational drugs

1001
00:45:29,030 --> 00:45:26,880
or people have an accident they have all

1002
00:45:30,890 --> 00:45:29,040
kinds of Impressions that have nothing

1003
00:45:33,650 --> 00:45:30,900
to do with the reality that surrounds

1004
00:45:38,510 --> 00:45:33,660
them and therefore we don't use people

1005
00:45:40,970 --> 00:45:38,520
as detectors okay now uh we can use it

1006
00:45:43,609 --> 00:45:40,980
as intriguing evidence that is worth

1007
00:45:46,130 --> 00:45:43,619
putting instruments but inside in

1008
00:45:47,750 --> 00:45:46,140
physics you need to rely on data

1009
00:45:50,390 --> 00:45:47,760
collected by instruments because it's

1010
00:45:52,750 --> 00:45:50,400
repeatable you can repeat the experiment

1011
00:45:56,349 --> 00:45:52,760
and instruments do not have

1012
00:45:59,690 --> 00:45:56,359
personalities you know they just do

1013
00:46:03,170 --> 00:45:59,700

they measure whatever they measure and

1014

00:46:06,890 --> 00:46:03,180

then we fully understand how they get

1015

00:46:08,450 --> 00:46:06,900

the data that that we collect and so not

1016

00:46:10,190 --> 00:46:08,460

only that you have to use instruments

1017

00:46:12,950 --> 00:46:10,200

you have to understand to calibrate the

1018

00:46:15,050 --> 00:46:12,960

instruments and for example when we see

1019

00:46:16,790 --> 00:46:15,060

fuzzy images from the cockpits of

1020

00:46:19,069 --> 00:46:16,800

fighter jets that's not a scientific

1021

00:46:21,230 --> 00:46:19,079

experiment because we don't know what

1022

00:46:23,329 --> 00:46:21,240

the camera was doing when this or or the

1023

00:46:27,349 --> 00:46:23,339

cockpit was doing when we these photos

1024

00:46:30,190 --> 00:46:27,359

were taken so one so Science is based on

1025

00:46:33,170 --> 00:46:30,200

using instruments separate from people

1026

00:46:34,970 --> 00:46:33,180

that provide quantitative results and

1027

00:46:37,790 --> 00:46:34,980

are fully understood fully calibrated

1028

00:46:39,710 --> 00:46:37,800

and controlled in a way that one

1029

00:46:41,690 --> 00:46:39,720

understands because otherwise you can't

1030

00:46:42,770 --> 00:46:41,700

really digest the information that you

1031

00:46:46,569 --> 00:46:42,780

get

1032

00:46:50,150 --> 00:46:46,579

all right well um I another another

1033

00:46:52,190 --> 00:46:50,160

question I have about this is

1034

00:46:55,970 --> 00:46:52,200

um have you been

1035

00:46:59,510 --> 00:46:55,980

uh treated any different since you

1036

00:47:00,349 --> 00:46:59,520

started looking into this by Harvard oh

1037

00:47:02,210 --> 00:47:00,359

no

1038

00:47:04,910 --> 00:47:02,220

um how are those fully supportive I mean

1039

00:47:06,530 --> 00:47:04,920

there was an initial phase where I was

1040

00:47:07,430 --> 00:47:06,540

asked whether

1041

00:47:11,390 --> 00:47:07,440

um

1042

00:47:13,550 --> 00:47:11,400

I said of course because in astronomy we

1043

00:47:16,190 --> 00:47:13,560

use telescopes and look at the sky and

1044

00:47:18,829 --> 00:47:16,200

analyze the data and that's what the

1045

00:47:21,170 --> 00:47:18,839

Galileo project is doing and that was a

1046

00:47:23,569 --> 00:47:21,180

question asked when I started to get

1047

00:47:24,890 --> 00:47:23,579

funding for the Galileo project and the

1048

00:47:27,290 --> 00:47:24,900

funding is being channeled through

1049

00:47:31,370 --> 00:47:27,300

Harvard so it was just an administrative

1050

00:47:33,050 --> 00:47:31,380

question but otherwise no what I should

1051
00:47:37,190 --> 00:47:33,060
say is

1052
00:47:38,870 --> 00:47:37,200
um you know this is a subject that my

1053
00:47:40,370 --> 00:47:38,880
hope is to bring to the mainstream

1054
00:47:43,130 --> 00:47:40,380
because we are following the scientific

1055
00:47:45,530 --> 00:47:43,140
method and collecting data the way

1056
00:47:47,450 --> 00:47:45,540
scientists doing any other respect just

1057
00:47:49,010 --> 00:47:47,460
like in the search for dark matter we

1058
00:47:51,109 --> 00:47:49,020
don't know what most of the matter in

1059
00:47:53,030 --> 00:47:51,119
the university is and people have

1060
00:47:54,589 --> 00:47:53,040
searched and and studied various

1061
00:47:57,050 --> 00:47:54,599
possibilities and

1062
00:47:59,210 --> 00:47:57,060
I I would argue that the the fact that

1063
00:48:01,910 --> 00:47:59,220

we exist that we send probes to

1064

00:48:03,410 --> 00:48:01,920

Interstellar space and the fact that we

1065

00:48:05,690 --> 00:48:03,420

know that the substantial fraction of

1066

00:48:08,630 --> 00:48:05,700

all the sun-like stars have planets like

1067

00:48:11,990 --> 00:48:08,640

the Earth implies that it's quite

1068

00:48:14,930 --> 00:48:12,000

possible and even likely that that

1069

00:48:16,730 --> 00:48:14,940

someone like us predated us and and sent

1070

00:48:19,010 --> 00:48:16,740

probes that by now would have reached us

1071

00:48:20,690 --> 00:48:19,020

and we know that most stars from

1072

00:48:22,730 --> 00:48:20,700

billions of years before the Sun so

1073

00:48:25,730 --> 00:48:22,740

there was plenty of time even for

1074

00:48:27,530 --> 00:48:25,740

chemical Rockets to make the trip from

1075

00:48:30,410 --> 00:48:27,540

the edge of the galaxy to the solar

1076

00:48:33,589 --> 00:48:30,420

system so now another thing I wanted to

1077

00:48:35,750 --> 00:48:33,599

mention is I I already said that the

1078

00:48:39,230 --> 00:48:35,760

paper about the interstellar meteor was

1079

00:48:40,910 --> 00:48:39,240

first rejected because the argument was

1080

00:48:42,890 --> 00:48:40,920

we don't believe the US government it

1081

00:48:44,930 --> 00:48:42,900

was not because we don't believe avilo I

1082

00:48:50,690 --> 00:48:44,940

mean it was the US government that was

1083

00:48:53,390 --> 00:48:50,700

put in question and uh so um and now you

1084

00:48:55,490 --> 00:48:53,400

know when we submitted another paper on

1085

00:48:58,609 --> 00:48:55,500

the same subject after the letter came

1086

00:49:01,609 --> 00:48:58,619

from uh the Department of Defense which

1087

00:49:04,309 --> 00:49:01,619

came to my defense uh which by the way

1088

00:49:05,990 --> 00:49:04,319

is interesting in itself because it's a

1089

00:49:08,870 --> 00:49:06,000

very conservative organization the

1090

00:49:10,609 --> 00:49:08,880

government right and the fact that the

1091

00:49:11,589 --> 00:49:10,619

government comes to the defense of

1092

00:49:15,170 --> 00:49:11,599

science

1093

00:49:18,230 --> 00:49:15,180

uh you know at the frontier uh is

1094

00:49:20,990 --> 00:49:18,240

interesting because uh at the same time

1095

00:49:23,990 --> 00:49:21,000

there is a lot of pushback from what you

1096

00:49:25,849 --> 00:49:24,000

might call Blue Sky Academia and which

1097

00:49:28,190 --> 00:49:25,859

is supposed to be more open-minded than

1098

00:49:29,770 --> 00:49:28,200

government and you know the fact that I

1099

00:49:33,470 --> 00:49:29,780

get the

1100

00:49:37,730 --> 00:49:33,480

support from the government uh for this

1101
00:49:39,349 --> 00:49:37,740
study was remarkable in my I mean this

1102
00:49:41,750 --> 00:49:39,359
is not the first time it happened it

1103
00:49:45,710 --> 00:49:41,760
happened before when the US government

1104
00:49:47,390 --> 00:49:45,720
was looking for a set of satellites to

1105
00:49:51,050 --> 00:49:47,400
monitor nuclear explosions by the

1106
00:49:52,550 --> 00:49:51,060
Russians it was the late 9 1960s above

1107
00:49:55,609 --> 00:49:52,560
the atmosphere so they were looking for

1108
00:49:58,069 --> 00:49:55,619
gamma ray flashes and then they saw it's

1109
00:50:01,010 --> 00:49:58,079
called The Villa satellite system and

1110
00:50:03,170 --> 00:50:01,020
they saw flashes of gamma rays coming

1111
00:50:05,569 --> 00:50:03,180
and I'm sure that on the first few

1112
00:50:07,849 --> 00:50:05,579
instances they thought well it's every

1113
00:50:09,530 --> 00:50:07,859

day or every few days what are the

1114

00:50:10,970 --> 00:50:09,540

Russians doing and there must have been

1115

00:50:14,089 --> 00:50:10,980

a lot of troubled people in Washington

1116

00:50:18,170 --> 00:50:14,099

DC worrying about it but then it was

1117

00:50:20,809 --> 00:50:18,180

realized that it may come from far away

1118

00:50:22,569 --> 00:50:20,819

and so the data was brought to the

1119

00:50:25,550 --> 00:50:22,579

attention of

1120

00:50:29,809 --> 00:50:25,560

scientists astronomers in Los Alamos who

1121

00:50:31,190 --> 00:50:29,819

then published it in 1972 as gamma ray

1122

00:50:35,990 --> 00:50:31,200

birth and they said we don't know what

1123

00:50:38,930 --> 00:50:36,000

the source is and it took um until 1997

1124

00:50:41,690 --> 00:50:38,940

for astronomers to figure out that these

1125

00:50:44,270 --> 00:50:41,700

flashes of gamma rays originate from the

1126
00:50:47,089 --> 00:50:44,280
edge of the universe when the core of a

1127
00:50:49,430 --> 00:50:47,099
star collapses to a black hole and you

1128
00:50:52,190 --> 00:50:49,440
end up producing Jets very very

1129
00:50:54,829 --> 00:50:52,200
energetic Jets and if that the jet is

1130
00:50:57,770 --> 00:50:54,839
pointed at us we see it as a gamma ray

1131
00:50:59,630 --> 00:50:57,780
Flash and so it's basically the signal

1132
00:51:01,250 --> 00:50:59,640
of the formation of a black hole from

1133
00:51:04,190 --> 00:51:01,260
the collapse of the core of a massive

1134
00:51:08,690 --> 00:51:04,200
star and that was figured out only in

1135
00:51:10,790 --> 00:51:08,700
1997 and it shows you that the data from

1136
00:51:13,790 --> 00:51:10,800
the government helps progress in science

1137
00:51:16,130 --> 00:51:13,800
in in both instances but what I wanted

1138
00:51:17,930 --> 00:51:16,140

to say is when we reported the second

1139

00:51:20,329 --> 00:51:17,940

Interstellar meteor and that happened

1140

00:51:22,490 --> 00:51:20,339

just a couple of months ago that paper

1141

00:51:24,950 --> 00:51:22,500

also on an Interstellar meteor was

1142

00:51:27,950 --> 00:51:24,960

accepted for publication within weeks so

1143

00:51:30,530 --> 00:51:27,960

so I can see a shift for the better

1144

00:51:31,549 --> 00:51:30,540

right I didn't we didn't have as much

1145

00:51:34,549 --> 00:51:31,559

friction

1146

00:51:36,589 --> 00:51:34,559

that's right I I've seen that too here's

1147

00:51:39,349 --> 00:51:36,599

an interesting question and I hope you

1148

00:51:42,410 --> 00:51:39,359

may understand it better than I do could

1149

00:51:45,170 --> 00:51:42,420

uh you please explain nanotechnological

1150

00:51:47,470 --> 00:51:45,180

and synthetic biology-based multiplexed

1151
00:51:51,650 --> 00:51:47,480
and scalable chipset

1152
00:51:53,349 --> 00:51:51,660
Nano probe and bio probe technology do

1153
00:51:56,990 --> 00:51:53,359
you understand any of that

1154
00:52:00,470 --> 00:51:57,000
uh yeah well there was a paper that was

1155
00:52:03,470 --> 00:52:00,480
just published in astrobiology that's a

1156
00:52:05,089 --> 00:52:03,480
journal uh George Church a colleague of

1157
00:52:08,089 --> 00:52:05,099
mine from Harvard Medical School

1158
00:52:09,970 --> 00:52:08,099
published it it was inspired by the star

1159
00:52:14,710 --> 00:52:09,980
shot concept that I mentioned before

1160
00:52:16,329 --> 00:52:14,720
where the plan is to send the tiny

1161
00:52:19,730 --> 00:52:16,339
nanoprobe

1162
00:52:23,950 --> 00:52:19,740
to the nearest star system and so what

1163
00:52:27,109 --> 00:52:23,960

the church was advocating is perhaps

1164

00:52:29,089 --> 00:52:27,119

sending out DNA and sort of seeding the

1165

00:52:29,870 --> 00:52:29,099

Milky Way galaxy with things that we

1166

00:52:33,430 --> 00:52:29,880

want

1167

00:52:36,290 --> 00:52:33,440

to plant on other planets far away

1168

00:52:38,270 --> 00:52:36,300

that's a long-term project

1169

00:52:40,670 --> 00:52:38,280

you know sending it beyond the solar

1170

00:52:43,370 --> 00:52:40,680

system elsewhere there are people that

1171

00:52:46,490 --> 00:52:43,380

would argue yeah we shouldn't be so

1172

00:52:48,890 --> 00:52:46,500

proud of our seeds so that you know to

1173

00:52:50,990 --> 00:52:48,900

plant them elsewhere maybe you know

1174

00:52:53,390 --> 00:52:51,000

maybe there is a better thing to do

1175

00:52:54,829 --> 00:52:53,400

rather than contaminate the universe but

1176

00:52:57,230 --> 00:52:54,839

on the other hand it's a natural

1177

00:53:00,730 --> 00:52:57,240

tendency if Humanity wants to

1178

00:53:04,370 --> 00:53:00,740

make copies of things that it finds

1179

00:53:06,530 --> 00:53:04,380

attractive or worthwhile then it's good

1180

00:53:08,930 --> 00:53:06,540

to send these copies elsewhere so that

1181

00:53:11,030 --> 00:53:08,940

they will not disappear from a single

1182

00:53:14,049 --> 00:53:11,040

point catastrophe if something bad

1183

00:53:16,730 --> 00:53:14,059

happens on Earth you know we don't want

1184

00:53:17,930 --> 00:53:16,740

all forms of life as we know it to

1185

00:53:20,390 --> 00:53:17,940

disappear

1186

00:53:22,370 --> 00:53:20,400

so right one way to preserve them is to

1187

00:53:23,150 --> 00:53:22,380

send them to space and with the hope

1188

00:53:26,089 --> 00:53:23,160

that

1189

00:53:30,470 --> 00:53:26,099

it's just like dandelion seeds with the

1190

00:53:33,470 --> 00:53:30,480

hope that one of them will give birth to

1191

00:53:35,150 --> 00:53:33,480

another form of life somewhere yeah that

1192

00:53:37,670 --> 00:53:35,160

whole thing about seeds is fascinating

1193

00:53:39,470 --> 00:53:37,680

how we have some that are you know I

1194

00:53:41,630 --> 00:53:39,480

mean preserved we have all these seeds

1195

00:53:43,790 --> 00:53:41,640

preserved but anyway I can't believe how

1196

00:53:46,730 --> 00:53:43,800

quickly this hour went I know you have a

1197

00:53:47,870 --> 00:53:46,740

commitment so I really do appreciate uh

1198

00:53:50,270 --> 00:53:47,880

your time

1199

00:53:53,030 --> 00:53:50,280

a lot thank you very much for inviting

1200

00:53:54,829 --> 00:53:53,040

me it was a real pleasure and stay tuned

1201
00:53:57,530 --> 00:53:54,839
for what we find we should say that's

1202
00:54:00,109 --> 00:53:57,540
right I'll be glad to report back in in

1203
00:54:01,790 --> 00:54:00,119
more than half a year from now yes I

1204
00:54:03,410 --> 00:54:01,800
would love to find that out thank you

1205
00:54:06,410 --> 00:54:03,420
very much and nice talking to you again

1206
00:54:09,230 --> 00:54:06,420
bye-bye bye now all right everyone we'll

1207
00:54:11,329 --> 00:54:09,240
be back next week and I don't have a

1208
00:54:13,790 --> 00:54:11,339
guest to announce yet uh there was a

1209
00:54:15,950 --> 00:54:13,800
change so I will let you know if you

1210
00:54:19,069 --> 00:54:15,960
sign up at the uh website podcast

1211
00:54:21,650 --> 00:54:19,079
ufo.com the newsletter there and we'll

1212
00:54:23,390 --> 00:54:21,660
uh The Weekly Newsletter just sign up

1213
00:54:24,950 --> 00:54:23,400

for an email blast for that thanks so

1214

00:54:25,420 --> 00:54:24,960

much and remember to keep your eyes to

1215

00:54:28,549 --> 00:54:25,430

the sky

1216

00:54:28,559 --> 00:54:36,700

foreign