



# MERGED

PODCAST

WITH  
AVI LOEB



1

00:07:53,333 --> 00:07:56,125

From our private experience, when we find

2

00:07:56,125 --> 00:07:59,375

a partner, it changes the meaning that we

3

00:07:59,375 --> 00:08:01,458

assign to our existence.

4

00:08:01,458 --> 00:08:04,041

And in the same way, I believe that when

5

00:08:04,041 --> 00:08:06,666

humanity finds a partner, an interstellar

6

00:08:06,666 --> 00:08:09,541

partner, it will change everything.

7

00:08:09,541 --> 00:08:13,208

It will make the universe have some

8

00:08:13,208 --> 00:08:16,375

meaning, because they may have answers to

9

00:08:16,375 --> 00:08:17,000

questions that we

10

00:08:17,000 --> 00:08:18,666

didn't figure the answers to,

11

00:08:18,791 --> 00:08:21,375

but we could also interact with them in a

12

00:08:21,375 --> 00:08:24,583

way that we can learn about our future.

13

00:08:24,583 --> 00:08:26,500

Because if they already went through part

14

00:08:26,500 --> 00:08:29,416

of our technological future, we will see

15

00:08:29,416 --> 00:08:31,333

technologies that we've never imagined.

16

00:08:31,333 --> 00:08:33,458

This is knowledge that should be shared

17

00:08:33,458 --> 00:08:35,625

by all humans, because it will change our

18

00:08:35,625 --> 00:08:37,708

perspective about our

19

00:08:37,708 --> 00:08:38,708

place in the universe.

20

00:08:39,125 --> 00:08:41,291

And for one thing, my hope is that if we

21

00:08:41,291 --> 00:08:44,750

find evidence for a smarter civilization

22

00:08:44,750 --> 00:08:47,250

out there, then we would realize that the

23

00:08:47,250 --> 00:08:48,958

small differences among

24

00:08:48,958 --> 00:08:52,208

us humans are meaningless.

25

00:08:52,208 --> 00:08:54,375

And we should treat each other as equal

26

00:08:54,375 --> 00:08:55,708

members of the human species.

27

00:08:55,833 --> 00:08:58,250

Cuyas Institute is a pioneer in the field

28

00:08:58,250 --> 00:09:01,000

of AI-driven comparative and qualitative

29

00:09:01,000 --> 00:09:02,958

analysis, and was established with the

30

00:09:02,958 --> 00:09:04,875

primary goal of uncovering the hidden

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00:09:04,875 --> 00:09:07,333

value left behind in complex data sets.

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00:09:07,333 --> 00:09:09,333

Through a combination of human expertise

33

00:09:09,333 --> 00:09:11,791

and cutting-edge technologies, Cuyas has

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00:09:11,791 --> 00:09:13,541

developed a range of services that cater

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00:09:13,541 --> 00:09:14,833

to various industries.

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00:09:14,833 --> 00:09:16,708

They are providing valuable insights that

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00:09:16,708 --> 00:09:18,875

can help drive growth, formulate

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00:09:18,875 --> 00:09:21,333

competitive strategy, and to identify key

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00:09:21,333 --> 00:09:22,708

patterns in targeted demographics.

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00:09:23,166 --> 00:09:24,666

Head to their site to learn more.

41

00:09:24,666 --> 00:09:26,375

Cuyas.Institute. That's

42

00:09:26,375 --> 00:09:29,875

C-O-E-U-S.Institute.

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00:09:29,875 --> 00:09:32,458

Welcome to Merged. I'm Ryan Graves.

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00:09:32,458 --> 00:09:33,833

Today we're joined by a very

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00:09:33,833 --> 00:09:36,333

distinguished guest, Professor Avi Loeb.

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00:09:36,333 --> 00:09:38,541

Professor Loeb is a Frank B. Baird Jr.

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00:09:38,541 --> 00:09:39,458

Professor of Science

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00:09:39,458 --> 00:09:40,833

at Harvard University.

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00:09:40,833 --> 00:09:41,750

He has authored eight books

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00:09:41,750 --> 00:09:43,833

and over 800 scientific papers.

51  
00:09:43,833 --> 00:09:44,541  
Today we're going to

52  
00:09:44,541 --> 00:09:46,458  
delve into his views on UAP.

53  
00:09:46,458 --> 00:09:48,458  
We'll probe the profound implications of

54  
00:09:48,458 --> 00:09:50,250  
these phenomenon to help us better

55  
00:09:50,250 --> 00:09:51,708  
understand our place in the universe.

56  
00:09:52,500 --> 00:09:59,458  
And now, Professor Avi Loeb.

57  
00:09:59,458 --> 00:10:04,708  
Avi, thank you for

58  
00:10:04,708 --> 00:10:06,416  
inviting me in your home.

59  
00:10:06,416 --> 00:10:07,666  
My pleasure.

60  
00:10:07,666 --> 00:10:10,208  
It's truly an honor to be here.

61  
00:10:10,208 --> 00:10:12,458  
I'm a bit of a compatriot. I'm a

62  
00:10:12,458 --> 00:10:14,541  
Massachusetts native.

63  
00:10:14,541 --> 00:10:17,416

Yourself, currently at Harvard, it's

64

00:10:17,416 --> 00:10:18,083

always been a school

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00:10:18,083 --> 00:10:18,708

that I've looked up to.

66

00:10:18,791 --> 00:10:20,791

But it's been part of kind of my local

67

00:10:20,791 --> 00:10:22,958

culture being from Massachusetts.

68

00:10:22,958 --> 00:10:24,541

So it's truly an honor and a pleasure

69

00:10:24,541 --> 00:10:25,291

sitting down across from

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00:10:25,291 --> 00:10:26,666

you today in your home.

71

00:10:26,666 --> 00:10:29,291

Thank you. I've been in Massachusetts for

72

00:10:29,291 --> 00:10:31,500

30 years at Harvard.

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00:10:31,500 --> 00:10:33,875

And altogether, half of

74

00:10:33,875 --> 00:10:35,958

my life were spent here.

75

00:10:35,958 --> 00:10:38,833

The other half elsewhere, five years at

76

00:10:38,833 --> 00:10:40,166

Princeton and before

77

00:10:40,166 --> 00:10:41,666

that, 26 years in Israel.

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00:10:41,666 --> 00:10:42,875

That's where I grew up.

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00:10:42,875 --> 00:10:44,916

Wow. I'm very excited to talk about some

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00:10:44,916 --> 00:10:46,416

of your experiences in Israel.

81

00:10:46,833 --> 00:10:48,750

But first, let's just start very quickly

82

00:10:48,750 --> 00:10:50,625

with the Galileo Project.

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00:10:50,625 --> 00:10:52,250

We're sitting down across from each other

84

00:10:52,250 --> 00:10:55,416

because we're both tangentially involved

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00:10:55,416 --> 00:10:58,166

in the unidentified anomalous or aerial

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00:10:58,166 --> 00:11:00,250

phenomenon activities that

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00:11:00,250 --> 00:11:01,875

have been going on lately.

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00:11:01,875 --> 00:11:03,500

I think one thing that we can agree on is

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00:11:03,500 --> 00:11:04,083

that there's not

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00:11:04,083 --> 00:11:06,750

enough data on the topic.

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00:11:06,750 --> 00:11:08,416

Can you please tell us what the Galileo

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00:11:08,416 --> 00:11:10,708

doing to help remedy that situation?

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00:11:10,708 --> 00:11:12,500

Right. So first, why do we

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00:11:12,500 --> 00:11:14,375

call it the Galileo Project?

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00:11:15,041 --> 00:11:17,458

Because the idea was conceived already by

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00:11:17,458 --> 00:11:21,000

Galileo Galilei about four centuries ago.

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00:11:21,000 --> 00:11:23,791

And it was a simple idea rather than

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00:11:23,791 --> 00:11:26,750

insist of what the world should be.

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00:11:26,750 --> 00:11:27,875

Let's look through our

100

00:11:27,875 --> 00:11:29,625

telescopes to figure it out.

101  
00:11:29,625 --> 00:11:30,416

And he found that

102  
00:11:30,416 --> 00:11:32,916

there are moons to Jupiter.

103  
00:11:32,916 --> 00:11:35,041

And from that came across the idea that

104  
00:11:35,041 --> 00:11:37,083

perhaps the Earth orbits the sun, that in

105  
00:11:37,083 --> 00:11:37,916

fact, not everything

106  
00:11:37,916 --> 00:11:39,125

moves around the Earth.

107  
00:11:40,458 --> 00:11:44,166

And at the time he was cancelled, put in

108  
00:11:44,166 --> 00:11:48,208

house arrest simply because the clergy at

109  
00:11:48,208 --> 00:11:49,416

the time did not want the

110  
00:11:49,416 --> 00:11:51,375

public to hear this opinion.

111  
00:11:51,375 --> 00:11:53,125

Of course, that didn't change the motion

112  
00:11:53,125 --> 00:11:54,458

of the Earth around the sun.

113  
00:11:54,458 --> 00:11:56,375

So that's the lesson to learn that

114

00:11:56,375 --> 00:11:57,875

reality is whatever it is.

115

00:11:57,875 --> 00:12:00,083

And we better adapt to it.

116

00:12:00,083 --> 00:12:02,375

We shouldn't adhere to our wishful

117

00:12:02,375 --> 00:12:03,833

thinking, which usually

118

00:12:03,833 --> 00:12:06,708

puts us at a favorable light.

119

00:12:07,291 --> 00:12:10,125

For example, the universe enters on us.

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00:12:10,125 --> 00:12:13,750

That was a view advocated by Aristotle.

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00:12:13,750 --> 00:12:15,791

And then for a thousand years, everyone

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00:12:15,791 --> 00:12:16,583

believed it because

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00:12:16,583 --> 00:12:18,083

it fluttered their ego.

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00:12:18,083 --> 00:12:19,916

Also, you see the sun moving in the sky.

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00:12:19,916 --> 00:12:24,541

So that seems like a very viable idea.

126

00:12:24,541 --> 00:12:26,958

But then Galileo argued otherwise.

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00:12:26,958 --> 00:12:29,750

Copernicus argued otherwise.

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00:12:29,750 --> 00:12:32,083

And we ended up figuring it out despite

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00:12:32,083 --> 00:12:33,416

the fact that there was a lot of

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00:12:33,416 --> 00:12:34,666

opposition to that view.

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00:12:35,250 --> 00:12:37,250

And now we launch a spacecraft that

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00:12:37,250 --> 00:12:39,416

reached the destinations thanks to our

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00:12:39,416 --> 00:12:41,166

understanding of how the Earth moved

134

00:12:41,166 --> 00:12:42,833

around the sun, how the planets move

135

00:12:42,833 --> 00:12:44,458

around the sun and so forth.

136

00:12:44,458 --> 00:12:45,333

Otherwise, we would never

137

00:12:45,333 --> 00:12:46,208

reach those destinations.

138

00:12:46,208 --> 00:12:50,083

We'd never get to Mars or to the moon.

139

00:12:50,083 --> 00:12:52,041

So reality is whatever it is.

140

00:12:52,041 --> 00:12:53,166

And we better not

141

00:12:53,166 --> 00:12:54,875

insist on our prejudice.

142

00:12:54,875 --> 00:12:55,708

That's the lesson.

143

00:12:56,666 --> 00:12:59,083

And we apply that within the Galileo

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00:12:59,083 --> 00:13:03,791

project to objects near Earth that look

145

00:13:03,791 --> 00:13:06,708

weird, that do not look like rocks that

146

00:13:06,708 --> 00:13:09,166

were found before from the solar system

147

00:13:09,166 --> 00:13:12,916

in our neighborhood, because it is our

148

00:13:12,916 --> 00:13:14,583

backyard near the Earth.

149

00:13:14,583 --> 00:13:17,791

And then if you go out to your backyard,

150

00:13:17,791 --> 00:13:20,291

often you see rocks that are familiar.

151  
00:13:20,291 --> 00:13:22,583  
But every now and then you might see a

152  
00:13:22,583 --> 00:13:23,541  
tennis ball that was

153  
00:13:23,541 --> 00:13:24,583  
thrown by a neighbor.

154  
00:13:25,166 --> 00:13:26,208  
And so that's the idea.

155  
00:13:26,208 --> 00:13:27,916  
Let's check if there are any

156  
00:13:27,916 --> 00:13:31,250  
technological devices that were produced

157  
00:13:31,250 --> 00:13:33,666  
by extraterrestrial technological

158  
00:13:33,666 --> 00:13:37,500  
civilizations, because we know that most

159  
00:13:37,500 --> 00:13:39,708  
stars in the Milky Way galaxy and also in

160  
00:13:39,708 --> 00:13:40,750  
the universe formed

161  
00:13:40,750 --> 00:13:43,208  
billions of years before the sun.

162  
00:13:43,208 --> 00:13:45,708  
So time is measured in billions of years.

163  
00:13:46,541 --> 00:13:51,000

In the cosmos, we live for at best one

164

00:13:51,000 --> 00:13:53,250

part in a hundred million of the age of

165

00:13:53,250 --> 00:13:56,916

the universe. That's a tiny blip.

166

00:13:56,916 --> 00:14:01,333

And moreover, space is vast.

167

00:14:01,333 --> 00:14:04,041

The size of the observable universe is

168

00:14:04,041 --> 00:14:07,000

quadrillion times bigger, 10 to the power

169

00:14:07,000 --> 00:14:10,916

of 15 times bigger than the separation

170

00:14:10,916 --> 00:14:12,583

between the Earth and the sun.

171

00:14:12,958 --> 00:14:17,541

So when Elon Musk was interviewed

172

00:14:17,541 --> 00:14:21,666

recently and was asked about aliens and

173

00:14:21,666 --> 00:14:25,208

he said, I don't see anything out there.

174

00:14:25,208 --> 00:14:27,041

And, you know, I'm the space guy and I

175

00:14:27,041 --> 00:14:28,416

would be the first to

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00:14:28,416 --> 00:14:31,583

notice and I will tweet about it.

177

00:14:31,583 --> 00:14:35,541

That's a little bit presumptuous because

178

00:14:35,541 --> 00:14:39,916

if if you compare it, let's say, to

179

00:14:39,916 --> 00:14:41,500

exploring the solar system.

180

00:14:42,500 --> 00:14:46,333

What he witnessed in his life experience

181

00:14:46,333 --> 00:14:50,500

is similar to what an ant will see in an

182

00:14:50,500 --> 00:14:53,666

area the size of the head of a pin

183

00:14:53,666 --> 00:14:56,458

relative to the size of the planetary

184

00:14:56,458 --> 00:14:58,000

system around the sun.

185

00:14:58,000 --> 00:15:00,208

So you cannot say anything about the

186

00:15:00,208 --> 00:15:02,458

planets in the solar system just by

187

00:15:02,458 --> 00:15:04,458

observing an area the size of the head of

188

00:15:04,458 --> 00:15:06,125

a pin, which is pretty much the

189

00:15:06,125 --> 00:15:06,708

experience of Elon Musk.

190

00:15:07,375 --> 00:15:11,041

And moreover, his lifespan is one part in

191

00:15:11,041 --> 00:15:16,333

a hundred million of the age of the sun.

192

00:15:16,333 --> 00:15:22,708

So claiming I don't see evidence is just

193

00:15:22,708 --> 00:15:25,375

like a homebody, you know, looking around

194

00:15:25,375 --> 00:15:27,875

the living room and

195

00:15:27,875 --> 00:15:30,583

saying, where is everybody?

196

00:15:31,291 --> 00:15:33,833

We don't have neighbors the way Enrico

197

00:15:33,833 --> 00:15:38,916

Fermi said. And the answer is, well, you

198

00:15:38,916 --> 00:15:41,208

better look through your windows and you

199

00:15:41,208 --> 00:15:43,583

better use telescopes to do that, which

200

00:15:43,583 --> 00:15:45,416

is what the Galileo project is doing.

201

00:15:45,416 --> 00:15:48,375

So saying that we don't have

202

00:15:48,375 --> 00:15:50,083

extraordinary evidence for neighbors,

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00:15:50,083 --> 00:15:53,250

technological neighbors without seeking

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00:15:53,250 --> 00:15:55,250

the evidence is inappropriate,

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00:15:55,250 --> 00:15:55,708

scientifically speaking.

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00:15:55,916 --> 00:15:58,291

It's not professional. You are just

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00:15:58,291 --> 00:15:59,541

expressing your opinion

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00:15:59,541 --> 00:16:01,958

without checking if it's right.

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00:16:01,958 --> 00:16:04,208

And what Galileo taught us is that

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00:16:04,208 --> 00:16:06,250

sometimes we have the wrong ideas.

211

00:16:06,250 --> 00:16:08,250

And the best way to figure out whether we

212

00:16:08,250 --> 00:16:09,791

are right or wrong is by

213

00:16:09,791 --> 00:16:11,708

collecting data and evidence.

214

00:16:12,166 --> 00:16:15,000

And of course, on this subject, the

215

00:16:15,000 --> 00:16:19,250

public has a lot of opinions and not only

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00:16:19,250 --> 00:16:23,708

the public, but people within academia

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00:16:23,708 --> 00:16:26,416

have very strong opinions and they're

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00:16:26,416 --> 00:16:29,833

often amplifying the importance of us

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00:16:29,833 --> 00:16:32,208

saying maybe we are the only intelligent

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00:16:32,208 --> 00:16:34,458

species that ever existed since the Big

221

00:16:34,458 --> 00:16:36,708

Bang 13.8 billion years ago.

222

00:16:37,083 --> 00:16:39,041

I say that is very unlikely because there

223

00:16:39,041 --> 00:16:40,708

are tens of billions of stars in the

224

00:16:40,708 --> 00:16:43,583

Milky Way galaxy alone and a substantial

225

00:16:43,583 --> 00:16:45,500

fraction of them somewhere between 3

226  
00:16:45,500 --> 00:16:47,875  
percent to 100 percent of the sunlight

227  
00:16:47,875 --> 00:16:49,833  
stars have a planet the size of the

228  
00:16:49,833 --> 00:16:51,500  
Earth, roughly the same separation.

229  
00:16:51,500 --> 00:16:55,250  
So it's really arrogant to suggest that

230  
00:16:55,250 --> 00:16:58,833  
we are the only species that sent

231  
00:16:58,833 --> 00:17:02,333  
equipment to interstellar space,

232  
00:17:02,333 --> 00:17:04,541  
especially when you deal

233  
00:17:04,541 --> 00:17:05,708  
with SpaceX of Elon Musk.

234  
00:17:06,083 --> 00:17:08,708  
You know, there could be space Y, space Z

235  
00:17:08,708 --> 00:17:09,875  
of other civilizations

236  
00:17:09,875 --> 00:17:11,625  
out there, very likely.

237  
00:17:11,625 --> 00:17:14,541  
And one thing to recognize is that we

238  
00:17:14,541 --> 00:17:17,208

invest two trillion dollars a year in

239

00:17:17,208 --> 00:17:20,041

military budgets worldwide.

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00:17:20,041 --> 00:17:23,208

If we were to listen to the words of John

241

00:17:23,208 --> 00:17:25,791

Lennon in his song saying, imagine all

242

00:17:25,791 --> 00:17:28,291

the people living in peace and then we

243

00:17:28,291 --> 00:17:30,208

would have a surplus of two trillion

244

00:17:30,208 --> 00:17:31,833

dollars a year because we

245

00:17:31,833 --> 00:17:33,708

don't want to kill each other.

246

00:17:34,333 --> 00:17:36,750

What would we do with it? One possibility

247

00:17:36,750 --> 00:17:38,333

is space exploration.

248

00:17:38,333 --> 00:17:41,083

And I calculated that we could send a

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00:17:41,083 --> 00:17:43,958

CubeSat to every star in the Milky Way

250

00:17:43,958 --> 00:17:47,041

galaxy, tens of billions of them within

251

00:17:47,041 --> 00:17:49,333

this century if we were to, instead of

252

00:17:49,333 --> 00:17:51,541

fight each other, explore space.

253

00:17:52,291 --> 00:17:54,875

So another civilization could have been

254

00:17:54,875 --> 00:17:57,208

more intelligent than we are. I mean, one

255

00:17:57,208 --> 00:17:59,916

reason I'm seeking intelligence in our

256

00:17:59,916 --> 00:18:02,125

space is because I don't

257

00:18:02,125 --> 00:18:04,416

often find it here on Earth.

258

00:18:04,416 --> 00:18:06,041

Now, some of these experts that you've

259

00:18:06,041 --> 00:18:08,208

spoken to or you reference, such as Elon

260

00:18:08,208 --> 00:18:09,625

or even maybe some of the more

261

00:18:09,625 --> 00:18:11,375

academically flavored folks that you've

262

00:18:11,375 --> 00:18:13,083

dealt with, I'm sure

263

00:18:13,083 --> 00:18:13,708

there's been opposition.

264

00:18:14,791 --> 00:18:18,833

Do you really think that they go to those

265

00:18:18,833 --> 00:18:20,708

numbers and statistics that you just

266

00:18:20,708 --> 00:18:23,958

listed and say, even though I recognize

267

00:18:23,958 --> 00:18:25,750

these numbers are so large and the

268

00:18:25,750 --> 00:18:27,791

possibility of us being alone would make

269

00:18:27,791 --> 00:18:29,416

that such a small probability?

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00:18:29,416 --> 00:18:31,958

Do you think they truly look at that

271

00:18:31,958 --> 00:18:34,375

objectively when they decide not to look

272

00:18:34,375 --> 00:18:36,416

at this topic scientifically or do you

273

00:18:36,416 --> 00:18:36,875

think there's

274

00:18:36,875 --> 00:18:37,708

something else stopping them?

275

00:18:38,708 --> 00:18:41,666

Well, there are several reasons why

276

00:18:41,666 --> 00:18:44,125

people in academia or the public would

277

00:18:44,125 --> 00:18:48,000

avoid seeking the evidence. One is the

278

00:18:48,000 --> 00:18:50,791

best way for us to be the most

279

00:18:50,791 --> 00:18:51,375

intelligent in the

280

00:18:51,375 --> 00:18:53,291

universe is not to find others.

281

00:18:53,291 --> 00:18:55,083

OK, so then we win the competition,

282

00:18:55,083 --> 00:18:56,666

right, because there is only one.

283

00:18:57,708 --> 00:19:00,583

And we put blinders basically not search

284

00:19:00,583 --> 00:19:02,083

and insist on the fact that there is

285

00:19:02,083 --> 00:19:04,291

nothing out there, that in fact, it's an

286

00:19:04,291 --> 00:19:06,958

extraordinary claim to assume that there

287

00:19:06,958 --> 00:19:08,083

might be something out there.

288

00:19:08,083 --> 00:19:10,541

Then you don't search. And obviously,

289

00:19:10,541 --> 00:19:12,166

this is a self-fulfilling prophecy. It's

290

00:19:12,166 --> 00:19:14,041

a circular argument and you

291

00:19:14,041 --> 00:19:16,291

will feel very comfortable.

292

00:19:16,291 --> 00:19:19,041

So that serves the ego of many people

293

00:19:19,041 --> 00:19:21,166

that want to believe that they are unique

294

00:19:21,166 --> 00:19:23,041

and special and serve

295

00:19:23,041 --> 00:19:24,708

some cosmic purpose.

296

00:19:25,625 --> 00:19:27,541

But it doesn't change reality just the

297

00:19:27,541 --> 00:19:29,083

way that the earth moved around the sun.

298

00:19:29,083 --> 00:19:31,208

You know, all these civilizations out

299

00:19:31,208 --> 00:19:33,333

there lived and died.

300

00:19:33,333 --> 00:19:35,416

Most of them died by now because, you

301  
00:19:35,416 --> 00:19:38,208  
know, most stars formed billions of years

302  
00:19:38,208 --> 00:19:40,083  
before the sun and within a billion

303  
00:19:40,083 --> 00:19:41,875  
years, the sun will burn up the surface

304  
00:19:41,875 --> 00:19:44,625  
of the earth, boil off all the oceans.

305  
00:19:45,041 --> 00:19:49,583  
And so we wouldn't be able to stay here

306  
00:19:49,583 --> 00:19:51,708  
within a billion years. And that means if

307  
00:19:51,708 --> 00:19:55,958  
the clock started ticking a billion years

308  
00:19:55,958 --> 00:19:57,875  
earlier for another civilization, they

309  
00:19:57,875 --> 00:20:01,958  
had to go on an exodus out

310  
00:20:01,958 --> 00:20:03,791  
of that planet at some point.

311  
00:20:03,791 --> 00:20:07,458  
They must have sent signals out, crying

312  
00:20:07,458 --> 00:20:10,750  
for help before all of them boarded

313  
00:20:10,750 --> 00:20:12,458

spaceship, tried to leave the planet.

314

00:20:12,791 --> 00:20:14,708

And we didn't listen because we were not

315

00:20:14,708 --> 00:20:18,458

around a billion years ago. And there

316

00:20:18,458 --> 00:20:20,958

must have been a lot of cries for help

317

00:20:20,958 --> 00:20:22,250

within the Milky Way galaxy.

318

00:20:22,250 --> 00:20:23,791

The point is, if they were sent

319

00:20:23,791 --> 00:20:25,666

electromagnetically, all these radio

320

00:20:25,666 --> 00:20:28,125

signals or whatever they were are now

321

00:20:28,125 --> 00:20:29,916

billions of light years away.

322

00:20:29,916 --> 00:20:32,958

So we can't detect them. And to say we

323

00:20:32,958 --> 00:20:35,291

don't hear anything for 70 years, which

324

00:20:35,291 --> 00:20:37,916

is basically the objective of the SETI

325

00:20:37,916 --> 00:20:40,000

community, to detect any signal

326

00:20:40,000 --> 00:20:40,791

electromagnetically

327

00:20:40,791 --> 00:20:41,708

from other civilizations.

328

00:20:42,333 --> 00:20:44,625

You know, that's a very short time and

329

00:20:44,625 --> 00:20:46,000

there aren't many stars

330

00:20:46,000 --> 00:20:50,791

within 70 light years from us.

331

00:20:50,791 --> 00:20:53,208

Signal degradation is a thing too. So the

332

00:20:53,208 --> 00:20:54,416

signals are not going to arrive.

333

00:20:54,416 --> 00:20:56,416

And also it's not, I mean, it's just like

334

00:20:56,416 --> 00:20:59,958

waiting for a phone call at home.

335

00:20:59,958 --> 00:21:02,208

You need the counterpart to be calling

336

00:21:02,208 --> 00:21:04,250

you at the time that you're waiting,

337

00:21:04,250 --> 00:21:06,250

taking into account that the time it

338

00:21:06,250 --> 00:21:08,416

takes the signal to arrive to you.

339

00:21:09,291 --> 00:21:13,250

And it may not be the case. However, if

340

00:21:13,250 --> 00:21:18,000

you are searching your mailbox for any

341

00:21:18,000 --> 00:21:20,750

packages that may have arrived, those

342

00:21:20,750 --> 00:21:22,416

packages may still be there

343

00:21:22,416 --> 00:21:24,958

even if the sender is dead.

344

00:21:24,958 --> 00:21:27,125

And the important thing to keep in mind

345

00:21:27,125 --> 00:21:29,833

is chemical rockets of the type that we

346

00:21:29,833 --> 00:21:34,000

are using move at a speed that is 10

347

00:21:34,000 --> 00:21:37,708

times smaller than the escape speed from the Milky Way galaxy.

348

00:21:38,541 --> 00:21:41,333

So they cannot escape. They basically

349

00:21:41,333 --> 00:21:43,583

move at the characteristic speed of stars

350

00:21:43,583 --> 00:21:46,375

within the disk of the Milky Way galaxy.

351

00:21:46,375 --> 00:21:49,166

And they're still around. So it's just

352

00:21:49,166 --> 00:21:51,333

like plastic in the

353

00:21:51,333 --> 00:21:53,750

ocean. It keeps accumulating.

354

00:21:53,750 --> 00:21:56,958

And by 2050, there will be more mass in

355

00:21:56,958 --> 00:21:59,583

plastic in the oceans than the mass there

356

00:21:59,583 --> 00:22:02,500

is in fish, which raises the possibility

357

00:22:02,500 --> 00:22:03,583

that we might eat

358

00:22:03,583 --> 00:22:03,708

plastic instead of fish.

359

00:22:04,541 --> 00:22:05,875

I think we're probably a little bit. Or

360

00:22:05,875 --> 00:22:08,333

plastic inside fish. But the point is it

361

00:22:08,333 --> 00:22:10,500

keeps accumulating over time because

362

00:22:10,500 --> 00:22:12,125

unless we clean it up.

363

00:22:12,125 --> 00:22:14,125

But interstellar space is not being

364

00:22:14,125 --> 00:22:17,583

cleaned up as far as I know. And so these

365

00:22:17,583 --> 00:22:19,416

probes may be out there.

366

00:22:19,416 --> 00:22:23,208

And Elon sent a Tesla into space. Just

367

00:22:23,208 --> 00:22:26,250

think of how many Elon-like entrepreneurs

368

00:22:26,250 --> 00:22:28,791

there might be on exoplanets, might have

369

00:22:28,791 --> 00:22:30,541

been over the past billions of years,

370

00:22:30,541 --> 00:22:32,166

that send not only

371

00:22:32,166 --> 00:22:32,708

cars, but small probes.

372

00:22:33,708 --> 00:22:38,041

And just to give you another sort of

373

00:22:38,041 --> 00:22:41,500

context, our telescopes and instruments

374

00:22:41,500 --> 00:22:46,416

were able to detect objects the size of a

375

00:22:46,416 --> 00:22:49,250

football field within the orbit of the

376

00:22:49,250 --> 00:22:52,333

Earth around the sun just over the past

377

00:22:52,333 --> 00:22:53,708

decade, only over the past decade.

378

00:22:54,541 --> 00:22:57,083

So Enrico Fermi could not have asked

379

00:22:57,083 --> 00:22:58,875

where is everybody because he couldn't

380

00:22:58,875 --> 00:23:01,666

have detected those probes back 70 years

381

00:23:01,666 --> 00:23:04,208

ago or 60 years ago.

382

00:23:04,208 --> 00:23:05,750

The point is only over the past decade we

383

00:23:05,750 --> 00:23:08,333

had a survey of the sky because Congress

384

00:23:08,333 --> 00:23:15,000

in 2005 basically told NASA to find 90

385

00:23:15,000 --> 00:23:16,750

percent of all the objects bigger than a

386

00:23:16,750 --> 00:23:20,083

football field, 140 meters, that may come

387

00:23:20,083 --> 00:23:22,458

close to Earth because they pose a risk.

388

00:23:23,208 --> 00:23:27,041

We know that the dinosaurs were killed by

389

00:23:27,041 --> 00:23:30,750

a rock the size of Manhattan Island. And

390

00:23:30,750 --> 00:23:33,583

here we're talking about the size that is

391

00:23:33,583 --> 00:23:35,750

about 100 times smaller.

392

00:23:35,750 --> 00:23:39,083

But nevertheless, we want to find even

393

00:23:39,083 --> 00:23:43,375

those so that we don't incur the damage

394

00:23:43,375 --> 00:23:47,125

to our cities, to precious strategic

395

00:23:47,125 --> 00:23:47,708

locations and so forth.

396

00:23:48,375 --> 00:23:52,333

And so as a result of that, a survey

397

00:23:52,333 --> 00:23:56,916

telescope named Panstas was established

398

00:23:56,916 --> 00:24:01,250

in Hawaii and in 2017, October 2017, they

399

00:24:01,250 --> 00:24:03,458

detected the near Earth object.

400

00:24:03,458 --> 00:24:05,500

They labeled it the near Earth object.

401  
00:24:05,500 --> 00:24:07,291  
That's why they looked at it because it

402  
00:24:07,291 --> 00:24:09,041  
came close within a sixth of

403  
00:24:09,041 --> 00:24:10,375  
the Earth's sun separation.

404  
00:24:10,375 --> 00:24:12,708  
And they realized it's moving too fast.

405  
00:24:12,708 --> 00:24:14,708  
So it came from outside the solar system.

406  
00:24:15,166 --> 00:24:17,041  
And then a couple of years later,

407  
00:24:17,041 --> 00:24:19,208  
together with my student Amir Siraj, we

408  
00:24:19,208 --> 00:24:21,125  
realized that in fact there were two

409  
00:24:21,125 --> 00:24:22,625  
other interstellar

410  
00:24:22,625 --> 00:24:26,291  
objects that were detected.

411  
00:24:26,291 --> 00:24:30,125  
One in January 2014 and the second in

412  
00:24:30,125 --> 00:24:33,958  
March 2017, seven months before the

413  
00:24:33,958 --> 00:24:36,708

Panstas object that is called Omuamua.

414

00:24:37,083 --> 00:24:39,166

And these interstellar objects were much

415

00:24:39,166 --> 00:24:42,000

smaller, about 100 times smaller, the

416

00:24:42,000 --> 00:24:44,166

size of a person roughly.

417

00:24:44,166 --> 00:24:45,416

Smaller than Omuamua?

418

00:24:45,416 --> 00:24:49,083

Yeah. And they were discovered not from

419

00:24:49,083 --> 00:24:50,125

the reflection of

420

00:24:50,125 --> 00:24:52,791

sunlight the way Omuamua was.

421

00:24:52,791 --> 00:24:55,458

You can't see objects much smaller than

422

00:24:55,458 --> 00:24:58,666

Omuamua with the Panstas telescope within

423

00:24:58,666 --> 00:25:00,583

the orbit of the Earth around the sun.

424

00:25:00,916 --> 00:25:02,750

These objects were discovered, the

425

00:25:02,750 --> 00:25:04,041

meteors, as a result of

426

00:25:04,041 --> 00:25:06,708

them bumping into the Earth.

427

00:25:06,708 --> 00:25:09,791

So they collided with the Earth and burnt

428

00:25:09,791 --> 00:25:10,958

up in the Earth's

429

00:25:10,958 --> 00:25:13,791

atmosphere, created a fireball.

430

00:25:13,791 --> 00:25:16,375

One of them released a few percent of the

431

00:25:16,375 --> 00:25:18,250

energy output of the Hiroshima atomic

432

00:25:18,250 --> 00:25:20,000

bomb that was the smaller among them,

433

00:25:20,000 --> 00:25:22,250

half a meter in size, over

434

00:25:22,250 --> 00:25:23,708

the Pacific Ocean in 2014.

435

00:25:24,125 --> 00:25:26,333

And the second one released as much as

436

00:25:26,333 --> 00:25:29,125

the Hiroshima atomic bomb, it was about a

437

00:25:29,125 --> 00:25:32,125

meter in size, twice as large, which

438

00:25:32,125 --> 00:25:35,291

means eight times the mass.

439

00:25:35,291 --> 00:25:42,208

So altogether we have the first three

440

00:25:42,208 --> 00:25:45,166

interstellar objects and each of them

441

00:25:45,166 --> 00:25:47,875

looked different than the space rocks

442

00:25:47,875 --> 00:25:49,041

that we had seen before

443

00:25:49,041 --> 00:25:49,708

from the solar system.

444

00:25:49,958 --> 00:25:52,500

Were the smaller ones of more unique

445

00:25:52,500 --> 00:25:53,875

shape elongated, similar

446

00:25:53,875 --> 00:25:55,458

to Oumuamua or were they?

447

00:25:55,458 --> 00:25:57,750

We couldn't tell the shape because they

448

00:25:57,750 --> 00:25:59,750

exploded in the Earth's atmosphere. All

449

00:25:59,750 --> 00:26:00,833

you could see is the fireball.

450

00:26:00,833 --> 00:26:02,791

That's how the US government sensors

451  
00:26:02,791 --> 00:26:05,583  
detected them. And nobody looked back to

452  
00:26:05,583 --> 00:26:07,416  
realize that they were moving too fast to

453  
00:26:07,416 --> 00:26:08,375  
be bound to the sun.

454  
00:26:08,375 --> 00:26:09,916  
The way to figure out an interstellar

455  
00:26:09,916 --> 00:26:12,291  
object is that outside the solar system,

456  
00:26:12,291 --> 00:26:15,041  
it was moving towards the solar system at

457  
00:26:15,041 --> 00:26:17,000  
some speed and then it gained more speed

458  
00:26:17,000 --> 00:26:17,708  
as it approached the sun.

459  
00:26:18,208 --> 00:26:21,166  
So usually near the Earth, it's moving

460  
00:26:21,166 --> 00:26:22,916  
faster than all the rocks

461  
00:26:22,916 --> 00:26:24,833  
that are bound to the sun.

462  
00:26:24,833 --> 00:26:26,625  
And if you measure the speed, you can

463  
00:26:26,625 --> 00:26:28,083

tell whether it came from outside the

464

00:26:28,083 --> 00:26:29,583

solar system or not.

465

00:26:29,583 --> 00:26:32,750

And so these meteors we figured out. In

466

00:26:32,750 --> 00:26:35,583

fact, the first one was moving at 60

467

00:26:35,583 --> 00:26:38,000

kilometers per second outside the solar

468

00:26:38,000 --> 00:26:39,916

system towards the sun.

469

00:26:39,916 --> 00:26:42,291

And that's faster than 95 percent of all

470

00:26:42,291 --> 00:26:43,958

the stars in the vicinity of the sun. So

471

00:26:43,958 --> 00:26:44,708

it was moving really fast.

472

00:26:45,583 --> 00:26:47,458

And an interesting possibility is that

473

00:26:47,458 --> 00:26:48,541

maybe it was a spacecraft,

474

00:26:48,541 --> 00:26:51,291

who knows, that was propelled.

475

00:26:51,291 --> 00:26:53,500

And the reason I say that is because the

476

00:26:53,500 --> 00:26:55,916

data that the government released allowed

477

00:26:55,916 --> 00:26:58,833

us to infer the material strength of this

478

00:26:58,833 --> 00:27:01,958

meteor, which was tougher than all other

479

00:27:01,958 --> 00:27:04,958

meteors ever recorded in the catalog that

480

00:27:04,958 --> 00:27:07,291

NASA compiled, 272 of

481

00:27:07,291 --> 00:27:08,708

them over the past decades.

482

00:27:09,708 --> 00:27:12,750

So why would the first interstellar

483

00:27:12,750 --> 00:27:15,458

meteor be at least 10 times tougher than

484

00:27:15,458 --> 00:27:20,541

the next in line from all the space rocks

485

00:27:20,541 --> 00:27:22,958

that belong to the solar system?

486

00:27:22,958 --> 00:27:25,041

So there are two possibilities. Either it

487

00:27:25,041 --> 00:27:27,750

came from some system that is very

488

00:27:27,750 --> 00:27:28,583

different than the

489

00:27:28,583 --> 00:27:29,708

planetary system that we live in.

490

00:27:30,791 --> 00:27:33,708

For example, an exploding star or a

491

00:27:33,708 --> 00:27:36,125

collision of two neutron stars, some

492

00:27:36,125 --> 00:27:37,208

other environment that

493

00:27:37,208 --> 00:27:41,375

makes very tough objects.

494

00:27:41,375 --> 00:27:44,166

Or it was artificial in origin. It was

495

00:27:44,166 --> 00:27:48,791

made of some alloy, like stainless steel.

496

00:27:48,791 --> 00:27:51,458

And we are going to find out. That's the

497

00:27:51,458 --> 00:27:52,416

amazing thing. We can

498

00:27:52,416 --> 00:27:52,708

follow the scientific method.

499

00:27:53,416 --> 00:27:56,208

It's not a matter of speculation because

500

00:27:56,208 --> 00:27:59,750

we are planning to go in summer 2023 to

501  
00:27:59,750 --> 00:28:02,250  
the Pacific Ocean and look for the

502  
00:28:02,250 --> 00:28:04,375  
fragments, the relics of this first

503  
00:28:04,375 --> 00:28:06,000  
interstellar meteor.

504  
00:28:06,000 --> 00:28:08,791  
And we will analyze their composition so

505  
00:28:08,791 --> 00:28:11,583  
we can tell if it's natural or

506  
00:28:11,583 --> 00:28:12,416  
artificial, depending on

507  
00:28:12,416 --> 00:28:15,208  
what elements made this meteor.

508  
00:28:15,208 --> 00:28:17,708  
But what I'm trying to say is this was

509  
00:28:17,708 --> 00:28:19,708  
unusual, an outlier, an anomalous object.

510  
00:28:20,458 --> 00:28:22,916  
And it was the first one. And then the

511  
00:28:22,916 --> 00:28:25,500  
second one was another meteor.

512  
00:28:25,500 --> 00:28:29,625  
And it also had a material strength

513  
00:28:29,625 --> 00:28:32,083

higher than all the rest of the meteors

514

00:28:32,083 --> 00:28:33,333

in the NASA catalog.

515

00:28:33,333 --> 00:28:36,000

So we now have two meteors from

516

00:28:36,000 --> 00:28:37,291

interstellar space that

517

00:28:37,291 --> 00:28:38,791

appear to be very different.

518

00:28:38,791 --> 00:28:41,416

The chance for that happening out of the

519

00:28:41,416 --> 00:28:45,333

distribution of material strengths of the

520

00:28:45,333 --> 00:28:47,500

space rocks in the solar system is less

521

00:28:47,500 --> 00:28:48,708

than one part in 10,000.

522

00:28:50,416 --> 00:28:53,708

So that's the first two objects. And then

523

00:28:53,708 --> 00:28:57,833

later, Oumuamua, the object from 2017,

524

00:28:57,833 --> 00:29:01,083

appeared to be most likely flat based on

525

00:29:01,083 --> 00:29:02,291

the reflection of sunlight.

526

00:29:02,291 --> 00:29:04,833

Again, we don't have an image of it. And

527

00:29:04,833 --> 00:29:08,041

it was pushed away from the sun by some

528

00:29:08,041 --> 00:29:11,500

mysterious non-gravitational force.

529

00:29:11,500 --> 00:29:15,875

And there was no cometary evaporation

530

00:29:15,875 --> 00:29:17,041

apparent from it. So the

531

00:29:17,041 --> 00:29:17,708

question is what pushed it?

532

00:29:18,166 --> 00:29:20,833

And I suggested it might have been just

533

00:29:20,833 --> 00:29:24,583

thin. And then the sunlight bouncing off

534

00:29:24,583 --> 00:29:26,875

this object would have pushed it.

535

00:29:26,875 --> 00:29:29,083

And of course, nature doesn't make very

536

00:29:29,083 --> 00:29:31,583

thin objects, like less than a millimeter

537

00:29:31,583 --> 00:29:34,500

in thickness, which is what you need in

538

00:29:34,500 --> 00:29:37,458

order to give the push that was observed.

539

00:29:37,458 --> 00:29:40,666

So I said, well, maybe it is a very thin

540

00:29:40,666 --> 00:29:41,708

object produced artificially.

541

00:29:43,541 --> 00:29:45,791

And recently I wrote a paper suggesting a

542

00:29:45,791 --> 00:29:48,208

specific scenario for that. Freeman

543

00:29:48,208 --> 00:29:51,791

Dyson, about six years ago, suggested

544

00:29:51,791 --> 00:29:53,750

that perhaps very advanced civilizations

545

00:29:53,750 --> 00:29:57,125

may build what is now called the Dyson

546

00:29:57,125 --> 00:30:01,500

sphere, basically a mega

547

00:30:01,500 --> 00:30:02,708

structure made of tiles.

548

00:30:03,458 --> 00:30:06,750

And the simplest configuration,

549

00:30:06,750 --> 00:30:09,375

engineering-wise, would be to have tiles

550

00:30:09,375 --> 00:30:13,083

that are like light sails.

551

00:30:13,083 --> 00:30:15,416

Basically, the radiation pressure from

552

00:30:15,416 --> 00:30:18,333

the star is balancing gravity. So they

553

00:30:18,333 --> 00:30:20,083

just hover above the star and you put

554

00:30:20,083 --> 00:30:22,666

lots of these tiles, just like kites.

555

00:30:22,666 --> 00:30:26,000

They float, hover above the star, and you

556

00:30:26,000 --> 00:30:29,291

basically cover the entire star, let's

557

00:30:29,291 --> 00:30:30,750

say, at the separation of the

558

00:30:30,750 --> 00:30:31,708

Earth from the star, roughly.

559

00:30:32,541 --> 00:30:34,625

And then you can harvest all the energy

560

00:30:34,625 --> 00:30:37,250

output. It's clean energy, except when we

561

00:30:37,250 --> 00:30:38,500

talk about clean energy, we are talking

562

00:30:38,500 --> 00:30:40,583

about the energy intercepting the Earth.

563

00:30:40,583 --> 00:30:42,166

And here it's the entire sphere

564

00:30:42,166 --> 00:30:43,958

surrounding the star. So Freeman Dyson

565

00:30:43,958 --> 00:30:44,916

said that's a very good

566

00:30:44,916 --> 00:30:48,541

way to get a lot of energy.

567

00:30:48,541 --> 00:30:51,791

And perhaps some civilizations do that.

568

00:30:51,791 --> 00:30:56,541

And if any of them does that, after a

569

00:30:56,541 --> 00:30:58,916

while, you know, the star will evolve and

570

00:30:58,916 --> 00:31:00,708

could break this Dyson sphere,

571

00:31:01,500 --> 00:31:03,791

either because it becomes brighter, so it

572

00:31:03,791 --> 00:31:05,333

basically pushes those

573

00:31:05,333 --> 00:31:07,916

tiles away very easily.

574

00:31:07,916 --> 00:31:10,250

I mean, they will just fly out because

575

00:31:10,250 --> 00:31:13,083

they were very barely bound to the star.

576

00:31:13,083 --> 00:31:13,958

They were not even bound.

577

00:31:13,958 --> 00:31:15,500

They were just hovering.

578

00:31:15,500 --> 00:31:17,000

And now if the star gets brighter, they

579

00:31:17,000 --> 00:31:20,458

will just be pushed out. Or you can have

580

00:31:20,458 --> 00:31:21,708

asteroids breaking that mega structure.

581

00:31:22,666 --> 00:31:25,541

At any event, what you would get as a

582

00:31:25,541 --> 00:31:28,875

result of that is lots of small fragments

583

00:31:28,875 --> 00:31:30,625

that are thin, filling

584

00:31:30,625 --> 00:31:32,125

up interstellar space.

585

00:31:32,125 --> 00:31:34,916

And perhaps a mua mua was a piece of a

586

00:31:34,916 --> 00:31:36,208

broken Dyson sphere.

587

00:31:36,208 --> 00:31:37,750

That's one possibility.

588

00:31:37,750 --> 00:31:39,750

It could be just space trash, like a

589

00:31:39,750 --> 00:31:41,916

layer from a bigger object, whatever it

590

00:31:41,916 --> 00:31:43,708

is. I argued maybe it's artificial.

591

00:31:44,458 --> 00:31:48,666

And just this suggestion got, I mean,

592

00:31:48,666 --> 00:31:52,375

people very emotional about it. I should

593

00:31:52,375 --> 00:31:53,833

say that when the paper was

594

00:31:53,833 --> 00:31:55,000

submitted for publication,

595

00:31:55,000 --> 00:31:57,291

it was accepted within a few days. And

596

00:31:57,291 --> 00:31:59,291

the referee was very positive about it.

597

00:31:59,291 --> 00:32:01,708

And at that time, most astronomers

598

00:32:01,708 --> 00:32:02,833

talking about mua mua,

599

00:32:02,833 --> 00:32:05,458

this object, were saying, "It's really

600

00:32:05,458 --> 00:32:07,791

weird. I wonder what it is."

601  
00:32:07,791 --> 00:32:10,666  
Was there any hesitation in publishing

602  
00:32:10,666 --> 00:32:11,708  
that idea, that concept?

603  
00:32:12,250 --> 00:32:14,250  
No, I didn't have. I'll tell you why,

604  
00:32:14,250 --> 00:32:17,791  
because prior to that, I worked on the

605  
00:32:17,791 --> 00:32:18,583  
nature of dark matter.

606  
00:32:18,583 --> 00:32:20,666  
I worked on the first stars when nobody

607  
00:32:20,666 --> 00:32:22,541  
was working on that. And I

608  
00:32:22,541 --> 00:32:24,166  
wrote two textbooks about it.

609  
00:32:24,166 --> 00:32:27,833  
And now it's the most celebrated frontier

610  
00:32:27,833 --> 00:32:29,000  
because of the Webb

611  
00:32:29,000 --> 00:32:31,166  
telescope observing the first star.

612  
00:32:31,166 --> 00:32:33,291  
So I basically established the

613  
00:32:33,291 --> 00:32:37,166

theoretical foundation to what we expect

614

00:32:37,166 --> 00:32:38,083

the first galaxies

615

00:32:38,083 --> 00:32:38,708

and stars to look like.

616

00:32:39,458 --> 00:32:42,541

And I wrote two textbooks about it. And

617

00:32:42,541 --> 00:32:43,708

nobody was interested at

618

00:32:43,708 --> 00:32:45,583

the time in this subject.

619

00:32:45,583 --> 00:32:49,333

I had a graduate student and at the PhD

620

00:32:49,333 --> 00:32:52,458

thesis defense, one of the reviewers

621

00:32:52,458 --> 00:32:55,083

said, "Well, but this

622

00:32:55,083 --> 00:32:56,291

will never be observed.

623

00:32:56,291 --> 00:32:58,916

This is how do you know that what you're

624

00:32:58,916 --> 00:33:00,875

working on is at all relevant to the

625

00:33:00,875 --> 00:33:01,708

future of astronomy?"

626

00:33:03,083 --> 00:33:04,958

So, you know, it taught me a lesson not

627

00:33:04,958 --> 00:33:07,125

to listen to what people say when you're

628

00:33:07,125 --> 00:33:09,333

pioneering a new frontier.

629

00:33:09,333 --> 00:33:13,333

But I also worked on black holes. And I

630

00:33:13,333 --> 00:33:15,041

was the founding director of the Black

631

00:33:15,041 --> 00:33:16,541

Hole Initiative at Harvard,

632

00:33:16,541 --> 00:33:19,458

the only center worldwide that brings

633

00:33:19,458 --> 00:33:22,250

together physicists, mathematicians,

634

00:33:22,250 --> 00:33:23,166

philosophers, and

635

00:33:23,166 --> 00:33:24,708

astronomers to study black holes.

636

00:33:25,125 --> 00:33:27,250

And Stephen Hawking came to exactly this

637

00:33:27,250 --> 00:33:29,583

room. He was sitting where you are back

638

00:33:29,583 --> 00:33:35,375

in April 2016 at the Passover Center.

639

00:33:35,375 --> 00:33:38,666

And he ate everything that my wife served

640

00:33:38,666 --> 00:33:41,958

to him. And he gave a speech actually

641

00:33:41,958 --> 00:33:43,666

just from the location where you are.

642

00:33:44,291 --> 00:33:47,750

At any event, I worked on black holes.

643

00:33:47,750 --> 00:33:51,833

But I also worked on dark matter because

644

00:33:51,833 --> 00:33:54,666

most of the matter in the universe is a

645

00:33:54,666 --> 00:33:56,958

substance that is not the same as the

646

00:33:56,958 --> 00:33:58,791

ordinary matter that we are made of or

647

00:33:58,791 --> 00:34:00,541

that we see in the solar system.

648

00:34:01,291 --> 00:34:04,625

And back in 1933, it was a revolutionary

649

00:34:04,625 --> 00:34:08,291

idea that was proposed by Fritz Zwicky

650

00:34:08,291 --> 00:34:11,625

from Caltech. And people didn't really

651

00:34:11,625 --> 00:34:14,708

follow him for about 40 years until it

652

00:34:14,708 --> 00:34:15,916

became more popular.

653

00:34:15,916 --> 00:34:17,625

And now if you ask young people, they'll

654

00:34:17,625 --> 00:34:19,458

say, "Of course, there is a huge amount

655

00:34:19,458 --> 00:34:21,666

of evidence that dark matter exists, but

656

00:34:21,666 --> 00:34:23,500

we don't know what it is."

657

00:34:23,500 --> 00:34:23,708

Sounds familiar.

658

00:34:24,916 --> 00:34:28,250

Yeah, it's an example of having something

659

00:34:28,250 --> 00:34:31,166

that we don't find in the solar system.

660

00:34:31,166 --> 00:34:33,958

So just by studying your backyard, you

661

00:34:33,958 --> 00:34:36,541

will never get across the dark matter.

662

00:34:36,541 --> 00:34:38,875

Well, you could get across it if you knew

663

00:34:38,875 --> 00:34:41,541

from other data that it might exist,

664

00:34:41,541 --> 00:34:43,666

which we know from studying the universe

665

00:34:43,666 --> 00:34:46,708

or the galaxy on the very large scales.

666

00:34:47,958 --> 00:34:49,916

But the point is, nobody thought that

667

00:34:49,916 --> 00:34:52,541

there is a substance different from what

668

00:34:52,541 --> 00:34:55,208

the solar system is made of. In fact,

669

00:34:55,208 --> 00:34:57,208

even the sun was thought to be made of

670

00:34:57,208 --> 00:34:59,708

the same substance as the Earth.

671

00:35:01,208 --> 00:35:03,916

The first PhD in astronomy at Harvard

672

00:35:03,916 --> 00:35:05,750

University was by Cecilia Payne

673

00:35:05,750 --> 00:35:08,375

Koppaschkin, who applied quantum

674

00:35:08,375 --> 00:35:11,791

mechanics that was about 100 years ago to

675

00:35:11,791 --> 00:35:15,750

the sun and interpreted the spectrum of

676  
00:35:15,750 --> 00:35:20,208  
the sun to argue that the surface of the

677  
00:35:20,208 --> 00:35:21,666  
sun is made mostly of hydrogen.

678  
00:35:22,416 --> 00:35:25,291  
And when she defended Henry Norris

679  
00:35:25,291 --> 00:35:26,958  
Russell, who was the director of the

680  
00:35:26,958 --> 00:35:28,625  
Princeton University Observatory, the

681  
00:35:28,625 --> 00:35:32,708  
most distinguished stellar astronomer

682  
00:35:32,708 --> 00:35:35,500  
worldwide, said to her,

683  
00:35:35,500 --> 00:35:38,041  
"You should take it out of your thesis.

684  
00:35:38,041 --> 00:35:40,416  
It makes all of us know that the sun is

685  
00:35:40,416 --> 00:35:42,708  
made of the same stuff as the Earth."

686  
00:35:43,666 --> 00:35:45,583  
And, you know, she was just at the

687  
00:35:45,583 --> 00:35:47,833  
beginning of her career. She took it out.

688  
00:35:47,833 --> 00:35:49,791

And then he worked on the problem for

689

00:35:49,791 --> 00:35:53,416

four years and wrote a long paper saying,

690

00:35:53,416 --> 00:35:56,291

in fact, she was right, that the sun is

691

00:35:56,291 --> 00:35:58,541

made mostly of hydrogen. And now we know

692

00:35:58,541 --> 00:36:00,375

it's not only the sun, but most of the

693

00:36:00,375 --> 00:36:01,291

ordinary matter in the

694

00:36:01,291 --> 00:36:01,708

universe is hydrogen.

695

00:36:02,291 --> 00:36:07,166

That was a major discovery. And so even

696

00:36:07,166 --> 00:36:09,875

that was a revelation 100 years ago, but

697

00:36:09,875 --> 00:36:12,916

then about a decade after Cecilia found

698

00:36:12,916 --> 00:36:15,666

that the sun is made of hydrogen, Fritz

699

00:36:15,666 --> 00:36:19,000

Rickey realized that, in fact, the most

700

00:36:19,000 --> 00:36:22,250

abundant substance in the universe, in

701  
00:36:22,250 --> 00:36:24,708  
the mass budget, is actually unknown.

702  
00:36:25,375 --> 00:36:26,916  
It's dark matter. It doesn't interact

703  
00:36:26,916 --> 00:36:30,416  
with light. So I say, what is the lesson

704  
00:36:30,416 --> 00:36:32,625  
we learned from that? That what we find

705  
00:36:32,625 --> 00:36:34,083  
in our backyard does not

706  
00:36:34,083 --> 00:36:34,833  
represent the universe.

707  
00:36:34,833 --> 00:36:38,166  
That's really easy to understand. But

708  
00:36:38,166 --> 00:36:41,583  
just a week ago, Elon Musk talked on TV

709  
00:36:41,583 --> 00:36:44,708  
as if he didn't see evidence for aliens.

710  
00:36:45,041 --> 00:36:48,875  
And I say, well, obviously, people before

711  
00:36:48,875 --> 00:36:51,125  
Swiggy didn't see evidence for dark

712  
00:36:51,125 --> 00:36:55,166  
matter. We know it exists. And before

713  
00:36:55,166 --> 00:36:58,500

that, people didn't realize that a decade

714

00:36:58,500 --> 00:36:59,958

before that the sun is

715

00:36:59,958 --> 00:37:00,833

made mostly of hydrogen.

716

00:37:00,833 --> 00:37:03,291

In fact, most of the ordinary matter in

717

00:37:03,291 --> 00:37:06,208

the universe is hydrogen. So you have to

718

00:37:06,208 --> 00:37:08,958

be humble. You can't just argue that

719

00:37:08,958 --> 00:37:11,375

based on your experience, you can

720

00:37:11,375 --> 00:37:12,708

extrapolate to the entire universe.

721

00:37:13,708 --> 00:37:15,666

And being modest and humble, learning

722

00:37:15,666 --> 00:37:18,166

from experience is really the big lesson

723

00:37:18,166 --> 00:37:20,291

from the days of Galileo that we are

724

00:37:20,291 --> 00:37:23,125

applying to the Galileo project.

725

00:37:23,125 --> 00:37:27,041

And we're trying to understand those

726

00:37:27,041 --> 00:37:28,833

interstellar objects, trying to find the

727

00:37:28,833 --> 00:37:31,500

next Oumuamua, for example. There will be

728

00:37:31,500 --> 00:37:34,875

a telescope, a survey telescope in Chile

729

00:37:34,875 --> 00:37:36,500

called the Vera Rubin Observatory,

730

00:37:36,500 --> 00:37:38,708

starting operations in 2024.

731

00:37:39,416 --> 00:37:42,375

And we're planning to use the pipeline of

732

00:37:42,375 --> 00:37:44,125

data, which will become public because

733

00:37:44,125 --> 00:37:45,166

it's funded by the

734

00:37:45,166 --> 00:37:47,041

National Science Foundation.

735

00:37:47,041 --> 00:37:51,708

We plan to analyze this data and look for

736

00:37:51,708 --> 00:37:55,916

additional weird objects out there. And

737

00:37:55,916 --> 00:37:57,875

it's just like, you know, we went on a

738

00:37:57,875 --> 00:37:59,500

date with Oumuamua. We liked it.

739

00:37:59,500 --> 00:38:01,500

It looked weird and interesting. But by

740

00:38:01,500 --> 00:38:03,875

the time we realized that it's so

741

00:38:03,875 --> 00:38:05,541

interesting, it left through the front

742

00:38:05,541 --> 00:38:06,708

door and we couldn't really follow it.

743

00:38:07,500 --> 00:38:09,541

And so then what do you do? I mean, you

744

00:38:09,541 --> 00:38:12,166

can obsess with it, argue about it. And

745

00:38:12,166 --> 00:38:14,250

in fact, just a few weeks ago, there was

746

00:38:14,250 --> 00:38:16,958

another paper about Oumuamua in nature

747

00:38:16,958 --> 00:38:18,416

that we showed is wrong

748

00:38:18,416 --> 00:38:20,583

and we can talk about it.

749

00:38:20,583 --> 00:38:24,083

But also there was a few days ago a paper

750

00:38:24,083 --> 00:38:25,500

analyzing the non-gravitational

751  
00:38:25,500 --> 00:38:27,666  
acceleration and confirming it again. So

752  
00:38:27,666 --> 00:38:28,708  
people keep coming back to it.

753  
00:38:28,958 --> 00:38:31,666  
But my point is, let's look for more of

754  
00:38:31,666 --> 00:38:33,416  
the same, you know, there must be more

755  
00:38:33,416 --> 00:38:35,791  
objects like it. And then we can get much

756  
00:38:35,791 --> 00:38:37,458  
better data with the Webb telescope

757  
00:38:37,458 --> 00:38:39,041  
because the Webb telescope will look at

758  
00:38:39,041 --> 00:38:41,291  
this object from a different direction

759  
00:38:41,291 --> 00:38:42,583  
than the Earth-based

760  
00:38:42,583 --> 00:38:43,875  
telescopes are looking at it.

761  
00:38:43,875 --> 00:38:45,458  
And then you can pinpoint the

762  
00:38:45,458 --> 00:38:47,166  
three-dimensional trajectory of the

763  
00:38:47,166 --> 00:38:50,250

object very precisely through parallax,

764

00:38:50,250 --> 00:38:52,083

basically triangulation.

765

00:38:52,083 --> 00:38:54,666

And that would allow us to tell whether

766

00:38:54,666 --> 00:38:57,250

there is any propulsion to an object that

767

00:38:57,250 --> 00:38:57,708

comes from interstellar space.

768

00:38:58,416 --> 00:38:59,500

And so this activity is

769

00:38:59,500 --> 00:39:00,750

under the Galileo project?

770

00:39:00,750 --> 00:39:02,208

This is under the Galileo project. So

771

00:39:02,208 --> 00:39:05,666

that's one of the missions to find more

772

00:39:05,666 --> 00:39:07,958

objects like Oumuamua or like the

773

00:39:07,958 --> 00:39:10,166

interstellar meteors and

774

00:39:10,166 --> 00:39:12,041

study them in great detail.

775

00:39:12,041 --> 00:39:15,166

And one interesting thing I realized this

776

00:39:15,166 --> 00:39:18,541

morning, I have some notes about it, is

777

00:39:18,541 --> 00:39:21,500

that the Webb telescope can detect the

778

00:39:21,500 --> 00:39:24,583

infrared emission from an object as a

779

00:39:24,583 --> 00:39:25,708

result of the illumination by sunlight.

780

00:39:26,791 --> 00:39:30,708

So the object gets warmed and then emits.

781

00:39:30,708 --> 00:39:32,541

And within the orbit of the Earth around

782

00:39:32,541 --> 00:39:34,291

the sun, the characteristic temperature

783

00:39:34,291 --> 00:39:35,083

is the same that we

784

00:39:35,083 --> 00:39:37,500

have on Earth, 300 degrees.

785

00:39:37,500 --> 00:39:42,000

And the peak of the emission is at about

786

00:39:42,000 --> 00:39:46,208

20 micron wavelength, which is being used

787

00:39:46,208 --> 00:39:48,291

by these goggles that the military

788

00:39:48,291 --> 00:39:50,791

personnel use at nighttime to see,

789

00:39:50,791 --> 00:39:52,708

because humans have the same body

790

00:39:52,708 --> 00:39:54,708

temperature roughly above absolute zero,

791

00:39:55,375 --> 00:39:59,125

as the Earth and as an object illuminated

792

00:39:59,125 --> 00:40:01,041

by the sun. So the Webb

793

00:40:01,041 --> 00:40:02,625

telescope could see that radiation.

794

00:40:02,625 --> 00:40:05,291

Now, what will it tell us? If we see the

795

00:40:05,291 --> 00:40:08,083

heat emitted from the object and we also

796

00:40:08,083 --> 00:40:11,458

see the reflected sunlight, then we can

797

00:40:11,458 --> 00:40:15,541

figure out the albedo of the object.

798

00:40:15,541 --> 00:40:17,666

Because if we know the position of it,

799

00:40:17,666 --> 00:40:19,416

then we know what should be the surface

800

00:40:19,416 --> 00:40:19,708

temperature of the object.

801  
00:40:21,333 --> 00:40:25,083  
And we can disentangle the area of the

802  
00:40:25,083 --> 00:40:27,875  
object and the reflectivity of the object

803  
00:40:27,875 --> 00:40:29,541  
by observing the emission from

804  
00:40:29,541 --> 00:40:31,833  
it and the reflection from it.

805  
00:40:31,833 --> 00:40:35,083  
So altogether, we can even map the object

806  
00:40:35,083 --> 00:40:38,958  
in three dimensions if it rotates,

807  
00:40:38,958 --> 00:40:41,500  
because the area keeps changing.

808  
00:40:41,500 --> 00:40:42,708  
And what we didn't know about the

809  
00:40:42,708 --> 00:40:44,750  
Ummuamua is what is the albedo, what is

810  
00:40:44,750 --> 00:40:45,791  
the reflectance. So we

811  
00:40:45,791 --> 00:40:46,708  
didn't know precisely the area.

812  
00:40:48,166 --> 00:40:51,583  
And also we observed it only from the

813  
00:40:51,583 --> 00:40:52,708

Earth. And now we will

814

00:40:52,708 --> 00:40:53,750

have the Webb telescope.

815

00:40:53,750 --> 00:40:56,083

So altogether, we will have a wealth of

816

00:40:56,083 --> 00:40:57,125

data on the next

817

00:40:57,125 --> 00:40:59,791

Ummuamua that we can analyze.

818

00:40:59,791 --> 00:41:01,458

And that's one of the missions of the

819

00:41:01,458 --> 00:41:04,125

Galois project. If we look.

820

00:41:04,125 --> 00:41:06,375

Well, I will definitely look.

821

00:41:06,375 --> 00:41:09,041

I will not miss a second

822

00:41:09,041 --> 00:41:10,708

before we start collecting data.

823

00:41:11,083 --> 00:41:13,958

It sounds like you are trying to link and

824

00:41:13,958 --> 00:41:15,833

you know, true to your statement about

825

00:41:15,833 --> 00:41:17,791

how Elon Musk is apparently approaching

826

00:41:17,791 --> 00:41:18,666

the problem by looking

827

00:41:18,666 --> 00:41:19,750

at a very small data set.

828

00:41:19,750 --> 00:41:21,208

You want to link what's happening, it

829

00:41:21,208 --> 00:41:22,875

sounds like, in our atmosphere

830

00:41:22,875 --> 00:41:24,458

potentially to what's

831

00:41:24,458 --> 00:41:25,833

happening outside of our atmosphere.

832

00:41:25,833 --> 00:41:29,041

Here is an interesting anecdote. The

833

00:41:29,041 --> 00:41:33,416

second interstellar meteor had the same

834

00:41:33,416 --> 00:41:37,041

speed as Ummuamua had at large distances

835

00:41:37,041 --> 00:41:38,708

relative to the Sun.

836

00:41:39,333 --> 00:41:42,291

And also the same distance of closest

837

00:41:42,291 --> 00:41:44,125

approach. Interesting.

838

00:41:44,125 --> 00:41:48,125

So I thought maybe it was a probe

839

00:41:48,125 --> 00:41:50,333

released from Ummuamua.

840

00:41:50,333 --> 00:41:52,208

But then I checked and it came from a

841

00:41:52,208 --> 00:41:54,083

different inclination, so a different

842

00:41:54,083 --> 00:41:55,458

direction in the sky.

843

00:41:55,458 --> 00:41:57,583

So it wasn't related, but it gave me the

844

00:41:57,583 --> 00:42:01,083

idea of a mothership releasing probes.

845

00:42:01,083 --> 00:42:03,416

And this is something I discussed in my

846

00:42:03,416 --> 00:42:04,708

book, "Exterrestrial".

847

00:42:06,208 --> 00:42:10,666

Which I wrote about Ummuamua in January

848

00:42:10,666 --> 00:42:14,333

2021. It had 28 editions in many

849

00:42:14,333 --> 00:42:16,041

languages and became

850

00:42:16,041 --> 00:42:17,375

bestseller in many countries.

851

00:42:17,375 --> 00:42:21,291

And I had about 2500 interviews about

852

00:42:21,291 --> 00:42:23,708

this subject since then.

853

00:42:24,875 --> 00:42:28,250

And just a week ago there were 20

854

00:42:28,250 --> 00:42:29,916

filmmakers and producers that approached

855

00:42:29,916 --> 00:42:34,708

me to make a documentary film about the

856

00:42:34,708 --> 00:42:36,916

research that I'm doing.

857

00:42:36,916 --> 00:42:41,333

And also a playwright that sent me an

858

00:42:41,333 --> 00:42:42,916

email with the title

859

00:42:42,916 --> 00:42:45,541

"Avilobone Broadway".

860

00:42:45,541 --> 00:42:48,791

So I thought it was an April Fool's Day

861

00:42:48,791 --> 00:42:49,916

joke because it came a

862

00:42:49,916 --> 00:42:51,708

few days before April 1st.

863

00:42:53,041 --> 00:42:56,041

But then he attached to the email some

864

00:42:56,041 --> 00:42:58,583

photos of him with Barbara

865

00:42:58,583 --> 00:43:00,208

Streisand and with Dick Van Dyke.

866

00:43:00,208 --> 00:43:02,333

And they had the serial number from the

867

00:43:02,333 --> 00:43:04,375

cell phone that he's using.

868

00:43:04,375 --> 00:43:06,875

And so it looked authentic. And by now he

869

00:43:06,875 --> 00:43:08,083

already wrote several

870

00:43:08,083 --> 00:43:11,791

tens of pages for display.

871

00:43:11,791 --> 00:43:13,666

Because I gave him the green light.

872

00:43:13,666 --> 00:43:17,125

Yesterday I met with our second postdoc,

873

00:43:17,125 --> 00:43:18,083

postdoctoral fellow

874

00:43:18,083 --> 00:43:18,708

at the Galileo Project.

875

00:43:19,583 --> 00:43:21,791

So I received funding from three

876

00:43:21,791 --> 00:43:25,791

postdoctoral fellows in one year.

877

00:43:25,791 --> 00:43:27,333

Expansion.

878

00:43:27,333 --> 00:43:31,958

Yeah, so each of these postdocs comes for

879

00:43:31,958 --> 00:43:34,458

three years. And it's about them.

880

00:43:34,458 --> 00:43:38,083

All together it's equivalent to a

881

00:43:38,083 --> 00:43:39,208

donation of a million

882

00:43:39,208 --> 00:43:41,958

dollars, the three of them.

883

00:43:41,958 --> 00:43:42,708

Just for three years.

884

00:43:43,583 --> 00:43:47,250

But the one that arrived yesterday, Laura

885

00:43:47,250 --> 00:43:49,916

Doming from Stanford University, you

886

00:43:49,916 --> 00:43:54,291

know, she was considered the brightest

887

00:43:54,291 --> 00:43:56,541

PhD student for many

888

00:43:56,541 --> 00:43:59,750

years by her mentors.

889

00:43:59,750 --> 00:44:03,208

And then when I called her to offer her

890

00:44:03,208 --> 00:44:04,750

the postdoctoral fellowship under the

891

00:44:04,750 --> 00:44:07,750

Galileo Project, she was so thrilled and

892

00:44:07,750 --> 00:44:09,500

said, "I can't believe

893

00:44:09,500 --> 00:44:10,708

that I hear your voice."

894

00:44:11,458 --> 00:44:13,000

And then I asked her

895

00:44:13,000 --> 00:44:16,541

yesterday, "Why is it?"

896

00:44:16,541 --> 00:44:18,750

And she said, "Well, since a very young

897

00:44:18,750 --> 00:44:22,125

age, I was following those reports about

898

00:44:22,125 --> 00:44:22,958

unidentified aerial

899

00:44:22,958 --> 00:44:25,416

phenomena, about aliens, about..."

900

00:44:25,416 --> 00:44:27,875

And I always wanted to be part of a

901  
00:44:27,875 --> 00:44:30,791  
scientific project that approaches this

902  
00:44:30,791 --> 00:44:32,708  
subject using the scientific method,

903  
00:44:33,500 --> 00:44:35,833  
meaning collecting data with instruments

904  
00:44:35,833 --> 00:44:38,333  
we understand, we calibrate under our

905  
00:44:38,333 --> 00:44:40,833  
control, and analyze it using the most

906  
00:44:40,833 --> 00:44:42,458  
sophisticated computer algorithms,

907  
00:44:42,458 --> 00:44:44,000  
which is pretty much what the Galileo

908  
00:44:44,000 --> 00:44:46,458  
Project is doing. We can get into that.

909  
00:44:46,458 --> 00:44:50,666  
But she said, "When you called me, that

910  
00:44:50,666 --> 00:44:53,458  
was a lifelong dream come true."

911  
00:44:53,458 --> 00:44:56,916  
And I've never heard that. I was the

912  
00:44:56,916 --> 00:44:58,958  
director of the Institute for Theory and

913  
00:44:58,958 --> 00:45:00,125

Computation for about

914

00:45:00,125 --> 00:45:01,708

two decades now at Harvard.

915

00:45:02,625 --> 00:45:05,500

And I made offers to about a hundred

916

00:45:05,500 --> 00:45:06,708

postdoctoral fellows

917

00:45:06,708 --> 00:45:09,375

during these 20 years.

918

00:45:09,375 --> 00:45:11,958

And none of these people who worked in

919

00:45:11,958 --> 00:45:14,166

theoretical astrophysics told me it was

920

00:45:14,166 --> 00:45:17,583

my life-long dream to

921

00:45:17,583 --> 00:45:19,083

work on black holes,

922

00:45:19,083 --> 00:45:21,458

or to work on the first star, or to work

923

00:45:21,458 --> 00:45:22,708

on galaxy formation.

924

00:45:23,666 --> 00:45:27,708

But she said that. And then when I

925

00:45:27,708 --> 00:45:30,625

mentioned it to the first postdoc that we

926

00:45:30,625 --> 00:45:32,375

accepted, Richard Clouette from the

927

00:45:32,375 --> 00:45:34,291

University of Cambridge in England,

928

00:45:34,291 --> 00:45:35,125

he said, "For me, it

929

00:45:35,125 --> 00:45:37,291

was exactly the same."

930

00:45:37,291 --> 00:45:39,958

And they both had to compromise because

931

00:45:39,958 --> 00:45:41,791

their academic environment did not

932

00:45:41,791 --> 00:45:44,291

provide opportunities to work on this

933

00:45:44,291 --> 00:45:45,791

subject, scientifically speaking.

934

00:45:45,791 --> 00:45:46,791

And the Galileo Project

935

00:45:46,791 --> 00:45:47,708

is really the first one.

936

00:45:48,000 --> 00:45:50,583

Now, many people say there are many other

937

00:45:50,583 --> 00:45:52,166

organizations dealing with

938

00:45:52,166 --> 00:45:53,583

unidentified objects near Earth.

939

00:45:53,583 --> 00:45:56,708

And there is a clear difference. The

940

00:45:56,708 --> 00:45:58,708

Galileo Project is the only one dedicated

941

00:45:58,708 --> 00:46:00,833

to the collection of new data

942

00:46:00,833 --> 00:46:02,458

using the scientific method.

943

00:46:02,458 --> 00:46:05,583

All of these other organizations are

944

00:46:05,583 --> 00:46:09,916

either seeking old data or trying to push

945

00:46:09,916 --> 00:46:12,291

the government to declassify some

946

00:46:12,291 --> 00:46:14,708

existing data that the government has.

947

00:46:15,041 --> 00:46:16,083

And the problem with that

948

00:46:16,083 --> 00:46:18,291

is that it was all anecdotal.

949

00:46:18,291 --> 00:46:21,250

Either private citizens or the government

950

00:46:21,250 --> 00:46:23,125

were looking at something else and

951  
00:46:23,125 --> 00:46:24,500  
suddenly saw something

952  
00:46:24,500 --> 00:46:26,041  
that they didn't expect.

953  
00:46:26,041 --> 00:46:29,291  
So it's limited in the amount of

954  
00:46:29,291 --> 00:46:31,666  
information we can milk out of it because

955  
00:46:31,666 --> 00:46:33,375  
it was not anticipated.

956  
00:46:33,375 --> 00:46:36,208  
And also the sensors that the government

957  
00:46:36,208 --> 00:46:40,833  
uses or the public uses are not of the

958  
00:46:40,833 --> 00:46:41,708  
highest quality that we have today.

959  
00:46:42,333 --> 00:46:45,041  
So instead of once again, instead of

960  
00:46:45,041 --> 00:46:47,083  
obsessing with the past, I'm a very young

961  
00:46:47,083 --> 00:46:48,458  
person in my attitude.

962  
00:46:48,458 --> 00:46:50,833  
Let's just collect new data. And within a

963  
00:46:50,833 --> 00:46:53,416

few months, the Galileo Project

964

00:46:53,416 --> 00:46:55,708

Observatory that is now functioning will

965

00:46:55,708 --> 00:46:58,333

collect more data than was ever collected

966

00:46:58,333 --> 00:47:00,666

by all the reports on unidentified area

967

00:47:00,666 --> 00:47:02,791

phenomena from one location at Harvard

968

00:47:02,791 --> 00:47:04,708

University, not far from where I live.

969

00:47:06,000 --> 00:47:09,833

And if you just wait a year, it will be

970

00:47:09,833 --> 00:47:12,375

10 times more than ever collected.

971

00:47:12,375 --> 00:47:14,958

So why should we worry about the

972

00:47:14,958 --> 00:47:16,875

government releasing what they have?

973

00:47:16,875 --> 00:47:18,666

Why should we force them when the data

974

00:47:18,666 --> 00:47:21,666

was collected by classified sensors?

975

00:47:21,666 --> 00:47:23,875

That's why the data is classified. It's

976

00:47:23,875 --> 00:47:26,000

not so much because of the content.

977

00:47:26,000 --> 00:47:27,458

To me, it's intriguing that the

978

00:47:27,458 --> 00:47:30,500

government is talking about it because it

979

00:47:30,500 --> 00:47:31,333

says there is something

980

00:47:31,333 --> 00:47:31,708

they don't understand.

981

00:47:32,333 --> 00:47:34,291

But the government is not a scientific

982

00:47:34,291 --> 00:47:34,875

organization, so we

983

00:47:34,875 --> 00:47:37,333

shouldn't ask them to do our job.

984

00:47:37,333 --> 00:47:38,916

And on the other hand, you have the

985

00:47:38,916 --> 00:47:41,041

scientific community, which I have a lot

986

00:47:41,041 --> 00:47:43,166

to say about, which is

987

00:47:43,166 --> 00:47:44,916

reluctant to touch it.

988

00:47:44,916 --> 00:47:47,916

Why? Because it's a risky subject and

989

00:47:47,916 --> 00:47:52,500

most scientists prefer to get honors and

990

00:47:52,500 --> 00:47:55,166

awards in a safe way without taking

991

00:47:55,166 --> 00:47:56,666

risks, which is completely opposite to

992

00:47:56,666 --> 00:47:59,708

the spirit of blue sky research.

993

00:48:00,125 --> 00:48:02,291

The only reason there is tenure in

994

00:48:02,291 --> 00:48:04,500

academia is to allow people to have job

995

00:48:04,500 --> 00:48:06,458

security and to take risks.

996

00:48:06,458 --> 00:48:08,666

But the strange thing is that almost all

997

00:48:08,666 --> 00:48:12,083

of them, after they get tenure, start to

998

00:48:12,083 --> 00:48:13,500

worry about their

999

00:48:13,500 --> 00:48:16,666

image, stature, prestige,

1000

00:48:16,666 --> 00:48:18,958

in order to get awards recognition from

1001

00:48:18,958 --> 00:48:19,791

their peers, and

1002

00:48:19,791 --> 00:48:20,708

therefore they don't take risks.

1003

00:48:20,958 --> 00:48:24,750

And they also don't want others to take

1004

00:48:24,750 --> 00:48:26,666

risks because if they are experts, if

1005

00:48:26,666 --> 00:48:29,708

they studied rocks in the sky for several

1006

00:48:29,708 --> 00:48:32,083

decades and they are the expert on

1007

00:48:32,083 --> 00:48:33,625

asteroids or comets,

1008

00:48:33,625 --> 00:48:36,208

they would insist that everything we see

1009

00:48:36,208 --> 00:48:38,916

in the sky is an asteroid or a comet.

1010

00:48:38,916 --> 00:48:42,125

And the most extreme example is actually

1011

00:48:42,125 --> 00:48:44,666

a young person who wrote a

1012

00:48:44,666 --> 00:48:46,041

review paper about Umoa Umoa.

1013

00:48:47,208 --> 00:48:49,208

And he said to me in an email, he said,

1014

00:48:49,208 --> 00:48:51,583

"I just finished an extensive review

1015

00:48:51,583 --> 00:48:53,958

about the comet Umoa Umoa."

1016

00:48:53,958 --> 00:48:55,916

So I wrote back and said, "What do you

1017

00:48:55,916 --> 00:48:58,666

mean by the comet Umoa Umoa? We both know

1018

00:48:58,666 --> 00:49:01,000

there was no cometary tail, there was no

1019

00:49:01,000 --> 00:49:02,333

coma, there was no

1020

00:49:02,333 --> 00:49:03,833

evidence for evaporation."

1021

00:49:03,833 --> 00:49:06,875

And he said, "Well, I have this theory

1022

00:49:06,875 --> 00:49:10,458

that when we looked at the object, it

1023

00:49:10,458 --> 00:49:12,041

didn't have a cometary tail, when we

1024

00:49:12,041 --> 00:49:13,916

looked away from it,

1025

00:49:13,916 --> 00:49:15,625

it had a cometary tail."

1026

00:49:16,083 --> 00:49:18,500

- Quantum comet. - Yeah, and I said,

1027

00:49:18,500 --> 00:49:20,125

"That's just like going to the zoo

1028

00:49:20,125 --> 00:49:21,583

looking at an elephant and claiming it's

1029

00:49:21,583 --> 00:49:23,166

a zebra that shows its

1030

00:49:23,166 --> 00:49:24,833

stripes when you look away."

1031

00:49:24,833 --> 00:49:27,125

That is not the way the mainstream

1032

00:49:27,125 --> 00:49:29,000

science should deal

1033

00:49:29,000 --> 00:49:31,083

with an anomalous object.

1034

00:49:31,083 --> 00:49:33,416

And the other thing is, I feel like the

1035

00:49:33,416 --> 00:49:37,500

kid in Hans Christian Andersen's tale,

1036

00:49:37,500 --> 00:49:39,666

who said the emperor has no clothes, Umoa

1037

00:49:39,666 --> 00:49:41,333

Umoa is the emperor, the

1038

00:49:41,333 --> 00:49:41,708

clothes are the cometary tail.

1039

00:49:42,375 --> 00:49:44,333

I just say what I see, you know, I don't

1040

00:49:44,333 --> 00:49:45,791

see a cometary tail. I say

1041

00:49:45,791 --> 00:49:47,208

the emperor has no clothes.

1042

00:49:47,208 --> 00:49:49,125

But everyone around me says, "Oh, no, no,

1043

00:49:49,125 --> 00:49:51,833

no, no, there are clothes, they're just

1044

00:49:51,833 --> 00:49:53,291

invisible and they're beautiful."

1045

00:49:53,291 --> 00:49:55,625

Like the most recent paper from a few

1046

00:49:55,625 --> 00:49:58,458

weeks ago in Nature was about this comet

1047

00:49:58,458 --> 00:50:02,666

being made of water that broke into

1048

00:50:02,666 --> 00:50:04,916

hydrogen and oxygen, and the hydrogen is

1049

00:50:04,916 --> 00:50:05,916

transparent when it evaporates.

1050

00:50:05,916 --> 00:50:08,041

And we actually showed that they made a

1051

00:50:08,041 --> 00:50:08,958

mistake in the energy

1052

00:50:08,958 --> 00:50:09,708

balance of the surface.

1053

00:50:10,458 --> 00:50:13,166

But at any event, people keep insisting

1054

00:50:13,166 --> 00:50:15,125

that indeed the emperor has beautiful

1055

00:50:15,125 --> 00:50:17,041

clothes, but we can't see them.

1056

00:50:17,041 --> 00:50:20,458

So how do you... Well, it sounds like

1057

00:50:20,458 --> 00:50:22,125

there's a younger generation that's more

1058

00:50:22,125 --> 00:50:23,958

eager to jump into those conversations

1059

00:50:23,958 --> 00:50:25,500

that might be more challenging.

1060

00:50:25,500 --> 00:50:27,041

And I know there's, you know, as you

1061

00:50:27,041 --> 00:50:29,083

alluded to, the problem with the older

1062

00:50:29,083 --> 00:50:31,416

generation not wanting to experiment with

1063

00:50:31,416 --> 00:50:33,750

maybe some new ideas that might cause the

1064

00:50:33,750 --> 00:50:34,708

base of their knowledge to crumble.

1065

00:50:35,541 --> 00:50:37,875

I get that. How does this make you feel

1066

00:50:37,875 --> 00:50:39,708

with this new generation coming in? And

1067

00:50:39,708 --> 00:50:41,791

how can we really tap into that

1068

00:50:41,791 --> 00:50:44,750

eagerness, excitement, that energy?

1069

00:50:44,750 --> 00:50:48,208

Well, so the younger people also make a

1070

00:50:48,208 --> 00:50:49,666

calculation because they need to think

1071

00:50:49,666 --> 00:50:51,208

about their future jobs.

1072

00:50:51,208 --> 00:50:53,666

And the calculation is when they see the

1073

00:50:53,666 --> 00:50:55,708

pushback that I encounter, and frankly, I

1074

00:50:55,708 --> 00:50:57,541

don't care about it, I don't care how

1075

00:50:57,541 --> 00:50:59,333

many likes I get, because I

1076

00:50:59,333 --> 00:50:59,708

just want to do the right thing.

1077

00:51:00,375 --> 00:51:02,791

I want to advance the knowledge of

1078

00:51:02,791 --> 00:51:05,166

humanity in the context of whether we are

1079

00:51:05,166 --> 00:51:06,500

the smartest kid in

1080

00:51:06,500 --> 00:51:08,041

our cosmic neighborhood.

1081

00:51:08,041 --> 00:51:10,458

And if not, let's learn from them. That's

1082

00:51:10,458 --> 00:51:12,250

my objective. There is a lot

1083

00:51:12,250 --> 00:51:14,291

for humanity to benefit from.

1084

00:51:14,291 --> 00:51:16,583

And this is discussed in my next book,

1085

00:51:16,583 --> 00:51:19,333

actually, that comes out in August 2023.

1086

00:51:19,333 --> 00:51:21,916

It's called Interstellar.

1087

00:51:21,916 --> 00:51:24,708

And it discusses the implications for humanity.

1088

00:51:25,875 --> 00:51:32,000

So you see, when you meet a partner, it

1089

00:51:32,000 --> 00:51:36,208

affects you. And in my view, it would be

1090

00:51:36,208 --> 00:51:40,916

a great benefit to humanity to recognize

1091

00:51:40,916 --> 00:51:43,375

that there might have been a smarter kid

1092

00:51:43,375 --> 00:51:45,708

on our blog because we can learn from it.

1093

00:51:47,125 --> 00:51:49,166

And moreover, it will change our

1094

00:51:49,166 --> 00:51:51,291

aspirations to space, will give us a

1095

00:51:51,291 --> 00:51:52,458

better understanding about

1096

00:51:52,458 --> 00:51:53,833

our place in the universe.

1097

00:51:53,833 --> 00:51:55,833

And, you know, Steven Weinberg, the Nobel

1098

00:51:55,833 --> 00:51:59,291

laureate in physics, said towards the end

1099

00:51:59,291 --> 00:52:01,291

of his book, famous book, the

1100

00:52:01,291 --> 00:52:03,541

first three minutes, he said,

1101

00:52:03,541 --> 00:52:07,416

"The more we understand, the more the

1102

00:52:07,416 --> 00:52:10,333

universe appears comprehensible to us,

1103

00:52:10,333 --> 00:52:12,625

the more pointless it looks."

1104

00:52:12,958 --> 00:52:14,708

And I say it looks pointless to

1105

00:52:14,708 --> 00:52:18,875

cosmologists because they focused for

1106

00:52:18,875 --> 00:52:22,583

decades on lifeless entities like

1107

00:52:22,583 --> 00:52:23,833

elementary particles

1108

00:52:23,833 --> 00:52:25,625

or stars or galaxies.

1109

00:52:25,625 --> 00:52:27,083

These are entities that

1110

00:52:27,083 --> 00:52:29,708

have no life. They are dead.

1111

00:52:29,708 --> 00:52:33,208

And from our private experience, when we

1112

00:52:33,208 --> 00:52:36,000

find a partner, it changes the meaning

1113

00:52:36,000 --> 00:52:38,083

that we assign to our existence.

1114

00:52:38,916 --> 00:52:41,166

In the same way, I believe that when

1115

00:52:41,166 --> 00:52:43,833

humanity finds a partner, an interstellar

1116

00:52:43,833 --> 00:52:46,708

partner, it will change everything.

1117

00:52:46,708 --> 00:52:50,208

It will make the universe have some

1118

00:52:50,208 --> 00:52:53,500

meaning because they may have answers to

1119

00:52:53,500 --> 00:52:55,166

questions that we didn't figure the

1120

00:52:55,166 --> 00:52:57,875

answers to, but we could also interact

1121

00:52:57,875 --> 00:52:59,791

with them in a way that we

1122

00:52:59,791 --> 00:53:01,708

can learn about our future.

1123

00:53:01,833 --> 00:53:03,625

Because if they already went through part

1124

00:53:03,625 --> 00:53:06,583

of our technological future, we will see

1125

00:53:06,583 --> 00:53:08,958

technologies that we've never imagined.

1126

00:53:08,958 --> 00:53:11,791

What about our past? Do you have any

1127

00:53:11,791 --> 00:53:16,291

thoughts on the concept of panspermia?

1128

00:53:16,291 --> 00:53:20,166

Yeah, so there are two types of ways by

1129

00:53:20,166 --> 00:53:21,625

which life can move

1130

00:53:21,625 --> 00:53:24,500

from one planet to another.

1131

00:53:25,833 --> 00:53:30,375

In fact, Mars cooled before Earth and had

1132

00:53:30,375 --> 00:53:33,166

liquid water and an atmosphere on it for

1133

00:53:33,166 --> 00:53:38,208

the first half of its lifespan.

1134

00:53:38,208 --> 00:53:40,916

And so only about two billion years ago,

1135

00:53:40,916 --> 00:53:45,166

it lost its atmosphere and the liquid

1136

00:53:45,166 --> 00:53:46,875

water evaporated because liquid water

1137

00:53:46,875 --> 00:53:49,583

needs an atmospheric pressure to stay.

1138

00:53:50,375 --> 00:53:53,791

And so it's possible that life started on

1139

00:53:53,791 --> 00:53:55,833

Mars before it started on Earth.

1140

00:53:55,833 --> 00:53:57,416

And in fact, it's also possible we know

1141

00:53:57,416 --> 00:53:59,041

there are rocks from

1142

00:53:59,041 --> 00:54:01,083

Mars that arrived to Earth.

1143

00:54:01,083 --> 00:54:03,125

One of them was not heated to

1144

00:54:03,125 --> 00:54:06,583

more than 40 degrees Celsius.

1145

00:54:06,583 --> 00:54:11,500

So you could have tiny microbes as tiny

1146

00:54:11,500 --> 00:54:14,291

astronauts in the interior of a rock that

1147

00:54:14,291 --> 00:54:15,125

would survive the

1148

00:54:15,125 --> 00:54:16,583

journey from Mars to Earth.

1149

00:54:16,958 --> 00:54:19,041

And perhaps we are all Martians. And when

1150

00:54:19,041 --> 00:54:21,000

Elon Musk says he wants to die on Mars,

1151

00:54:21,000 --> 00:54:24,083

it's just like wanting to go back to your

1152

00:54:24,083 --> 00:54:26,750

childhood home and die there.

1153

00:54:26,750 --> 00:54:29,291

So we don't know whether life started on

1154

00:54:29,291 --> 00:54:30,500

Mars and was delivered to

1155

00:54:30,500 --> 00:54:32,625

Earth or started on Earth.

1156

00:54:32,625 --> 00:54:35,125

And it's quite plausible that rocks made

1157

00:54:35,125 --> 00:54:37,416

it with the kind of life.

1158

00:54:37,416 --> 00:54:40,666

And one way to find out the history of

1159

00:54:40,666 --> 00:54:42,833

Earth would be to find

1160

00:54:42,833 --> 00:54:44,708

evidence for life on Mars.

1161

00:54:44,791 --> 00:54:48,125

It's not easy, but there are some

1162

00:54:48,125 --> 00:54:49,875

attempts to do that.

1163

00:54:49,875 --> 00:54:52,750

And if we do find life on Mars, the

1164

00:54:52,750 --> 00:54:54,833

question is, is it identical to life on

1165

00:54:54,833 --> 00:54:58,000

Earth in terms of the DNA structure?

1166

00:54:58,000 --> 00:54:59,958

And if it is, there is a good chance that

1167

00:54:59,958 --> 00:55:01,208

it was transferred

1168

00:55:01,208 --> 00:55:02,625

between the two planets.

1169

00:55:02,625 --> 00:55:04,291

And that's called panspermia.

1170

00:55:04,291 --> 00:55:06,875

I'm personally interested in something

1171

00:55:06,875 --> 00:55:09,416

that was never done, which is there are

1172

00:55:09,416 --> 00:55:12,041

these lava tubes on Mars, which are

1173

00:55:12,041 --> 00:55:13,708

similar to those that you find in Hawaii.

1174

00:55:14,541 --> 00:55:16,833

Basically, when there is volcanic

1175

00:55:16,833 --> 00:55:19,166

activity, lava flows and

1176

00:55:19,166 --> 00:55:22,166

then it cools at the top first,

1177

00:55:22,166 --> 00:55:25,250

and you create sort of a crust that

1178

00:55:25,250 --> 00:55:26,208

serves as a ceiling.

1179

00:55:26,208 --> 00:55:29,083

And then the lava continues to flow under

1180

00:55:29,083 --> 00:55:30,583

that ceiling and you end

1181

00:55:30,583 --> 00:55:33,291

up with a cave, a tunnel.

1182

00:55:33,291 --> 00:55:34,708

And you see that in

1183

00:55:34,708 --> 00:55:38,208

Hawaii, beautiful lava tubes.

1184

00:55:38,208 --> 00:55:40,708

But the moon and Mars also have that.

1185

00:55:41,666 --> 00:55:45,416

And what I'm curious about is, you know,

1186

00:55:45,416 --> 00:55:48,333

we started in caves to protect ourselves

1187

00:55:48,333 --> 00:55:50,166

from harsh weather

1188

00:55:50,166 --> 00:55:51,166

conditions and so forth.

1189

00:55:51,166 --> 00:55:54,416

And I'm curious to go into one of these

1190

00:55:54,416 --> 00:55:58,291

lava tubes on Mars with a flashlight and

1191

00:55:58,291 --> 00:56:01,833

check without any paintings on the walls

1192

00:56:01,833 --> 00:56:04,541

of those lava tubes from some beings that

1193

00:56:04,541 --> 00:56:05,833

used to exist there.

1194

00:56:05,833 --> 00:56:08,208

I'd go with you. I'll hold the light.

1195

00:56:09,416 --> 00:56:11,583

I mean, we can send a drone just not to

1196

00:56:11,583 --> 00:56:13,958

risk our lives, but it's quite possible

1197

00:56:13,958 --> 00:56:17,708

that there were creatures on Mars.

1198

00:56:17,708 --> 00:56:20,666

And one thing I calculated is over a

1199

00:56:20,666 --> 00:56:23,125

billion years, you know, the two billion

1200

00:56:23,125 --> 00:56:26,958

years since Mars lost its atmosphere and

1201

00:56:26,958 --> 00:56:30,541

liquid water for every

1202

00:56:30,541 --> 00:56:31,708

square kilometer on Mars,

1203

00:56:32,791 --> 00:56:37,416

there were asteroid impacts that released

1204

00:56:37,416 --> 00:56:40,583

energy equivalent to 20 Hiroshima atomic

1205

00:56:40,583 --> 00:56:42,916

bombs for every square kilometer.

1206

00:56:42,916 --> 00:56:44,791

Just think about it. So much energy

1207

00:56:44,791 --> 00:56:46,875

release. So it's very difficult to find

1208

00:56:46,875 --> 00:56:50,083

on the surface skeletons or

1209

00:56:50,083 --> 00:56:53,625

any anything other than dust.

1210

00:56:53,625 --> 00:56:56,875

But in the caves, you might still find

1211

00:56:56,875 --> 00:56:58,500

something. And especially because it's

1212

00:56:58,500 --> 00:56:59,708

protected from cosmic rays.

1213

00:57:00,791 --> 00:57:03,791

By the way, if we ever go there, the

1214

00:57:03,791 --> 00:57:06,833

first place to go is to these lava tubes,

1215

00:57:06,833 --> 00:57:09,166

not to be on the surface because

1216

00:57:09,166 --> 00:57:11,666

bombardment by cosmic rays can harm the

1217

00:57:11,666 --> 00:57:13,458

human body and basically make it

1218

00:57:13,458 --> 00:57:17,583

unlivable within a few years.

1219

00:57:17,583 --> 00:57:19,541

So those problems we haven't quite solved

1220

00:57:19,541 --> 00:57:21,291

yet. We're kind of looking past in some

1221

00:57:21,291 --> 00:57:22,666

ways when we talk about Mars.

1222

00:57:22,916 --> 00:57:25,125

And we started in caves. And if we go to

1223

00:57:25,125 --> 00:57:26,625

Mars, we'll end up in caves. That's what

1224

00:57:26,625 --> 00:57:28,333

I'm saying. The humans go

1225

00:57:28,333 --> 00:57:30,541

back to their roots, so to speak.

1226  
00:57:30,541 --> 00:57:34,833  
But altogether, you know, panspermia in

1227  
00:57:34,833 --> 00:57:37,125  
the natural ways, transfer of rocks

1228  
00:57:37,125 --> 00:57:38,958  
between two neighboring planets.

1229  
00:57:38,958 --> 00:57:41,791  
And there are other planetary systems.

1230  
00:57:41,791 --> 00:57:46,250  
For example, Trappist 1 is an example at

1231  
00:57:46,250 --> 00:57:48,875  
about several tenths of light years away

1232  
00:57:48,875 --> 00:57:50,791  
from us that has seven

1233  
00:57:50,791 --> 00:57:51,708  
planets packed in a very,

1234  
00:57:52,333 --> 00:57:54,500  
in very close proximity. So if one of

1235  
00:57:54,500 --> 00:57:57,000  
them had life, it's quite possible that

1236  
00:57:57,000 --> 00:57:59,250  
rocks were liberated from that planet.

1237  
00:57:59,250 --> 00:58:00,875  
These rocks are liberated when an

1238  
00:58:00,875 --> 00:58:03,625

asteroid impacts the surface and lifts

1239

00:58:03,625 --> 00:58:06,125

some surface material and

1240

00:58:06,125 --> 00:58:08,625

it could include microbes.

1241

00:58:08,625 --> 00:58:11,666

So that's natural indirect panspermia.

1242

00:58:11,666 --> 00:58:13,750

But there is also the concept of directed

1243

00:58:13,750 --> 00:58:16,291

panspermia where a civilization decides

1244

00:58:16,291 --> 00:58:20,500

to send probes that would replicate life.

1245

00:58:21,166 --> 00:58:24,333

And the way I think about the future of

1246

00:58:24,333 --> 00:58:29,166

humanity is, well, it involves artificial

1247

00:58:29,166 --> 00:58:30,958

intelligence, AI, because we are already

1248

00:58:30,958 --> 00:58:34,291

at a point where GPT-4 has a hundred

1249

00:58:34,291 --> 00:58:36,250

trillion connections,

1250

00:58:36,250 --> 00:58:39,166

only a factor of six shy of the number of

1251

00:58:39,166 --> 00:58:40,625

synapses in the human

1252

00:58:40,625 --> 00:58:42,500

brain, six hundred trillion.

1253

00:58:42,875 --> 00:58:45,500

So we are getting to the point where the

1254

00:58:45,500 --> 00:58:49,208

complexity of these language learning

1255

00:58:49,208 --> 00:58:53,416

models like GPT-4 are getting to the

1256

00:58:53,416 --> 00:58:54,916

level of complexity of the human brain.

1257

00:58:54,916 --> 00:58:57,291

So we won't fully understand how they

1258

00:58:57,291 --> 00:59:00,583

operate. But the way I see it is as an

1259

00:59:00,583 --> 00:59:02,416

opportunity to send those systems to

1260

00:59:02,416 --> 00:59:04,958

space because they could learn from

1261

00:59:04,958 --> 00:59:07,791

experience and then we can harden them so

1262

00:59:07,791 --> 00:59:08,750

that they don't suffer

1263

00:59:08,750 --> 00:59:10,708

the damage from cosmic rays

1264

00:59:11,291 --> 00:59:14,375

or ultraviolet light or they would not

1265

00:59:14,375 --> 00:59:16,625

mind being dormant for millions of years

1266

00:59:16,625 --> 00:59:20,541

on travel to another planetary system.

1267

00:59:20,541 --> 00:59:22,833

And then once they get there, they could,

1268

00:59:22,833 --> 00:59:25,291

if they have 3D printing capabilities

1269

00:59:25,291 --> 00:59:28,458

with them, they can make the kind of life

1270

00:59:28,458 --> 00:59:29,625

that we have here on Earth.

1271

00:59:29,625 --> 00:59:31,958

So instead of sending passengers like in

1272

00:59:31,958 --> 00:59:34,250

Star Trek, and by the way, just a couple

1273

00:59:34,250 --> 00:59:36,208

of days ago, I sent my wishes, best

1274

00:59:36,208 --> 00:59:39,291

wishes to the producer of Star Trek.

1275

00:59:40,708 --> 00:59:44,375

From 1966, he will turn 100 years old on

1276

00:59:44,375 --> 00:59:47,958

May 1st, 2023. And he responded.

1277

00:59:47,958 --> 00:59:48,666

Wow.

1278

00:59:48,666 --> 00:59:54,416

And I also met a few weeks ago the person

1279

00:59:54,416 --> 00:59:56,791

who wrote the script for Contact.

1280

00:59:56,791 --> 00:59:58,458

Oh, that's one of my favorite ones.

1281

00:59:58,458 --> 01:00:01,791

Jim Hart. And he came to me and said, you

1282

01:00:01,791 --> 01:00:02,958

know, I think of you as

1283

01:00:02,958 --> 01:00:04,416

the successor of Carl Sagan.

1284

01:00:05,791 --> 01:00:08,833

He also said that he believes he spent

1285

01:00:08,833 --> 01:00:10,958

three years with Carl Sagan and his wife,

1286

01:00:10,958 --> 01:00:15,625

Andrea, that the hero in the film Contact

1287

01:00:15,625 --> 01:00:17,333

represents Andrea, he thinks.

1288

01:00:17,333 --> 01:00:19,125

Oh.

1289

01:00:19,125 --> 01:00:22,291

And so it's interesting to see those

1290

01:00:22,291 --> 01:00:24,875

people from the past. And in fact, I'm

1291

01:00:24,875 --> 01:00:29,916

working now with the producer of another

1292

01:00:29,916 --> 01:00:31,875

fantastic film,

1293

01:00:31,875 --> 01:00:32,708

science fiction film Arrival,

1294

01:00:33,875 --> 01:00:36,208

which I like the most, actually, because

1295

01:00:36,208 --> 01:00:40,875

it talks about the challenge of

1296

01:00:40,875 --> 01:00:43,125

communication with something that is

1297

01:00:43,125 --> 01:00:44,625

different than you are.

1298

01:00:44,625 --> 01:00:46,333

That will be the next challenge. You

1299

01:00:46,333 --> 01:00:48,083

know, the first challenge is to find

1300

01:00:48,083 --> 01:00:50,083

something that is not natural to Earth,

1301

01:00:50,083 --> 01:00:53,458

not a bird, not a bug, and

1302

01:00:53,458 --> 01:00:55,708

not also human made like drones,

1303

01:00:56,666 --> 01:00:58,541

balloons of the type that the US

1304

01:00:58,541 --> 01:01:02,250

government shut down, not airplanes. But

1305

01:01:02,250 --> 01:01:04,500

it looks technological and it maneuvers

1306

01:01:04,500 --> 01:01:07,000

in ways that we cannot

1307

01:01:07,000 --> 01:01:09,166

explain using our own technologies.

1308

01:01:09,166 --> 01:01:12,916

So if we find that that will be the first

1309

01:01:12,916 --> 01:01:15,208

revelation, which would be amazing.

1310

01:01:15,208 --> 01:01:17,250

Then the next phase would be more

1311

01:01:17,250 --> 01:01:19,000

challenging. And that would be to figure

1312

01:01:19,000 --> 01:01:22,666

out the intent of such devices, what

1313

01:01:22,666 --> 01:01:23,708

information are they seeking?

1314

01:01:23,791 --> 01:01:26,000

So what do they represent? It's sort of

1315

01:01:26,000 --> 01:01:29,583

like looking at being in a cave.

1316

01:01:29,583 --> 01:01:34,083

I go back to the cave allegory of Plato,

1317

01:01:34,083 --> 01:01:37,083

which was basically dealing with

1318

01:01:37,083 --> 01:01:41,250

prisoners chained to a cave and looking

1319

01:01:41,250 --> 01:01:43,041

at the shadows on the wall in front of

1320

01:01:43,041 --> 01:01:44,708

them from things behind

1321

01:01:44,708 --> 01:01:46,291

them that they cannot see.

1322

01:01:46,791 --> 01:01:50,666

And when we meet devices like AI

1323

01:01:50,666 --> 01:01:54,333

astronauts from other civilizations,

1324

01:01:54,333 --> 01:01:55,291

there would be the

1325

01:01:55,291 --> 01:01:57,625

shadows of the senders.

1326

01:01:57,625 --> 01:01:59,125

There will not be the senders. I don't

1327

01:01:59,125 --> 01:02:01,750

believe we will have an encounter with

1328

01:02:01,750 --> 01:02:03,583

biological creatures because they cannot

1329

01:02:03,583 --> 01:02:04,958

survive the journey over millions of

1330

01:02:04,958 --> 01:02:07,625

years and they need a lot of patience.

1331

01:02:08,291 --> 01:02:09,916

It's much more likely to be a

1332

01:02:09,916 --> 01:02:13,750

technological gadget with AI. And so

1333

01:02:13,750 --> 01:02:16,583

these AI systems, just like we are

1334

01:02:16,583 --> 01:02:20,958

creating AI systems in our image,

1335

01:02:20,958 --> 01:02:22,416

whatever we find from another

1336

01:02:22,416 --> 01:02:24,000

civilization will be in

1337

01:02:24,000 --> 01:02:26,125

the image of the senders.

1338

01:02:26,125 --> 01:02:29,333

And just like the prisoners in Plato's

1339

01:02:29,333 --> 01:02:32,375

allegory of the cave, we are chained to

1340

01:02:32,375 --> 01:02:33,916

earth by gravity. Okay,

1341

01:02:33,916 --> 01:02:35,708

so it's a perfect match.

1342

01:02:36,291 --> 01:02:39,583

This is our cave. We are looking at the

1343

01:02:39,583 --> 01:02:43,166

shadows of the senders of those gadgets.

1344

01:02:43,166 --> 01:02:46,500

And the question is, could we figure out

1345

01:02:46,500 --> 01:02:48,750

what the senders were like?

1346

01:02:48,750 --> 01:02:51,083

At the very least, we can learn something

1347

01:02:51,083 --> 01:02:53,458

about our technological future because

1348

01:02:53,458 --> 01:02:55,333

these AI systems will probably be much

1349

01:02:55,333 --> 01:02:56,708

more advanced than ours.

1350

01:02:57,291 --> 01:03:03,291

So you know, Alan Turing about almost 90

1351

01:03:03,291 --> 01:03:07,375

years ago came up with the imitation game

1352

01:03:07,375 --> 01:03:11,208

of the Turing test, figuring out whether

1353

01:03:11,208 --> 01:03:15,958

a machine is a machine or a person based

1354

01:03:15,958 --> 01:03:19,500

on the interactions, the exchange of

1355

01:03:19,500 --> 01:03:20,708

information that you have with it.

1356

01:03:21,541 --> 01:03:25,291

And the way I see the imitation game is

1357

01:03:25,291 --> 01:03:27,541

between our AI systems and

1358

01:03:27,541 --> 01:03:30,291

extraterrestrial AI systems because once

1359

01:03:30,291 --> 01:03:33,791

they come here, the visitors, we will use

1360

01:03:33,791 --> 01:03:35,041

our AI systems to

1361

01:03:35,041 --> 01:03:37,041

interpret their AI systems.

1362

01:03:37,041 --> 01:03:39,666

And in fact, their AI systems might be so

1363

01:03:39,666 --> 01:03:41,500

much more advanced than ours that ours

1364

01:03:41,500 --> 01:03:43,875

would like to imitate them. And that

1365

01:03:43,875 --> 01:03:44,708

would be the imitation game.

1366

01:03:45,916 --> 01:03:48,291

Very interesting. We've talked a little

1367

01:03:48,291 --> 01:03:52,125

bit about, you know, I think how you've

1368

01:03:52,125 --> 01:03:53,666

got to where you are today. And I think I

1369

01:03:53,666 --> 01:03:56,833

see some of the the corollators with your

1370

01:03:56,833 --> 01:03:58,500

past research and how you've kind of

1371

01:03:58,500 --> 01:04:00,250

taken that bold stance on UAP.

1372

01:04:00,250 --> 01:04:02,916

But people are familiar with that, I

1373

01:04:02,916 --> 01:04:06,083

think people might not be as familiar

1374

01:04:06,083 --> 01:04:08,375

with the earlier past and some of your

1375

01:04:08,375 --> 01:04:09,458

earlier experiences.

1376

01:04:10,458 --> 01:04:14,500

So if we could, I'd love to hear as you

1377

01:04:14,500 --> 01:04:16,583

know, I'm a former military pilot and you

1378

01:04:16,583 --> 01:04:18,458

have some very interesting military

1379

01:04:18,458 --> 01:04:20,458

experiences yourself.

1380

01:04:20,458 --> 01:04:22,083

The big question is, how did that really

1381

01:04:22,083 --> 01:04:23,750

lead to you to where you are today? But

1382

01:04:23,750 --> 01:04:25,416

first, let's talk a little bit about, you

1383

01:04:25,416 --> 01:04:27,833

know, what you experienced in the

1384

01:04:27,833 --> 01:04:28,625

military when you were in Israel.

1385

01:04:29,625 --> 01:04:32,041

Yeah, I'll be glad to. First, I just

1386

01:04:32,041 --> 01:04:34,625

wanted to mention that the Galileo

1387

01:04:34,625 --> 01:04:39,583

project is trying to figure out the

1388

01:04:39,583 --> 01:04:41,041

nature of the objects that you were

1389

01:04:41,041 --> 01:04:42,125

reporting about when

1390

01:04:42,125 --> 01:04:44,708

you were a fighter pilot.

1391

01:04:45,041 --> 01:04:48,875

And so we have an observatory operating

1392

01:04:48,875 --> 01:04:53,666

at Harvard University 24/7 and basically

1393

01:04:53,666 --> 01:04:56,291

taking a full picture of the sky in the

1394

01:04:56,291 --> 01:04:58,708

infrared, the optical band.

1395

01:04:59,166 --> 01:05:02,958

It has a passive radar system and an

1396

01:05:02,958 --> 01:05:07,750

audio system. And we hope to make

1397

01:05:07,750 --> 01:05:09,583

multiple such sensors such that we can

1398

01:05:09,583 --> 01:05:12,791

triangulate in all of these wave bands

1399

01:05:12,791 --> 01:05:14,208

and find the distance to

1400

01:05:14,208 --> 01:05:16,375

objects because that's crucial.

1401

01:05:17,041 --> 01:05:20,583

And then we are currently planning to

1402

01:05:20,583 --> 01:05:23,708

have copies of this first observatory and

1403

01:05:23,708 --> 01:05:25,458

place them in different geographical

1404

01:05:25,458 --> 01:05:27,958

locations. And the number of copies will

1405

01:05:27,958 --> 01:05:29,583

depend on how much funding we have.

1406

01:05:29,583 --> 01:05:31,875

So currently, I received a few million

1407

01:05:31,875 --> 01:05:34,375

dollars from people who came to my home

1408

01:05:34,375 --> 01:05:37,000

during the pandemic and without any

1409

01:05:37,000 --> 01:05:39,500

fundraising offered to

1410

01:05:39,500 --> 01:05:40,708

support this research.

1411

01:05:41,041 --> 01:05:44,208

And we have about 100 people involved in

1412

01:05:44,208 --> 01:05:46,416

the Galileo project with a thousand

1413

01:05:46,416 --> 01:05:49,333

showing interest and so forth.

1414

01:05:49,333 --> 01:05:54,041

But if we get several tens of millions of

1415

01:05:54,041 --> 01:05:56,291

dollars, that would allow us to build

1416

01:05:56,291 --> 01:05:58,958

tens of copies of our first observatory,

1417

01:05:58,958 --> 01:06:00,541

which is operating already.

1418

01:06:00,541 --> 01:06:02,250

So we know exactly what needs to be done.

1419

01:06:02,250 --> 01:06:04,083

We have the expertise. It took us a year

1420

01:06:04,083 --> 01:06:04,958

and a half to build

1421

01:06:04,958 --> 01:06:06,500

it. A lot of hard work.

1422

01:06:07,166 --> 01:06:09,458

So all we are missing is several tens of

1423

01:06:09,458 --> 01:06:12,625

millions of dollars in order to get to

1424

01:06:12,625 --> 01:06:14,833

the bottom of the nature of those

1425

01:06:14,833 --> 01:06:16,958

unidentified objects, because we

1426

01:06:16,958 --> 01:06:18,416

calculated if we have tens of

1427

01:06:18,416 --> 01:06:20,791

observatories spread over the US or

1428

01:06:20,791 --> 01:06:23,000

elsewhere, we should have enough

1429

01:06:23,000 --> 01:06:26,000

statistics to figure out what these

1430

01:06:26,000 --> 01:06:28,583

anomalous objects in the sky might be.

1431

01:06:29,375 --> 01:06:31,791

And we are also analyzing data from

1432

01:06:31,791 --> 01:06:36,041

satellites of planet labs. And so

1433

01:06:36,041 --> 01:06:39,166

altogether, I'm hopeful that with enough

1434

01:06:39,166 --> 01:06:42,125

funding, within a year or two, we will

1435

01:06:42,125 --> 01:06:45,250

have much more information.

1436

01:06:45,250 --> 01:06:48,958

Now, how did I get to this point? I

1437

01:06:48,958 --> 01:06:51,541

started as a farm boy. You know, I was

1438

01:06:51,541 --> 01:06:53,291

very much connected to nature. I grew up

1439

01:06:53,291 --> 01:06:54,333

on a farm. I used to

1440

01:06:54,333 --> 01:06:55,583

collect eggs every afternoon.

1441

01:06:56,041 --> 01:07:00,541

I had two sisters. And in fact, when

1442

01:07:00,541 --> 01:07:02,666

collecting eggs, they forced me to the

1443

01:07:02,666 --> 01:07:04,458

left lane because they were right handed.

1444

01:07:04,458 --> 01:07:06,125

I was also right handed, but I had to

1445

01:07:06,125 --> 01:07:08,291

collect the eggs with my left hand.

1446

01:07:08,291 --> 01:07:12,750

So I was able to do it both ways. And I

1447

01:07:12,750 --> 01:07:15,625

remember finding the chicks when we got

1448

01:07:15,625 --> 01:07:18,250

them to the farm at night with a

1449

01:07:18,250 --> 01:07:20,583

flashlight looking for them, which is

1450

01:07:20,583 --> 01:07:21,750

similar to going with a

1451

01:07:21,750 --> 01:07:23,708

flashlight on Mars now, I guess.

1452

01:07:24,208 --> 01:07:28,541

But then I used to drive the tractor to

1453

01:07:28,541 --> 01:07:31,083

the hills of the village and read the

1454

01:07:31,083 --> 01:07:32,708

philosophy books because I cared about

1455

01:07:32,708 --> 01:07:35,208

the big picture. That was

1456

01:07:35,208 --> 01:07:35,708

the thing that attracted me.

1457

01:07:36,125 --> 01:07:40,083

I read the books on existentialism,

1458

01:07:40,083 --> 01:07:42,541

mainly by French philosophers like Sartre

1459

01:07:42,541 --> 01:07:46,291

or Camus, and really saw my future in

1460

01:07:46,291 --> 01:07:50,958

philosophy because this was the stage

1461

01:07:50,958 --> 01:07:55,041

where the biggest questions were asked.

1462

01:07:55,041 --> 01:07:56,958

Had you been introduced to mathematics to

1463

01:07:56,958 --> 01:07:57,708

a high degree at that point?

1464

01:07:58,166 --> 01:08:00,375

So I learned mathematics and physics in

1465

01:08:00,375 --> 01:08:02,291

high school, and I was very good at it. I

1466

01:08:02,291 --> 01:08:05,333

was at the top of my class. But what I

1467

01:08:05,333 --> 01:08:07,833

cared about are the big questions.

1468

01:08:07,833 --> 01:08:09,916

And in Israel, you have to serve in the

1469

01:08:09,916 --> 01:08:13,291

military. There is no way out. And

1470

01:08:13,291 --> 01:08:15,083

because I was good in math and physics, I

1471

01:08:15,083 --> 01:08:18,458

was selected to a program that allowed me

1472

01:08:18,458 --> 01:08:23,125

to finish a first degree in physics and

1473

01:08:23,125 --> 01:08:25,708

mathematics for three years.

1474

01:08:26,000 --> 01:08:30,375

And then serve five additional years

1475

01:08:30,375 --> 01:08:34,791

developing research projects that are

1476

01:08:34,791 --> 01:08:37,500

useful for the defense of the country.

1477

01:08:37,500 --> 01:08:39,916

And to me, that sounded the closest to

1478

01:08:39,916 --> 01:08:41,750

philosophy that I can do rather than run

1479

01:08:41,750 --> 01:08:43,416

in the fields with a machine gun.

1480

01:08:44,333 --> 01:08:47,125

And so I agreed to go there. And in fact,

1481

01:08:47,125 --> 01:08:49,416

this program was very special because we

1482

01:08:49,416 --> 01:08:53,458

went to all the military sections,

1483

01:08:53,458 --> 01:08:56,458

including the Air Force and the Navy.

1484

01:08:56,458 --> 01:09:00,250

And we drove tanks. I parachuted three

1485

01:09:00,250 --> 01:09:02,791

times, jumped from a plane, and it took a

1486

01:09:02,791 --> 01:09:04,458

few minutes. And of course, we knew what

1487

01:09:04,458 --> 01:09:08,541

to do if the parachute doesn't open up.

1488

01:09:08,541 --> 01:09:09,750

That was very important.

1489

01:09:11,333 --> 01:09:16,125

I was very good at sports among the top

1490

01:09:16,125 --> 01:09:18,791

three of a few thousands in my high

1491

01:09:18,791 --> 01:09:21,958

school. And when I was in the military, I

1492

01:09:21,958 --> 01:09:28,041

was offered to join the Delta Force,

1493

01:09:28,041 --> 01:09:32,000

which is a very challenging...

1494

01:09:32,000 --> 01:09:32,708

Essentially special operations.

1495

01:09:33,458 --> 01:09:36,625

Special operations in Israel. I declined

1496

01:09:36,625 --> 01:09:39,708

it because I was mostly

1497

01:09:39,708 --> 01:09:42,541

interested in the intellectual work.

1498

01:09:42,541 --> 01:09:44,916

And so what I ended up doing is develop a

1499

01:09:44,916 --> 01:09:50,625

new research project at age 21 and

1500

01:09:50,625 --> 01:09:52,791

proposed it to the Strategic Defense

1501  
01:09:52,791 --> 01:09:54,833  
Initiative of Ronald Reagan, President

1502  
01:09:54,833 --> 01:09:56,708  
Reagan, in the mid-1980s.

1503  
01:09:57,750 --> 01:10:01,041  
In fact, General Abramson, who led that

1504  
01:10:01,041 --> 01:10:04,250  
program, came to visit Israel. And I

1505  
01:10:04,250 --> 01:10:06,000  
presented the project to him. In fact, I

1506  
01:10:06,000 --> 01:10:07,791  
have a photograph of him.

1507  
01:10:07,791 --> 01:10:10,916  
I don't think it was ever made public.

1508  
01:10:10,916 --> 01:10:18,125  
That's me here. Sorry, here. And this is

1509  
01:10:18,125 --> 01:10:19,916  
General Abramson looking at my

1510  
01:10:19,916 --> 01:10:20,708  
presentation with a slide projector.

1511  
01:10:21,416 --> 01:10:24,958  
Back then, that was the technology. And

1512  
01:10:24,958 --> 01:10:32,750  
we presented it to him in February 1986.

1513  
01:10:32,750 --> 01:10:36,250

And this was the first international

1514

01:10:36,250 --> 01:10:38,541  
project supported by the US.

1515

01:10:38,541 --> 01:10:42,500  
And that brought me to Washington, D.C.,

1516

01:10:42,500 --> 01:10:45,125  
to visit, because I was still in the

1517

01:10:45,125 --> 01:10:45,708  
military at the time.

1518

01:10:46,750 --> 01:10:48,583  
And in one of the visits, I went to

1519

01:10:48,583 --> 01:10:50,666  
Princeton, the Institute for Advanced

1520

01:10:50,666 --> 01:10:52,833  
Study, because I was told that's a very

1521

01:10:52,833 --> 01:10:54,375  
prestigious place where

1522

01:10:54,375 --> 01:10:57,291  
Albert Einstein was faculty.

1523

01:10:57,291 --> 01:11:00,166  
And I remember the administrators there

1524

01:11:00,166 --> 01:11:02,083  
saying, "We don't allow anyone to come

1525

01:11:02,083 --> 01:11:03,500  
here for a visit.

1526

01:11:03,500 --> 01:11:05,625

Please send me your CV."

1527

01:11:05,625 --> 01:11:07,791

And I sent the list of publications. I

1528

01:11:07,791 --> 01:11:11,500

had 11 publications by then. And it was

1529

01:11:11,500 --> 01:11:12,125

almost at the

1530

01:11:12,125 --> 01:11:12,708

completion of my PhD thesis.

1531

01:11:13,666 --> 01:11:16,375

And by now, I have more than a thousand.

1532

01:11:16,375 --> 01:11:19,666

But back then, it was just the beginning.

1533

01:11:19,666 --> 01:11:21,916

And she allowed me to come over.

1534

01:11:21,916 --> 01:11:23,708

And she said, "Well, you know, there is

1535

01:11:23,708 --> 01:11:26,125

only one faculty member who has plenty of

1536

01:11:26,125 --> 01:11:27,250

time. All the others are

1537

01:11:27,250 --> 01:11:31,208

busy. His name is Freeman Dyson."

1538

01:11:31,208 --> 01:11:33,916

And so she introduced me to Freeman. And

1539

01:11:33,916 --> 01:11:35,875

Freeman said, "You know, there is a

1540

01:11:35,875 --> 01:11:37,833

faculty person here that

1541

01:11:37,833 --> 01:11:38,708

is married to an Israeli.

1542

01:11:39,750 --> 01:11:42,625

His name is John Bacall. And he loves to

1543

01:11:42,625 --> 01:11:45,416

spek Hebrew. Do you know him?" And I

1544

01:11:45,416 --> 01:11:47,791

said, "No, I've never heard of him,

1545

01:11:47,791 --> 01:11:49,833

because I never worked in astrophysics.

1546

01:11:49,833 --> 01:11:51,916

I worked in plasma physics. That was the

1547

01:11:51,916 --> 01:11:54,541

project. We actually had a

1548

01:11:54,541 --> 01:11:56,541

patent also on the project."

1549

01:11:57,458 --> 01:12:00,833

Anyway, Freeman picked up the phone and

1550

01:12:00,833 --> 01:12:03,000

called John and said, "There is an

1551

01:12:03,000 --> 01:12:04,833

Israeli here visiting. Do you have a few

1552

01:12:04,833 --> 01:12:06,375

minutes to meet with him?" And John said,

1553

01:12:06,375 --> 01:12:10,125

"Yeah, why don't we have him for lunch?"

1554

01:12:10,125 --> 01:12:11,916

And then he invited me for a month and

1555

01:12:11,916 --> 01:12:14,125

then ended up offering me a five-year

1556

01:12:14,125 --> 01:12:16,250

fellowship, which was a huge risk from

1557

01:12:16,250 --> 01:12:18,833

his perspective, because I had no track

1558

01:12:18,833 --> 01:12:19,708

record in astrophysics.

1559

01:12:20,291 --> 01:12:22,958

I didn't know how the sun shines. And

1560

01:12:22,958 --> 01:12:25,791

John's main contribution to astronomy was

1561

01:12:25,791 --> 01:12:29,291

to explain how the sun shines and to

1562

01:12:29,291 --> 01:12:31,458

predict how many neutrinos should be

1563

01:12:31,458 --> 01:12:34,416

emitted per unit time from the sun, which

1564

01:12:34,416 --> 01:12:35,500

didn't agree with data.

1565

01:12:35,500 --> 01:12:37,041

And then it was interpreted in terms of

1566

01:12:37,041 --> 01:12:39,166

the mass of the neutrino. But at any

1567

01:12:39,166 --> 01:12:41,541

event, it was very embarrassing for me to

1568

01:12:41,541 --> 01:12:44,000

enter a new field after my military

1569

01:12:44,000 --> 01:12:46,291

service, not knowing anything, because

1570

01:12:46,291 --> 01:12:47,708

Princeton was very competitive.

1571

01:12:48,208 --> 01:12:50,458

And I had to learn the vocabulary from

1572

01:12:50,458 --> 01:12:54,458

scratch. It felt like there is a thing.

1573

01:12:54,458 --> 01:12:56,041

You were learning English at this point

1574

01:12:56,041 --> 01:12:57,250

when you say learning vocabulary?

1575

01:12:57,250 --> 01:12:59,958

I know. Vocabulary of astrophysics. I

1576

01:12:59,958 --> 01:13:02,708

knew English not very well, but I knew

1577

01:13:02,708 --> 01:13:06,291

some of it. Now I'm a writer. But back

1578

01:13:06,291 --> 01:13:08,416

then, it took me a while to start

1579

01:13:08,416 --> 01:13:09,583

dreaming in English. I

1580

01:13:09,583 --> 01:13:11,708

dreamt in Hebrew for a while.

1581

01:13:13,291 --> 01:13:18,333

Anyway, so after five years at Princeton,

1582

01:13:18,333 --> 01:13:20,000

where I learned the vocabulary of

1583

01:13:20,000 --> 01:13:22,916

astrophysics, I had basically to invent

1584

01:13:22,916 --> 01:13:25,083

myself, because nobody guided me as to

1585

01:13:25,083 --> 01:13:26,833

which areas are most interesting.

1586

01:13:26,833 --> 01:13:30,583

And therefore, I decided when I received

1587

01:13:30,583 --> 01:13:32,958

an offer from Harvard University, I mean,

1588

01:13:32,958 --> 01:13:34,875

at the time, nobody was tenured at

1589

01:13:34,875 --> 01:13:37,041

Harvard from within for about 20 years.

1590

01:13:37,041 --> 01:13:37,708

They didn't tenure anyone.

1591

01:13:38,375 --> 01:13:40,833

So nobody wanted the job, the dream of...

1592

01:13:40,833 --> 01:13:42,833

In fact, they offered it to someone who

1593

01:13:42,833 --> 01:13:43,416

declined it and then they

1594

01:13:43,416 --> 01:13:45,458

said, "Okay, we'll go for Avi."

1595

01:13:45,458 --> 01:13:48,375

So I was the second in line. They gave me

1596

01:13:48,375 --> 01:13:51,458

the offer and I was not worried because I

1597

01:13:51,458 --> 01:13:52,833

could always go back to the

1598

01:13:52,833 --> 01:13:57,583

farm, my father's life work.

1599

01:13:57,583 --> 01:14:01,791

And there was nobody to continue the work

1600

01:14:01,791 --> 01:14:04,208

on the farm. And I was

1601

01:14:04,208 --> 01:14:05,500

very happy to do that.

1602

01:14:06,958 --> 01:14:09,708

My mother was into linguistics philosophy

1603

01:14:09,708 --> 01:14:13,000

at the time. And that's, you know, a lot

1604

01:14:13,000 --> 01:14:15,541

of my inspiration came from her,

1605

01:14:15,541 --> 01:14:17,958

basically, the intellectual curiosity.

1606

01:14:17,958 --> 01:14:20,875

But at any event, I went to Harvard

1607

01:14:20,875 --> 01:14:24,250

because I had plan B to go back to the

1608

01:14:24,250 --> 01:14:26,625

farm. I didn't worry about job security.

1609

01:14:27,250 --> 01:14:34,500

I was tenured three years later because

1610

01:14:34,500 --> 01:14:36,708

Cornell was looking for someone and they

1611

01:14:36,708 --> 01:14:40,291

made me a tenured offer.

1612

01:14:40,291 --> 01:14:43,583

And then Harvard came forward six months

1613

01:14:43,583 --> 01:14:44,250

later and offered me

1614

01:14:44,250 --> 01:14:46,208  
a tenured appointment.

1615

01:14:46,208 --> 01:14:48,666  
So altogether, you know, I

1616

01:14:48,666 --> 01:14:51,708  
ended up in an arranged marriage.

1617

01:14:52,416 --> 01:14:55,000  
And at the time when I got tenure, I

1618

01:14:55,000 --> 01:14:56,916  
realized that even though it was

1619

01:14:56,916 --> 01:14:59,875  
arranged, I'm married to my true love

1620

01:14:59,875 --> 01:15:01,541  
because there are some fundamental

1621

01:15:01,541 --> 01:15:03,875  
questions in astrophysics that I can

1622

01:15:03,875 --> 01:15:05,958  
explore using the scientific method.

1623

01:15:05,958 --> 01:15:06,875  
And I'm very

1624

01:15:06,875 --> 01:15:08,958  
different than my colleagues.

1625

01:15:08,958 --> 01:15:11,125  
Now, in 2011, I became chair of the

1626  
01:15:11,125 --> 01:15:12,750  
astronomy department at Harvard and

1627  
01:15:12,750 --> 01:15:14,250  
served for nine years,

1628  
01:15:14,250 --> 01:15:15,708  
the longest serving chair.

1629  
01:15:15,875 --> 01:15:17,625  
I'm still the director of the Institute

1630  
01:15:17,625 --> 01:15:20,416  
for Theory and Computation for about

1631  
01:15:20,416 --> 01:15:22,208  
almost 20 years now.

1632  
01:15:22,208 --> 01:15:24,291  
And I was the founding director of the

1633  
01:15:24,291 --> 01:15:26,083  
Black Hole Initiative at Harvard.

1634  
01:15:26,083 --> 01:15:28,666  
And so I was very much

1635  
01:15:28,666 --> 01:15:31,083  
part of the establishment.

1636  
01:15:31,083 --> 01:15:32,791  
And moreover, I chaired the board on

1637  
01:15:32,791 --> 01:15:33,666  
physics and astronomy of

1638  
01:15:33,666 --> 01:15:34,708

the National Academies.

1639

01:15:35,416 --> 01:15:42,458

And I was a member of the board of

1640

01:15:42,458 --> 01:15:45,333

science and technology advisors of the US

1641

01:15:45,333 --> 01:15:47,375

president at the White House.

1642

01:15:47,375 --> 01:15:52,291

And so I served on many important boards.

1643

01:15:52,291 --> 01:15:55,666

I also chaired the scientific advisory

1644

01:15:55,666 --> 01:15:58,000

board for the Star Shot project, which is

1645

01:15:58,000 --> 01:16:00,041

to send a probe to the nearest star

1646

01:16:00,041 --> 01:16:01,708

within a human's lifetime.

1647

01:16:02,083 --> 01:16:06,750

And that's where I got introduced to the

1648

01:16:06,750 --> 01:16:09,416

concept of a light sail, because that's

1649

01:16:09,416 --> 01:16:11,041

the only technology that would allow us

1650

01:16:11,041 --> 01:16:11,833

to reach a fraction

1651

01:16:11,833 --> 01:16:13,375

of the speed of light.

1652

01:16:13,375 --> 01:16:15,625

And whether there is a probe moving at

1653

01:16:15,625 --> 01:16:17,708

that speed through the solar system is

1654

01:16:17,708 --> 01:16:18,958

still an open question because

1655

01:16:18,958 --> 01:16:19,791

astronomers would not

1656

01:16:19,791 --> 01:16:21,750

notice it, by the way.

1657

01:16:21,750 --> 01:16:23,416

It would just appear in one image and

1658

01:16:23,416 --> 01:16:26,208

then they would dismiss it because most

1659

01:16:26,208 --> 01:16:28,125

of the rocks move at the speed that is

1660

01:16:28,125 --> 01:16:28,708

10,000 times smaller.

1661

01:16:29,416 --> 01:16:31,916

So anything moving so fast, close to the

1662

01:16:31,916 --> 01:16:33,000

speed of light would

1663

01:16:33,000 --> 01:16:36,791

not be even analyzed.

1664

01:16:36,791 --> 01:16:39,083

So anyway, altogether I was

1665

01:16:39,083 --> 01:16:40,041

part of the establishment.

1666

01:16:40,041 --> 01:16:42,000

But then in 2017,

1667

01:16:42,000 --> 01:16:44,500

Oumuamua was discovered.

1668

01:16:44,500 --> 01:16:47,541

And I should say about Oumuamua that when

1669

01:16:47,541 --> 01:16:50,000

I suggested that it may be a very thin

1670

01:16:50,000 --> 01:16:52,625

object, it sounded far fetched.

1671

01:16:52,625 --> 01:16:52,708

Why would it be so thin?

1672

01:16:53,541 --> 01:16:56,500

But then three years later, the same

1673

01:16:56,500 --> 01:16:58,583

telescope in Hawaii, Pan-STARRS,

1674

01:16:58,583 --> 01:17:00,791

discovered another object which was

1675

01:17:00,791 --> 01:17:01,833

pushed away from the sun

1676

01:17:01,833 --> 01:17:03,250

by reflecting sunlight.

1677

01:17:03,250 --> 01:17:06,458

They verified that and had no cometary

1678

01:17:06,458 --> 01:17:08,208

tail, no cometary evaporation.

1679

01:17:08,208 --> 01:17:10,916

It was given the name 2020SO,

1680

01:17:10,916 --> 01:17:13,916

discovered in September 2020.

1681

01:17:13,916 --> 01:17:16,083

And then within a few weeks, the

1682

01:17:16,083 --> 01:17:17,666

astronomers realized, oh,

1683

01:17:17,666 --> 01:17:18,708

it actually came from Earth.

1684

01:17:18,833 --> 01:17:22,000

But if you go back in time, it was a

1685

01:17:22,000 --> 01:17:24,333

rocket booster that was launched by NASA

1686

01:17:24,333 --> 01:17:26,541

in 1966 as part of a

1687

01:17:26,541 --> 01:17:28,500

lunar lander mission.

1688

01:17:28,500 --> 01:17:31,166

It's called 2020SO. It has a Wikipedia

1689

01:17:31,166 --> 01:17:32,958

page. You can check it.

1690

01:17:32,958 --> 01:17:36,250

And that was an object that we produced.

1691

01:17:36,250 --> 01:17:37,333

And we know that it was

1692

01:17:37,333 --> 01:17:39,500

made of stainless steel.

1693

01:17:39,500 --> 01:17:41,625

That's why it didn't evaporate.

1694

01:17:41,625 --> 01:17:44,125

There was no coma around it.

1695

01:17:44,125 --> 01:17:45,708

And it had thin walls.

1696

01:17:45,875 --> 01:17:46,958

That's why it was pushed

1697

01:17:46,958 --> 01:17:49,291

by reflecting sunlight.

1698

01:17:49,291 --> 01:17:53,416

So here is the technological object that

1699

01:17:53,416 --> 01:17:55,958

is artificial, not a rock.

1700

01:17:55,958 --> 01:17:58,666

And we know that because we made it.

1701

01:17:58,666 --> 01:18:02,000

The question is, who made Oumuamua?

1702

01:18:02,000 --> 01:18:03,250

And that's a fundamental question.

1703

01:18:03,250 --> 01:18:05,583

So here is an example that my background

1704

01:18:05,583 --> 01:18:09,958

in philosophy helped me focus on

1705

01:18:09,958 --> 01:18:12,041

questions that have a big impact on the

1706

01:18:12,041 --> 01:18:13,666

future, on our future,

1707

01:18:14,833 --> 01:18:16,416

which are not necessarily popular.

1708

01:18:16,416 --> 01:18:17,250

That's the strange thing.

1709

01:18:17,250 --> 01:18:19,708

I told my wife, look, this is amazing.

1710

01:18:19,708 --> 01:18:21,125

Here is a subject that

1711

01:18:21,125 --> 01:18:23,666

would impact humanity greatly.

1712

01:18:23,666 --> 01:18:26,000

Yet all of my colleagues

1713

01:18:26,000 --> 01:18:27,791

in academia are ignoring it.

1714

01:18:27,791 --> 01:18:29,791

Makes no sense whatsoever.

1715

01:18:29,791 --> 01:18:32,583

And just, you know, if you want, we live

1716

01:18:32,583 --> 01:18:33,583

for such a short time.

1717

01:18:33,583 --> 01:18:37,416

Let's focus on substance, you know, the

1718

01:18:37,416 --> 01:18:38,375

nature of dark matter,

1719

01:18:38,375 --> 01:18:40,000

even though we invested billions of

1720

01:18:40,000 --> 01:18:41,791

dollars in searching for the dark matter,

1721

01:18:41,791 --> 01:18:42,708

we haven't found it.

1722

01:18:43,375 --> 01:18:44,875

But the nature of dark matter, we have

1723

01:18:44,875 --> 01:18:47,875

very little impact on our lives.

1724

01:18:47,875 --> 01:18:50,791

And yet not even a percent of that money

1725

01:18:50,791 --> 01:18:52,583

was invested in the search for objects

1726

01:18:52,583 --> 01:18:56,208

near Earth in a scientific fashion.

1727

01:18:56,208 --> 01:18:58,916

That's why we have the Galileo Project.

1728

01:18:58,916 --> 01:19:00,583

So, you know, we talked a little bit

1729

01:19:00,583 --> 01:19:03,208

about how I think your goal with Galileo

1730

01:19:03,208 --> 01:19:04,541

is to perhaps be able to

1731

01:19:04,541 --> 01:19:06,000

look beyond our atmosphere

1732

01:19:06,000 --> 01:19:07,375

and be able to link what's happening

1733

01:19:07,375 --> 01:19:08,791

outside the universe to potentially

1734

01:19:08,791 --> 01:19:09,541

what's happening with

1735

01:19:09,541 --> 01:19:11,708

UAP in our atmosphere.

1736

01:19:11,833 --> 01:19:13,791

Is that fair? Do you think we can really

1737

01:19:13,791 --> 01:19:15,583

ever figure out the origin and understand

1738

01:19:15,583 --> 01:19:16,833

UAP only looking at

1739

01:19:16,833 --> 01:19:18,291  
them in our atmosphere?

1740

01:19:18,291 --> 01:19:21,166  
Well, so there are two types of objects

1741

01:19:21,166 --> 01:19:22,750  
that we may expect from an

1742

01:19:22,750 --> 01:19:24,250  
extraterrestrial origin.

1743

01:19:24,250 --> 01:19:26,833  
And I should tell you that I was at the

1744

01:19:26,833 --> 01:19:27,875  
Washington National

1745

01:19:27,875 --> 01:19:29,958  
Cathedral for the Ignatius Forum

1746

01:19:29,958 --> 01:19:33,125  
together with the Director of National

1747

01:19:33,125 --> 01:19:34,416  
Intelligence, Ariel Haynes,

1748

01:19:35,666 --> 01:19:37,166  
who was actually about five months after

1749

01:19:37,166 --> 01:19:38,958  
she delivered the first report to the

1750

01:19:38,958 --> 01:19:40,500  
U.S. Congress about

1751

01:19:40,500 --> 01:19:42,875

unidentified aerial phenomena.

1752

01:19:42,875 --> 01:19:45,291

There was also Jeff Bezos in the green

1753

01:19:45,291 --> 01:19:47,375

room, but I approached Avril because she

1754

01:19:47,375 --> 01:19:50,708

has a bachelor degree in physics from the

1755

01:19:50,708 --> 01:19:51,458

University of Chicago.

1756

01:19:51,458 --> 01:19:53,791

So she speaks my language.

1757

01:19:53,791 --> 01:19:56,375

And so I went to her and I said, these

1758

01:19:56,375 --> 01:19:59,166

objects that you reported about, what is

1759

01:19:59,166 --> 01:20:00,708

your hunch? What are they?

1760

01:20:01,291 --> 01:20:04,208

And she said, I don't know. And I believe

1761

01:20:04,208 --> 01:20:08,166

her because I think the government sees

1762

01:20:08,166 --> 01:20:09,583

things they don't fully understand.

1763

01:20:09,583 --> 01:20:12,000

It's impossible from anecdotal data to

1764

01:20:12,000 --> 01:20:16,208

figure out what this data represents.

1765

01:20:16,208 --> 01:20:18,000

And the only way to figure it out is

1766

01:20:18,000 --> 01:20:20,291

through a systematic survey of the sky

1767

01:20:20,291 --> 01:20:22,083

with the best instruments we have

1768

01:20:22,083 --> 01:20:24,666

currently and getting new data,

1769

01:20:24,666 --> 01:20:26,333

which is pretty much the philosophy of

1770

01:20:26,333 --> 01:20:27,708

the Galileo project.

1771

01:20:28,791 --> 01:20:31,291

We don't want to rely on past data

1772

01:20:31,291 --> 01:20:33,416

because it was compromised. It was not

1773

01:20:33,416 --> 01:20:36,291

intentional, the search.

1774

01:20:36,291 --> 01:20:39,291

And we want to calibrate the instruments

1775

01:20:39,291 --> 01:20:41,125

we're using to have them under full

1776

01:20:41,125 --> 01:20:42,333

control so that we can

1777

01:20:42,333 --> 01:20:44,791

reproduce whatever is out there.

1778

01:20:44,791 --> 01:20:47,541

And one thing about reports is that they

1779

01:20:47,541 --> 01:20:50,000

correlate with the population density,

1780

01:20:50,000 --> 01:20:51,375

those from civilians.

1781

01:20:51,375 --> 01:20:52,416

There is no other

1782

01:20:52,416 --> 01:20:53,708

correlation if you look at it.

1783

01:20:54,541 --> 01:20:57,416

And basically, they represent a number of

1784

01:20:57,416 --> 01:20:59,208

eyes looking at the sky.

1785

01:20:59,208 --> 01:21:04,000

And to me, that says one thing, that

1786

01:21:04,000 --> 01:21:06,083

unidentified objects may be everywhere.

1787

01:21:06,083 --> 01:21:08,416

And if you think about it, it could be

1788

01:21:08,416 --> 01:21:10,916

balloons. Balloons are everywhere.

1789

01:21:10,916 --> 01:21:12,333

And when you look

1790

01:21:12,333 --> 01:21:13,500

around, you would see balloons.

1791

01:21:13,500 --> 01:21:15,458

Now, the director of National

1792

01:21:15,458 --> 01:21:18,875

Intelligence Report did mention the

1793

01:21:18,875 --> 01:21:21,541

recent one from 2022 that about half of

1794

01:21:21,541 --> 01:21:22,708

the objects may be balloons.

1795

01:21:24,708 --> 01:21:27,083

From the government's perspective, of

1796

01:21:27,083 --> 01:21:30,666

course, the key question is, do they pose

1797

01:21:30,666 --> 01:21:32,166

a national security threat?

1798

01:21:32,166 --> 01:21:34,666

And because they worry about the safety

1799

01:21:34,666 --> 01:21:35,583

of the nation, the

1800

01:21:35,583 --> 01:21:38,333

safety of military personnel.

1801

01:21:38,333 --> 01:21:40,500

And of course, for that, they need to

1802

01:21:40,500 --> 01:21:43,791

understand what all the objects are.

1803

01:21:43,791 --> 01:21:45,041

And sometimes they

1804

01:21:45,041 --> 01:21:45,708

need to shoot them down.

1805

01:21:47,500 --> 01:21:50,916

To me, from a scientist's perspective, if

1806

01:21:50,916 --> 01:21:52,791

the government shoots down objects, it's

1807

01:21:52,791 --> 01:21:54,541

great because first it protects the

1808

01:21:54,541 --> 01:21:55,541

nation, but also it

1809

01:21:55,541 --> 01:21:57,041

reduces the clutter in the sky.

1810

01:21:57,041 --> 01:21:59,583

So it reduces the level of noise that

1811

01:21:59,583 --> 01:22:01,083

they have to deal with.

1812

01:22:01,083 --> 01:22:03,333

But as a scientist, I want to know

1813

01:22:03,333 --> 01:22:06,208

whether even one object out of hundreds

1814

01:22:06,208 --> 01:22:08,333  
is from an extraterrestrial origin.

1815

01:22:08,333 --> 01:22:09,583  
And that possibility, as

1816

01:22:09,583 --> 01:22:10,708  
of now, is not ruled out.

1817

01:22:11,500 --> 01:22:15,291  
In fact, Avril related to that. She

1818

01:22:15,291 --> 01:22:17,416  
mentioned the word extraterrestrial in

1819

01:22:17,416 --> 01:22:20,333  
her discussion in

1820

01:22:20,333 --> 01:22:22,375  
Washington when I was there.

1821

01:22:22,375 --> 01:22:23,875  
The other thing that happened was I was

1822

01:22:23,875 --> 01:22:26,333  
sitting next to her when Jeff Bezos was

1823

01:22:26,333 --> 01:22:28,708  
talking about the fact that he was

1824

01:22:28,708 --> 01:22:29,458  
inspired by watching

1825

01:22:29,458 --> 01:22:31,750  
as a kid, the Star Trek,

1826

01:22:31,750 --> 01:22:33,333

inspired to go into space, to venture

1827

01:22:33,333 --> 01:22:35,291

into space and establish

1828

01:22:35,291 --> 01:22:35,708

blue origins and so forth.

1829

01:22:36,333 --> 01:22:40,000

And I told Avril, "Well, I never liked

1830

01:22:40,000 --> 01:22:42,708

science fiction. I enjoyed doing science,

1831

01:22:42,708 --> 01:22:46,250

but I separated from fiction.

1832

01:22:46,250 --> 01:22:48,625

And when I see in science fiction a

1833

01:22:48,625 --> 01:22:49,791

violation of the laws of

1834

01:22:49,791 --> 01:22:52,083

physics, it bothers me.

1835

01:22:52,083 --> 01:22:53,125

It doesn't look real

1836

01:22:53,125 --> 01:22:54,958

and I cannot enjoy it."

1837

01:22:54,958 --> 01:22:56,875

And she said, "Avril,

1838

01:22:56,875 --> 01:22:59,791

we have to work on you."

1839

01:22:59,791 --> 01:23:03,708

But, you know, let me explain, actually.

1840

01:23:04,666 --> 01:23:08,708

The reason I'm reluctant to consider new

1841

01:23:08,708 --> 01:23:12,875

physics is because the known physics

1842

01:23:12,875 --> 01:23:15,125

explains so much and is being

1843

01:23:15,125 --> 01:23:18,083

tested so much that, in fact,

1844

01:23:18,083 --> 01:23:20,583

physicists in laboratories worked for

1845

01:23:20,583 --> 01:23:23,708

decades to tease out a tiny deviation

1846

01:23:23,708 --> 01:23:24,708

from what we know about physics.

1847

01:23:25,583 --> 01:23:29,250

And fundamental particle physics did not

1848

01:23:29,250 --> 01:23:32,666

discover anything fundamentally new over

1849

01:23:32,666 --> 01:23:36,416

the past maybe several decades.

1850

01:23:36,416 --> 01:23:38,333

I mean, the Higgs boson was found, but

1851

01:23:38,333 --> 01:23:41,791

it's old news because it was believed

1852

01:23:41,791 --> 01:23:44,708

that it must exist already from the '60s.

1853

01:23:45,291 --> 01:23:48,541

But nothing really fundamentally new

1854

01:23:48,541 --> 01:23:52,333

about the universe was discovered in

1855

01:23:52,333 --> 01:23:54,541

laboratories and it shows you how

1856

01:23:54,541 --> 01:23:57,250

difficult it is to discover new physics.

1857

01:23:57,250 --> 01:24:00,583

And in order to argue that what you see

1858

01:24:00,583 --> 01:24:01,500

represents new physics, you

1859

01:24:01,500 --> 01:24:03,583

need to have exquisite data.

1860

01:24:03,583 --> 01:24:05,250

You need to have the best data so that

1861

01:24:05,250 --> 01:24:07,208

you rule out all

1862

01:24:07,208 --> 01:24:08,708

interpretations based on known physics.

1863

01:24:09,958 --> 01:24:12,458

However, in the public, the

1864

01:24:12,458 --> 01:24:15,583

conception is very different.

1865

01:24:15,583 --> 01:24:18,416

People may argue that if you see a hole

1866

01:24:18,416 --> 01:24:22,750

in the clouds, it may be a wormhole, a

1867

01:24:22,750 --> 01:24:24,625

tunnel in space-time that allows you to

1868

01:24:24,625 --> 01:24:26,958

move faster than light.

1869

01:24:26,958 --> 01:24:30,041

Of course, it allows for a wormhole, but

1870

01:24:30,041 --> 01:24:30,708

it's not evidence for a wormhole.

1871

01:24:31,750 --> 01:24:35,916

Evidence in science for new physics means

1872

01:24:35,916 --> 01:24:38,500

that you have such good data that you can

1873

01:24:38,500 --> 01:24:41,291

rule out a meteorological

1874

01:24:41,291 --> 01:24:43,083

origin for the hole in the clouds.

1875

01:24:43,083 --> 01:24:44,791

You have to understand what is happening

1876

01:24:44,791 --> 01:24:47,291

there to exquisite precision.

1877

01:24:47,291 --> 01:24:49,666

You can't go to a place for a day, see

1878

01:24:49,666 --> 01:24:50,541

something unusual and

1879

01:24:50,541 --> 01:24:50,708

claim, "Oh, that's a miracle."

1880

01:24:51,916 --> 01:24:54,875

I mean, of course, if someone would claim

1881

01:24:54,875 --> 01:24:58,416

that they see a burning bush like Moses

1882

01:24:58,416 --> 01:25:02,708

did in the Bible, the Old Testament,

1883

01:25:02,708 --> 01:25:05,083

I would argue we should send infrared

1884

01:25:05,083 --> 01:25:06,125

cameras to figure out

1885

01:25:06,125 --> 01:25:08,666

what this burning bush is.

1886

01:25:08,666 --> 01:25:13,416

Okay, so with present-day science, it's

1887

01:25:13,416 --> 01:25:14,708

instruments that count.

1888

01:25:15,291 --> 01:25:21,291

And for the soccer World Cup in Qatar,

1889

01:25:21,291 --> 01:25:24,250

FIFA established a semi-automatic

1890

01:25:24,250 --> 01:25:27,833

procedure using cameras and artificial

1891

01:25:27,833 --> 01:25:32,041

intelligence to figure out offsides.

1892

01:25:32,041 --> 01:25:37,708

So instead of relying on referees or the

1893

01:25:37,708 --> 01:25:39,250

audience or the players, whether there

1894

01:25:39,250 --> 01:25:41,125

was an offside, they

1895

01:25:41,125 --> 01:25:41,708

have an automated system.

1896

01:25:42,500 --> 01:25:45,041

Why? Because when there is a car

1897

01:25:45,041 --> 01:25:47,583

accident, you can't really rely on the

1898

01:25:47,583 --> 01:25:49,458

people involved as to what happened

1899

01:25:49,458 --> 01:25:50,416

because they give

1900

01:25:50,416 --> 01:25:53,333

conflicting reports to the same event.

1901

01:25:53,333 --> 01:25:56,958

And so think of the Galileo project as

1902

01:25:56,958 --> 01:25:59,791

the same tool that FIFA is using to

1903

01:25:59,791 --> 01:26:00,708

decide about offsides.

1904

01:26:01,833 --> 01:26:03,791

The Galileo project is building an

1905

01:26:03,791 --> 01:26:09,041

assembly of instruments that will give us

1906

01:26:09,041 --> 01:26:11,791

confidence in our conclusions and allow

1907

01:26:11,791 --> 01:26:14,416

us to infer in an objective manner using

1908

01:26:14,416 --> 01:26:15,791

computer algorithms,

1909

01:26:15,791 --> 01:26:17,083

what we are looking at

1910

01:26:17,083 --> 01:26:19,250

and what really happened.

1911

01:26:19,250 --> 01:26:23,166

And if FIFA realizes it, we should all

1912

01:26:23,166 --> 01:26:26,333

realize it about unusual objects in space

1913

01:26:26,333 --> 01:26:27,916

because if we were to rely

1914

01:26:27,916 --> 01:26:28,708

on eyewitness testimonies,

1915

01:26:29,500 --> 01:26:31,250

we'll end up with the same situation as

1916

01:26:31,250 --> 01:26:32,916

we end up in the courtroom where people

1917

01:26:32,916 --> 01:26:36,208

are put in jail and then DNA testing

1918

01:26:36,208 --> 01:26:37,583

shows that they were innocent.

1919

01:26:37,583 --> 01:26:38,666

Let me ask you a question

1920

01:26:38,666 --> 01:26:40,833

about your soccer example.

1921

01:26:40,833 --> 01:26:43,833

In that example, with the automation,

1922

01:26:43,833 --> 01:26:45,500

someone who was not familiar with that

1923

01:26:45,500 --> 01:26:48,416

game might infer that there was some type

1924

01:26:48,416 --> 01:26:52,958

of magic or influence that was causing

1925

01:26:52,958 --> 01:26:54,791

that determination if someone was

1926

01:26:54,791 --> 01:26:55,708

offsides or not to happen.

1927

01:26:56,500 --> 01:26:58,916

But from our perspective, it's clever

1928

01:26:58,916 --> 01:27:01,083

engineering versus something miraculous.

1929

01:27:01,083 --> 01:27:04,416

So in the conversation about new physics

1930

01:27:04,416 --> 01:27:06,833

versus what we're seeing, how do we know

1931

01:27:06,833 --> 01:27:09,583

we're not just observing clever physics

1932

01:27:09,583 --> 01:27:10,916

versus, excuse me, clever

1933

01:27:10,916 --> 01:27:12,708

engineering versus new physics?

1934

01:27:12,708 --> 01:27:14,000

And where's the line?

1935

01:27:14,000 --> 01:27:16,708

Well, so far we have no evidence for new

1936

01:27:16,708 --> 01:27:21,666

physics because what I'm trying to say is

1937

01:27:21,666 --> 01:27:24,000

that to have evidence for new physics,

1938

01:27:24,000 --> 01:27:24,708

you need extremely good data.

1939

01:27:25,500 --> 01:27:27,958

You can't just argue that you see dark

1940

01:27:27,958 --> 01:27:30,541

objects in the sky that you can infer the

1941

01:27:30,541 --> 01:27:32,875

distance to using an approximate method,

1942

01:27:32,875 --> 01:27:34,958

as some astronomers in

1943

01:27:34,958 --> 01:27:36,791

Ukraine were trying to do.

1944

01:27:36,791 --> 01:27:38,875

And they argue that these objects are

1945

01:27:38,875 --> 01:27:41,375

moving faster than the escape speed from

1946

01:27:41,375 --> 01:27:44,000

the Earth, 15 kilometers per second at a

1947

01:27:44,000 --> 01:27:45,666

distance of 10 kilometers.

1948

01:27:45,666 --> 01:27:47,041

And they were saying these objects are

1949

01:27:47,041 --> 01:27:50,708

the size of an airplane, like 10 meters.

1950

01:27:51,333 --> 01:27:55,250

And I said, well, you know, if there were

1951

01:27:55,250 --> 01:27:56,541

objects moving through the atmosphere and

1952

01:27:56,541 --> 01:27:59,291

they were blocking light, that's what

1953

01:27:59,291 --> 01:28:01,166

these dark objects should have been

1954

01:28:01,166 --> 01:28:03,666

doing, blocking light, then they interact

1955

01:28:03,666 --> 01:28:06,291

also with molecules electromagnetically,

1956

01:28:06,291 --> 01:28:07,833

because if they block light, they

1957

01:28:07,833 --> 01:28:08,708

interact electromagnetically.

1958

01:28:09,458 --> 01:28:12,083

And so there is no way out from them

1959

01:28:12,083 --> 01:28:13,791

producing a fireball, just the way

1960

01:28:13,791 --> 01:28:18,083

meteors do because of these speeds and

1961

01:28:18,083 --> 01:28:20,166

they would not look dark. So the fact

1962

01:28:20,166 --> 01:28:22,791

that these objects look dark already sets

1963

01:28:22,791 --> 01:28:25,875

a maximum distance from the observer.

1964

01:28:25,875 --> 01:28:28,791

And if, on the other hand, the Ukrainian

1965

01:28:28,791 --> 01:28:31,833

astronomers would have triangulation,

1966

01:28:31,833 --> 01:28:32,541

then it would be a

1967

01:28:32,541 --> 01:28:34,708

much more convincing case.

1968

01:28:35,125 --> 01:28:37,625

They did have triangulation for other

1969

01:28:37,625 --> 01:28:39,958

objects, and those ended up being at

1970

01:28:39,958 --> 01:28:40,916

exactly the elevation that

1971

01:28:40,916 --> 01:28:43,375

you expect spy satellites to be.

1972

01:28:43,375 --> 01:28:47,000

So I say, well, your bright objects may

1973

01:28:47,000 --> 01:28:49,291

be satellites, because that's the

1974

01:28:49,291 --> 01:28:51,750

distance that they hover above the Earth.

1975

01:28:51,750 --> 01:28:53,791

But the dark objects did

1976

01:28:53,791 --> 01:28:55,208

not have triangulation.

1977

01:28:55,208 --> 01:28:58,458

And when I said there is no fireball,

1978

01:28:58,458 --> 01:29:00,166

therefore it must be closer, maybe

1979

01:29:00,166 --> 01:29:01,291

artillery shells, maybe

1980

01:29:01,291 --> 01:29:02,708

bullets flying closer to you.

1981

01:29:03,166 --> 01:29:05,041

These would look like dark objects moving

1982

01:29:05,041 --> 01:29:07,416

fast across the sky. Then a lot of people

1983

01:29:07,416 --> 01:29:09,916

in the public got upset and said, well,

1984

01:29:09,916 --> 01:29:11,625

20 years ago, there were other people

1985

01:29:11,625 --> 01:29:13,166

reporting about objects moving through

1986

01:29:13,166 --> 01:29:15,958

air without much friction.

1987

01:29:15,958 --> 01:29:19,416

And that is completely irrelevant.

1988

01:29:19,416 --> 01:29:23,875

Any case should be dealt with the data

1989

01:29:23,875 --> 01:29:25,416

that we have for it,

1990

01:29:25,416 --> 01:29:26,708

irrespective of other cases.

1991

01:29:27,125 --> 01:29:29,125

And if the data is not exquisite, if we

1992

01:29:29,125 --> 01:29:30,750

don't have distance measurements, we

1993

01:29:30,750 --> 01:29:32,916

can't argue for new physics. That's all.

1994

01:29:32,916 --> 01:29:34,875

That's the way science is done.

1995

01:29:34,875 --> 01:29:35,875

And that's the

1996

01:29:35,875 --> 01:29:38,833

professional way of approaching it.

1997

01:29:38,833 --> 01:29:43,041

And you have scientists in academia

1998

01:29:43,041 --> 01:29:45,125

reluctant to get engaged with

1999

01:29:45,125 --> 01:29:47,458

unidentified objects because they say,

2000

01:29:47,458 --> 01:29:49,250

well, we don't want to be in the same bed

2001

01:29:49,250 --> 01:29:52,250

with people that argue on any incomplete

2002

01:29:52,250 --> 01:29:54,250

data set that there is no physics.

2003

01:29:54,875 --> 01:29:56,958

I say this is inappropriate as well

2004

01:29:56,958 --> 01:29:58,833

because we have the ability to collect

2005

01:29:58,833 --> 01:30:02,791

the data. We should not say extraordinary

2006

01:30:02,791 --> 01:30:04,708

claims require extraordinary evidence

2007

01:30:04,708 --> 01:30:06,708

without seeking the evidence.

2008

01:30:06,708 --> 01:30:10,000

This is Carl Sagan's mantra.

2009

01:30:11,000 --> 01:30:14,166

My mantra is extraordinary evidence

2010

01:30:14,166 --> 01:30:16,458

requires extraordinary funding and

2011

01:30:16,458 --> 01:30:18,166

effort. You need to put the effort to do

2012

01:30:18,166 --> 01:30:20,750

the work. And this is hard work,

2013

01:30:20,750 --> 01:30:23,083

collecting the evidence in a reliable way

2014

01:30:23,083 --> 01:30:24,750

using well calibrated instruments that

2015

01:30:24,750 --> 01:30:26,708

you fully understand and are under your

2016

01:30:26,708 --> 01:30:27,708

control is hard work.

2017

01:30:27,708 --> 01:30:29,958

It's much easier to be a blogger that

2018

01:30:29,958 --> 01:30:32,708

didn't write a scientific paper for 15

2019

01:30:32,708 --> 01:30:33,916

years to argue that you're an

2020

01:30:33,916 --> 01:30:35,416

astrophysicist and you have an opinion

2021

01:30:35,416 --> 01:30:38,666

about whether you are this or that.

2022

01:30:38,791 --> 01:30:40,666

It's very easy. You just sit back and

2023

01:30:40,666 --> 01:30:43,333

say, make, you know, tweet about it. And

2024

01:30:43,333 --> 01:30:45,583

you can tweet about it in a way that

2025

01:30:45,583 --> 01:30:49,375

reflects the opinions of your tribe.

2026

01:30:49,375 --> 01:30:51,625

And you will get a lot of likes. And then

2027

01:30:51,625 --> 01:30:53,458

someone from the other tribe will get a

2028

01:30:53,458 --> 01:30:55,791

lot of likes for the opposite opinion.

2029

01:30:55,791 --> 01:30:58,000

But that will not promote our knowledge

2030

01:30:58,000 --> 01:30:59,708

of what reality is like.

2031

01:31:00,000 --> 01:31:02,000

We will just have these tribes like we

2032

01:31:02,000 --> 01:31:04,208

have in politics. You can't rely on

2033

01:31:04,208 --> 01:31:06,708

people to tell you what reality is. You

2034

01:31:06,708 --> 01:31:09,500

have to rely on instruments and you have

2035

01:31:09,500 --> 01:31:11,708

to rely on reproducibility of results

2036

01:31:11,708 --> 01:31:13,041

through instruments,

2037

01:31:13,041 --> 01:31:14,250

quantitative measurements.

2038

01:31:14,250 --> 01:31:15,291

That's the way science is

2039

01:31:15,291 --> 01:31:17,958

done. Now, this is not just theory.

2040

01:31:17,958 --> 01:31:20,000

The reason the two of us are using these

2041

01:31:20,000 --> 01:31:22,291

microphones and that this conversation is

2042

01:31:22,291 --> 01:31:24,583

recorded electronically is because we

2043

01:31:24,583 --> 01:31:26,333

understand quantum mechanics and nobody

2044

01:31:26,333 --> 01:31:27,208

expected quantum

2045

01:31:27,208 --> 01:31:28,708

mechanics in the first case.

2046

01:31:29,666 --> 01:31:31,750

So a hundred years ago, it was discovered

2047

01:31:31,750 --> 01:31:34,041

experimentally. And what did we learn

2048

01:31:34,041 --> 01:31:36,375

from that experience that we should

2049

01:31:36,375 --> 01:31:39,166

listen to nature, not to people because

2050

01:31:39,166 --> 01:31:42,500

even Albert Einstein 1935 wrote a paper

2051  
01:31:42,500 --> 01:31:45,541  
saying quantum mechanics does not have

2052  
01:31:45,541 --> 01:31:48,666  
or I don't believe that quantum mechanics

2053  
01:31:48,666 --> 01:31:51,416  
has spooky action at a distance. That's

2054  
01:31:51,416 --> 01:31:52,708  
the way he called the entanglement.

2055  
01:31:53,875 --> 01:31:58,333  
And the Nobel Prize in physics in 2022,

2056  
01:31:58,333 --> 01:32:04,958  
'97 years after that, was given to the

2057  
01:32:04,958 --> 01:32:07,541  
experimentalists who

2058  
01:32:07,541 --> 01:32:09,916  
proved Einstein wrong.

2059  
01:32:09,916 --> 01:32:13,416  
And so even the brightest mind among

2060  
01:32:13,416 --> 01:32:16,458  
physicists of the 20th century made

2061  
01:32:16,458 --> 01:32:17,708  
mistakes. This is one of them.

2062  
01:32:17,708 --> 01:32:19,500  
He built a model and his model didn't

2063  
01:32:19,500 --> 01:32:19,708

encompass everything.

2064

01:32:20,916 --> 01:32:24,458

Well, no, he had the intuition that God

2065

01:32:24,458 --> 01:32:27,333

does not play dice kind of that. Quantum

2066

01:32:27,333 --> 01:32:30,458

mechanics can be explained using our

2067

01:32:30,458 --> 01:32:31,833

intuition that there is a

2068

01:32:31,833 --> 01:32:34,250

deterministic reality behind it.

2069

01:32:34,250 --> 01:32:35,958

But he was wrong about it. And we still

2070

01:32:35,958 --> 01:32:38,250

don't understand quantum mechanics. He

2071

01:32:38,250 --> 01:32:41,541

was wrong within five years of 1935. He

2072

01:32:41,541 --> 01:32:42,708

was wrong on two other counts.

2073

01:32:43,291 --> 01:32:45,583

One, he claimed that black holes do not

2074

01:32:45,583 --> 01:32:48,958

exist because he said that when a star

2075

01:32:48,958 --> 01:32:50,125

collapses to make a black

2076

01:32:50,125 --> 01:32:52,708

hole, it will have some rotation.

2077

01:32:52,708 --> 01:32:54,708

And as a result, that would prevent it

2078

01:32:54,708 --> 01:32:56,083

from collapsing all

2079

01:32:56,083 --> 01:32:58,458

the way to a black hole.

2080

01:32:58,458 --> 01:33:02,583

And I think that was a result of his

2081

01:33:02,583 --> 01:33:05,458

relationship with Oppenheimer, who at the

2082

01:33:05,458 --> 01:33:07,291

time had a model for a collapsing star

2083

01:33:07,291 --> 01:33:08,125

that was just

2084

01:33:08,125 --> 01:33:09,708

spherically symmetric with no spin.

2085

01:33:10,375 --> 01:33:11,875

And he was the director of the Institute

2086

01:33:11,875 --> 01:33:13,708

for Advanced Study, Oppenheimer, and they

2087

01:33:13,708 --> 01:33:16,083

had a sort of a very

2088

01:33:16,083 --> 01:33:18,250

unusual relationship.

2089

01:33:18,250 --> 01:33:22,333

But the third mistake that Einstein made

2090

01:33:22,333 --> 01:33:26,083

between 1935 and 1940 was to say that

2091

01:33:26,083 --> 01:33:28,166

gravitational waves do not exist.

2092

01:33:28,166 --> 01:33:30,791

And he wrote a paper about it with Nathan

2093

01:33:30,791 --> 01:33:33,500

Rosen and submitted it for publication in

2094

01:33:33,500 --> 01:33:35,208

the Physical Review.

2095

01:33:36,291 --> 01:33:39,291

And the paper was referred and Einstein

2096

01:33:39,291 --> 01:33:41,500

was upset because the referee did not

2097

01:33:41,500 --> 01:33:43,791

accept the paper for publication.

2098

01:33:43,791 --> 01:33:46,541

And Einstein said, I will never submit

2099

01:33:46,541 --> 01:33:48,291

another paper to the Physical Review

2100

01:33:48,291 --> 01:33:51,833

because they dare to doubt my opinion.

2101

01:33:51,833 --> 01:33:54,041

And this referee actually saved him from

2102

01:33:54,041 --> 01:33:58,250

a public embarrassment because, you know,

2103

01:33:58,250 --> 01:34:01,833

we now know, we measured in 2015,

2104

01:34:01,833 --> 01:34:02,416

gravitational waves

2105

01:34:02,416 --> 01:34:03,708

with the LIGO experiment.

2106

01:34:04,208 --> 01:34:06,666

And the Nobel Prize was awarded to that.

2107

01:34:06,666 --> 01:34:08,708

And also the Nobel Prize was awarded to

2108

01:34:08,708 --> 01:34:10,125

the discovery of

2109

01:34:10,125 --> 01:34:11,291

astrophysical black holes.

2110

01:34:11,291 --> 01:34:16,541

So over the past six years, there were

2111

01:34:16,541 --> 01:34:20,083

three Nobel Prizes in physics, correcting

2112

01:34:20,083 --> 01:34:22,375

three mistakes that Albert Einstein made

2113

01:34:22,375 --> 01:34:25,791

between 1935 and 1940.

2114

01:34:25,791 --> 01:34:27,583

Those people who proved him

2115

01:34:27,583 --> 01:34:28,708

wrong got the Nobel Prize.

2116

01:34:29,666 --> 01:34:32,000

What does it show us that when you work

2117

01:34:32,000 --> 01:34:36,583

at the frontiers of physics, you know,

2118

01:34:36,583 --> 01:34:37,916

obviously you don't know what's right,

2119

01:34:37,916 --> 01:34:39,583

what's wrong, and you can make mistakes.

2120

01:34:39,583 --> 01:34:43,333

That's a signature of taking risks and

2121

01:34:43,333 --> 01:34:46,000

willing to push the envelope.

2122

01:34:46,000 --> 01:34:49,458

So, you know, it's possible that Oumuamua

2123

01:34:49,458 --> 01:34:51,750

was a nitrogen iceberg.

2124

01:34:51,750 --> 01:34:53,583

And if the next object comes along and we

2125

01:34:53,583 --> 01:34:54,708

see that it's made of

2126

01:34:54,708 --> 01:34:56,708

nitrogen, I was wrong.

2127

01:34:57,958 --> 01:35:00,791

It's possible that unidentified aerial

2128

01:35:00,791 --> 01:35:04,583

phenomena are just balloons.

2129

01:35:04,583 --> 01:35:06,500

And we will go with the Galileo Project

2130

01:35:06,500 --> 01:35:10,291

observatories and find the balloons.

2131

01:35:10,291 --> 01:35:12,000

It's possible that the interstellar

2132

01:35:12,000 --> 01:35:15,541

meteors were tougher than iron because

2133

01:35:15,541 --> 01:35:18,875

the data reported by the US

2134

01:35:18,875 --> 01:35:20,708

government had errors in it.

2135

01:35:21,875 --> 01:35:24,375

And once we go to the Pacific Ocean with

2136

01:35:24,375 --> 01:35:26,541

an expedition and scoop the ocean floor

2137

01:35:26,541 --> 01:35:28,666

with the machinery that we just tested

2138

01:35:28,666 --> 01:35:32,708

last week, and it works amazingly well,

2139

01:35:32,708 --> 01:35:34,916

we have magnets to collect magnetic

2140

01:35:34,916 --> 01:35:36,708

particles, we have a Sluicing device to

2141

01:35:36,708 --> 01:35:38,958

collect other types of particles.

2142

01:35:38,958 --> 01:35:40,625

It's possible that we will find that it

2143

01:35:40,625 --> 01:35:43,666

was just an iron meteorite and that the

2144

01:35:43,666 --> 01:35:44,750

data from the US

2145

01:35:44,750 --> 01:35:46,708

government was inaccurate.

2146

01:35:47,666 --> 01:35:49,916

I mean, the US government in a way

2147

01:35:49,916 --> 01:35:53,000

supported this study more than the

2148

01:35:53,000 --> 01:35:56,708

academic community because the first

2149

01:35:56,708 --> 01:35:58,291

paper that we wrote about this

2150

01:35:58,291 --> 01:35:59,791

interstellar meteor with my student Amir

2151

01:35:59,791 --> 01:36:02,583

Siraj suggested that it's interstellar.

2152

01:36:02,583 --> 01:36:03,958

It was the first interstellar

2153

01:36:03,958 --> 01:36:06,541

object ever detected in 2014.

2154

01:36:06,541 --> 01:36:07,791

And the paper was not

2155

01:36:07,791 --> 01:36:08,666

accepted for publication.

2156

01:36:08,666 --> 01:36:11,125

It was rejected by the referees who

2157

01:36:11,125 --> 01:36:12,041

argued that they don't

2158

01:36:12,041 --> 01:36:12,708

believe the US government.

2159

01:36:14,250 --> 01:36:17,916

And I then at the time was the chair of

2160

01:36:17,916 --> 01:36:19,583

the board on physics and astronomy of the

2161

01:36:19,583 --> 01:36:21,000

National Academies, there was a member of

2162

01:36:21,000 --> 01:36:23,125

the board from Los Alamos.

2163

01:36:23,125 --> 01:36:26,083

And he connected me to some people behind

2164

01:36:26,083 --> 01:36:30,666  
the national security fence and

2165

01:36:30,666 --> 01:36:33,416  
eventually someone working at the Office

2166

01:36:33,416 --> 01:36:35,125  
of Science and Technology Policy in the

2167

01:36:35,125 --> 01:36:39,125  
White House enabled a

2168

01:36:39,125 --> 01:36:41,708  
letter from the US Space Command

2169

01:36:42,666 --> 01:36:46,166  
under the Department of Defense to NASA

2170

01:36:46,166 --> 01:36:50,958  
confirming publicly at the 99.999%

2171

01:36:50,958 --> 01:36:53,750  
confidence that this meteor came from

2172

01:36:53,750 --> 01:36:54,750  
outside the solar system.

2173

01:36:54,750 --> 01:36:57,083  
That was amazing. The Department of

2174

01:36:57,083 --> 01:37:00,166  
Defense came to my defense when I was

2175

01:37:00,166 --> 01:37:01,791  
confronted by colleagues in academia that

2176

01:37:01,791 --> 01:37:03,833

should think blue sky, right?

2177

01:37:03,833 --> 01:37:06,208

Because there are hundreds of papers

2178

01:37:06,208 --> 01:37:07,625

about the nature of dark matter talking

2179

01:37:07,625 --> 01:37:08,625

about particles that we

2180

01:37:08,625 --> 01:37:09,708

know do not exist by now.

2181

01:37:10,625 --> 01:37:12,458

And so why should that be allowed when

2182

01:37:12,458 --> 01:37:15,000

the US government reports data, you

2183

01:37:15,000 --> 01:37:17,041

should block the publication of claiming

2184

01:37:17,041 --> 01:37:18,291

they don't know what.

2185

01:37:18,291 --> 01:37:21,708

So, you know, in a way,

2186

01:37:21,708 --> 01:37:23,791

Do you think that's why Dr. Kirkpatrick

2187

01:37:23,791 --> 01:37:25,625

came to you out of anyone he could have

2188

01:37:25,625 --> 01:37:28,291

come to in academia?

2189

01:37:29,458 --> 01:37:33,083

Well, I think probably the reason he came

2190

01:37:33,083 --> 01:37:35,833

to speak with me and he came to this

2191

01:37:35,833 --> 01:37:40,625

house not far from where you sit and

2192

01:37:40,625 --> 01:37:41,625

there were plenty of people

2193

01:37:41,625 --> 01:37:42,750

that came to where you sit.

2194

01:37:42,750 --> 01:37:44,666

I mean, just Hawking and Kirkpatrick,

2195

01:37:44,666 --> 01:37:46,875

there were many multi billionaires and

2196

01:37:46,875 --> 01:37:48,125

over the past year or

2197

01:37:48,125 --> 01:37:49,833

two. Yeah, a lot of them.

2198

01:37:51,541 --> 01:37:53,750

If someone told me that they would have

2199

01:37:53,750 --> 01:37:55,291

loved to be a fly on the wall because

2200

01:37:55,291 --> 01:37:56,708

there were so many interesting

2201

01:37:56,708 --> 01:37:58,333

conversations that didn't make it to the

2202

01:37:58,333 --> 01:38:01,833

public in this house.

2203

01:38:01,833 --> 01:38:05,375

But I can only conjecture and I think the

2204

01:38:05,375 --> 01:38:07,958

reason he told me that he's visiting

2205

01:38:07,958 --> 01:38:09,541

Boston, that he would be in the area and

2206

01:38:09,541 --> 01:38:12,833

wanted to see me is because,

2207

01:38:13,916 --> 01:38:16,375

you know, I use common sense. I don't

2208

01:38:16,375 --> 01:38:17,875

pretend to know more than I know. And I

2209

01:38:17,875 --> 01:38:19,875

use the scientific method, which is the

2210

01:38:19,875 --> 01:38:21,125

only way to make

2211

01:38:21,125 --> 01:38:23,083

progress, not using prejudice.

2212

01:38:23,083 --> 01:38:26,041

And I'm not worried about how many likes

2213

01:38:26,041 --> 01:38:28,166

I get. That's the other quality that you

2214

01:38:28,166 --> 01:38:30,125

must have because I get a lot of pushback

2215

01:38:30,125 --> 01:38:32,166

and personal attacks.

2216

01:38:32,166 --> 01:38:33,708

And by the way, the personal attacks,

2217

01:38:33,708 --> 01:38:37,250

most surprisingly, come mostly from the

2218

01:38:37,250 --> 01:38:39,333

SETI community. That was

2219

01:38:39,333 --> 01:38:40,458

really surprising to me.

2220

01:38:41,125 --> 01:38:44,958

And it's sort of it's akin to a cat that

2221

01:38:44,958 --> 01:38:48,958

is used to drinking cow milk and then

2222

01:38:48,958 --> 01:38:50,583

realizes that other people

2223

01:38:50,583 --> 01:38:52,333

are talking about almond milk.

2224

01:38:52,333 --> 01:38:57,416

And the cat says, I loathe the use of the

2225

01:38:57,416 --> 01:38:58,708

word milk in that context.

2226

01:38:59,625 --> 01:39:02,958

So, you know, the SETI community decided

2227

01:39:02,958 --> 01:39:07,375

to ban any lecture on objects near Earth

2228

01:39:07,375 --> 01:39:08,875

that could have originated from

2229

01:39:08,875 --> 01:39:12,916

extraterrestrial technological

2230

01:39:12,916 --> 01:39:15,125

civilization in their conferences.

2231

01:39:15,125 --> 01:39:17,250

And that was just a year and a half ago.

2232

01:39:17,250 --> 01:39:20,291

And that band was not lifted as far until

2233

01:39:20,291 --> 01:39:22,041

now and as far as I know.

2234

01:39:22,041 --> 01:39:24,666

And you ask yourself, why?

2235

01:39:24,958 --> 01:39:27,208

I mean, just think about people working

2236

01:39:27,208 --> 01:39:28,875

on the nature of dark matter. There are

2237

01:39:28,875 --> 01:39:32,791

people searching for weakly interacting

2238

01:39:32,791 --> 01:39:34,166

massive particles using the

2239

01:39:34,166 --> 01:39:36,875

Large Hadron Collider at CERN.

2240

01:39:36,875 --> 01:39:40,833

And imagine them saying, we ban any

2241

01:39:40,833 --> 01:39:44,500

discussion in our conferences on the dark

2242

01:39:44,500 --> 01:39:47,291

matter being potentially an axion, a very

2243

01:39:47,291 --> 01:39:48,958

lightweight particle that has nothing to

2244

01:39:48,958 --> 01:39:49,833

do with weakly

2245

01:39:49,833 --> 01:39:50,708

interacting massive particles.

2246

01:39:51,791 --> 01:39:53,500

Imagine them doing that. That would be

2247

01:39:53,500 --> 01:39:57,833

completely unprofessional. Why? Why is it

2248

01:39:57,833 --> 01:39:59,666

special in this case? Is it something

2249

01:39:59,666 --> 01:40:02,125

about the mirror that we're potentially

2250

01:40:02,125 --> 01:40:04,083

going to look back at if we see other

2251

01:40:04,083 --> 01:40:04,708

life or other consciousness out there?

2252

01:40:05,916 --> 01:40:12,583

No. Well, SETI was at the fringes of

2253

01:40:12,583 --> 01:40:15,791

astronomy for many decades and developed

2254

01:40:15,791 --> 01:40:17,958

this psychology of being apologetic for

2255

01:40:17,958 --> 01:40:19,791

doing what they're doing and getting a

2256

01:40:19,791 --> 01:40:21,625

little bit of funding from

2257

01:40:21,625 --> 01:40:22,708

the mainstream of astronomy.

2258

01:40:23,291 --> 01:40:28,166

Now, one thing that happened in the

2259

01:40:28,166 --> 01:40:30,958

background was all these unsubstantiated

2260

01:40:30,958 --> 01:40:34,541

claims by people in the general public

2261

01:40:34,541 --> 01:40:38,583

about visitation by aliens, abductions

2262

01:40:38,583 --> 01:40:43,791

and things that were not substantiated by

2263

01:40:43,791 --> 01:40:44,708

scientific evidence.

2264

01:40:44,958 --> 01:40:49,375

And as a result, a lot of scientists do

2265

01:40:49,375 --> 01:40:52,500

not want even to discuss that

2266

01:40:52,500 --> 01:40:54,333

possibility. And the SETI community lines

2267

01:40:54,333 --> 01:40:57,083

up with the mainstream on this so that

2268

01:40:57,083 --> 01:41:00,416

they would not lose the little bit of

2269

01:41:00,416 --> 01:41:01,375

allowance that they're given.

2270

01:41:02,500 --> 01:41:05,375

So I came into the scene

2271

01:41:05,375 --> 01:41:07,333

unapologetically. Why? Because I worked

2272

01:41:07,333 --> 01:41:10,166

on the nature of dark matter. And at the

2273

01:41:10,166 --> 01:41:13,125

time, we suggested all kinds of

2274

01:41:13,125 --> 01:41:14,875

possibilities and it was very much

2275

01:41:14,875 --> 01:41:17,416

encouraged to consider all possibilities

2276

01:41:17,416 --> 01:41:19,375

because they stimulate experimental work

2277

01:41:19,375 --> 01:41:20,333

and then we learned

2278

01:41:20,333 --> 01:41:21,708

something new as a result.

2279

01:41:21,875 --> 01:41:23,625

And so in this context, when the moon

2280

01:41:23,625 --> 01:41:25,958

came along, I said, well, maybe it's

2281

01:41:25,958 --> 01:41:28,791

artificial. That was an alternative. And

2282

01:41:28,791 --> 01:41:30,791

in my mind, it was just like suggesting

2283

01:41:30,791 --> 01:41:32,625

the dark matter is of specific types so

2284

01:41:32,625 --> 01:41:33,750

that experimentalists

2285

01:41:33,750 --> 01:41:36,041

can move on and check it.

2286

01:41:36,041 --> 01:41:37,916

So I suggested the moon might be

2287

01:41:37,916 --> 01:41:40,541

artificial so that we will next look for

2288

01:41:40,541 --> 01:41:43,583

other objects like it or look at the data

2289

01:41:43,583 --> 01:41:45,625

from it and try to figure it out.

2290

01:41:46,125 --> 01:41:49,250

Okay. And that sounded to me like a very

2291

01:41:49,250 --> 01:41:50,750

positive development in science because

2292

01:41:50,750 --> 01:41:52,083

when there is something anomalous, you

2293

01:41:52,083 --> 01:41:54,416

might learn something new. It may well be

2294

01:41:54,416 --> 01:41:55,666

a nitrogen iceberg, but

2295

01:41:55,666 --> 01:41:56,916

it may also be artificial.

2296

01:41:56,916 --> 01:42:00,125

So let's check. And that was part of the

2297

01:42:00,125 --> 01:42:01,791

scientific process that I'm used to from

2298

01:42:01,791 --> 01:42:03,875

cosmology about the dark matter and so

2299

01:42:03,875 --> 01:42:06,333

forth. And then suddenly I get hate

2300

01:42:06,333 --> 01:42:10,708

messages, you know, like arguing, you

2301

01:42:10,708 --> 01:42:11,750

know, you're pissing

2302

01:42:11,750 --> 01:42:13,708

us off with this thing.

2303

01:42:14,291 --> 01:42:17,791

And why did you write this book? And that

2304

01:42:17,791 --> 01:42:22,041

to me sounds unprofessional because the

2305

01:42:22,041 --> 01:42:23,375

way to figure it out is

2306

01:42:23,375 --> 01:42:24,333

through additional data.

2307

01:42:24,333 --> 01:42:27,000

Now, since I don't see others doing it,

2308

01:42:27,000 --> 01:42:28,875

I'm a theoretical astrophysicist. I think

2309

01:42:28,875 --> 01:42:32,250

of ideas, you know, when I met John

2310

01:42:32,250 --> 01:42:34,208

Bacall for the first time, he said, what

2311

01:42:34,208 --> 01:42:35,708

kind of computer languages do you know?

2312

01:42:36,125 --> 01:42:38,166

And I said, well, I know just the very

2313

01:42:38,166 --> 01:42:41,708

basics because, you know, I only use

2314

01:42:41,708 --> 01:42:44,375

computers when I really need it.

2315

01:42:44,375 --> 01:42:46,708

And he said, how do you imagine having a

2316

01:42:46,708 --> 01:42:49,291

career in science with very limited

2317

01:42:49,291 --> 01:42:50,333

knowledge of computer science?

2318

01:42:50,333 --> 01:42:52,958

And I said, well, we'll see what happens.

2319

01:42:52,958 --> 01:42:55,333

And I've been able to pursue a very

2320

01:42:55,333 --> 01:42:58,000

successful career thanks to the fact that

2321

01:42:58,000 --> 01:43:01,041

I have ideas or that seem to

2322

01:43:01,041 --> 01:43:03,583

me obvious and common sense.

2323

01:43:04,041 --> 01:43:06,875

But for some mysterious reasons, others

2324

01:43:06,875 --> 01:43:11,250

take a while before they realize that it

2325

01:43:11,250 --> 01:43:13,666

may be. And I noticed it on several

2326

01:43:13,666 --> 01:43:15,458

occasions when I proposed an idea that

2327

01:43:15,458 --> 01:43:17,250

people dismissed on the spot.

2328

01:43:17,250 --> 01:43:18,875

There were several such instances related

2329

01:43:18,875 --> 01:43:21,166

to black holes, related to the first

2330

01:43:21,166 --> 01:43:23,750

stars, and then it became the hottest

2331

01:43:23,750 --> 01:43:25,708

subject in their discipline.

2332

01:43:26,166 --> 01:43:29,250

And so that illustrated to me that how

2333

01:43:29,250 --> 01:43:31,791

narrow minded people are, those experts

2334

01:43:31,791 --> 01:43:35,458

that, you know, basically dig into a

2335

01:43:35,458 --> 01:43:39,000

subject very deep because they don't look

2336

01:43:39,000 --> 01:43:43,458

sideways and they very often hit the

2337

01:43:43,458 --> 01:43:45,833

bedrock of their expertise

2338

01:43:45,833 --> 01:43:47,166

where nothing much happens.

2339

01:43:47,166 --> 01:43:50,666

And then they sort of do boring stuff on

2340

01:43:50,666 --> 01:43:52,166

things that we already know.

2341

01:43:52,166 --> 01:43:54,500

That's the life of an expert.

2342

01:43:55,500 --> 01:43:58,583

However, it's much more exciting to look

2343

01:43:58,583 --> 01:44:00,500

sideways and consider possibilities that

2344

01:44:00,500 --> 01:44:03,291

might be realized because if they do get

2345

01:44:03,291 --> 01:44:04,708

realized, it changes our

2346

01:44:04,708 --> 01:44:06,125

perspective about reality.

2347

01:44:06,125 --> 01:44:08,375

And those objects near Earth that look

2348

01:44:08,375 --> 01:44:09,875

weird are an opportunity to learn

2349

01:44:09,875 --> 01:44:11,958

something new. So I thought everyone

2350

01:44:11,958 --> 01:44:14,041

would accept that and

2351

01:44:14,041 --> 01:44:14,708

celebrate that and move on.

2352

01:44:15,458 --> 01:44:18,000

But since nobody is doing the follow up

2353

01:44:18,000 --> 01:44:21,250

work of seeking evidence, I decided to

2354

01:44:21,250 --> 01:44:22,916

lead the Galileo Project. I'm a

2355

01:44:22,916 --> 01:44:24,208

theoretical astrophysicist and I'm

2356

01:44:24,208 --> 01:44:26,375

leading an experimental project.

2357

01:44:26,375 --> 01:44:30,458

And that to me is a way of educating two

2358

01:44:30,458 --> 01:44:32,708

communities. One is the general public

2359

01:44:32,708 --> 01:44:34,625

that speculates on the subject. There are

2360

01:44:34,625 --> 01:44:36,666

science fiction writers that imagine all

2361

01:44:36,666 --> 01:44:39,458

kinds of things and people claiming to

2362

01:44:39,458 --> 01:44:42,708

have seen anomalous things,

2363

01:44:43,541 --> 01:44:46,750

not in the scientific way. Okay, so to

2364

01:44:46,750 --> 01:44:49,708

them I have to explain that new physics

2365

01:44:49,708 --> 01:44:51,625

requires exquisite data. You can't just

2366

01:44:51,625 --> 01:44:54,875

argue it based on very poor data.

2367

01:44:54,875 --> 01:44:56,958

And then to the scientific community, I'm

2368

01:44:56,958 --> 01:44:59,583

trying to educate my colleagues that they

2369

01:44:59,583 --> 01:45:03,208

should be willing to explore the unknown

2370

01:45:03,208 --> 01:45:04,708

in a way that doesn't show prejudice.

2371

01:45:05,750 --> 01:45:09,166

And that is as challenging. So

2372

01:45:09,166 --> 01:45:12,791

altogether, I would argue, common sense

2373

01:45:12,791 --> 01:45:15,750

is not common. And it's just like in

2374

01:45:15,750 --> 01:45:16,291

politics, you have

2375

01:45:16,291 --> 01:45:17,291

people on the extremes.

2376

01:45:17,291 --> 01:45:20,625

And if you try to walk in the middle, in

2377

01:45:20,625 --> 01:45:24,791

a balanced way, it's not a path that is

2378

01:45:24,791 --> 01:45:27,458

very populated. And it's not easy because

2379

01:45:27,458 --> 01:45:28,708

you get attacked from both directions.

2380

01:45:29,833 --> 01:45:31,250

And one thing about the scientific

2381

01:45:31,250 --> 01:45:32,791

community, you might argue, okay, well,

2382

01:45:32,791 --> 01:45:35,541

maybe they represent sort of the

2383

01:45:35,541 --> 01:45:38,583

conservative view until proven wrong.

2384

01:45:38,583 --> 01:45:40,541

I don't think so because if you look at

2385

01:45:40,541 --> 01:45:43,291

theoretical physics over the past four

2386

01:45:43,291 --> 01:45:45,708

decades since I started,

2387

01:45:47,375 --> 01:45:52,000

the mainstream was engaged with string

2388

01:45:52,000 --> 01:45:53,791

theory in extra dimensions that were

2389

01:45:53,791 --> 01:45:55,708

never verified experimentally that might

2390

01:45:55,708 --> 01:45:58,666

not be verified in our lifetime.

2391

01:45:58,666 --> 01:46:03,250

And they just do mathematical gymnastics

2392

01:46:03,250 --> 01:46:06,458

and talk about concepts that exist in

2393

01:46:06,458 --> 01:46:08,875

extra dimensions that we cannot test

2394

01:46:08,875 --> 01:46:10,500

experimentally, we cannot falsify.

2395

01:46:11,125 --> 01:46:13,291

And in fact, there are many versions of

2396

01:46:13,291 --> 01:46:15,041

the theory, we don't know which one is

2397

01:46:15,041 --> 01:46:21,291

correct. Okay, so it's just like meeting

2398

01:46:21,291 --> 01:46:23,875

someone who claims that he is a plumber.

2399

01:46:23,875 --> 01:46:26,250

Okay. And you say, okay, can you fix my

2400

01:46:26,250 --> 01:46:30,583

toilet? And he says, that sounds too

2401

01:46:30,583 --> 01:46:31,583

complicated. I can't do that.

2402

01:46:32,000 --> 01:46:33,875

So he said, okay, well, maybe you can fix

2403

01:46:33,875 --> 01:46:37,291

my faucet. And this person says, I don't

2404

01:46:37,291 --> 01:46:39,583

think so. It's really complicated. But,

2405

01:46:39,583 --> 01:46:42,750

but if you put goggles on your head and

2406

01:46:42,750 --> 01:46:45,916

go to the metaverse, then you will see me

2407

01:46:45,916 --> 01:46:48,583

there solving all your plumbing problems.

2408

01:46:49,708 --> 01:46:51,708

Now, putting goggles on the head is

2409

01:46:51,708 --> 01:46:53,500

equivalent to going into a virtual

2410

01:46:53,500 --> 01:46:54,916

reality that we cannot test

2411

01:46:54,916 --> 01:46:56,791

experimentally. And that's what the

2412

01:46:56,791 --> 01:46:58,791

string theorists are doing. They're

2413

01:46:58,791 --> 01:47:02,416

saying just imagine extra dimensions that

2414

01:47:02,416 --> 01:47:04,083

we haven't found that we

2415

01:47:04,083 --> 01:47:06,208

cannot do experiments in.

2416

01:47:06,208 --> 01:47:09,666

And in that, we can solve some equations.

2417

01:47:09,666 --> 01:47:11,833

But I asked them, okay, what happened

2418

01:47:11,833 --> 01:47:13,583

before the Big Bang? And they

2419

01:47:13,583 --> 01:47:15,708

say, that's too complicated.

2420

01:47:16,291 --> 01:47:18,416

What happens in the center of a black

2421

01:47:18,416 --> 01:47:22,625

hole? We can't deal with that. So I rest

2422

01:47:22,625 --> 01:47:24,625

my case. There's no predictive power in

2423

01:47:24,625 --> 01:47:27,083

there. Well, the issue is falsifiability.

2424

01:47:27,083 --> 01:47:29,041

Unless you put your ideas under the

2425

01:47:29,041 --> 01:47:32,500

guillotine of experiments, you will never

2426

01:47:32,500 --> 01:47:33,208

know if they're right.

2427

01:47:33,208 --> 01:47:35,375

You can spend your life imagining things.

2428

01:47:35,375 --> 01:47:37,500

Let me give you an example. I was at the

2429

01:47:37,500 --> 01:47:39,916

lunch with a very

2430

01:47:39,916 --> 01:47:41,708

distinguished string theorist.

2431

01:47:42,291 --> 01:47:47,458

A few months ago, and I asked him, what

2432

01:47:47,458 --> 01:47:49,416

is your most important paper, scientific

2433

01:47:49,416 --> 01:47:52,208

paper? And he said it

2434

01:47:52,208 --> 01:47:54,500

was about supersymmetry.

2435

01:47:55,625 --> 01:48:00,791

And I just realized, why is he so proud

2436

01:48:00,791 --> 01:48:02,750

of this paper? After all, the Large

2437

01:48:02,750 --> 01:48:06,166

Hadron Collider looked for supersymmetry

2438

01:48:06,166 --> 01:48:09,458

in the most natural range of parameters

2439

01:48:09,458 --> 01:48:12,333

and didn't find it. So it's ruled out.

2440

01:48:12,333 --> 01:48:14,750

We don't know if it exists. If it exists,

2441

01:48:14,750 --> 01:48:16,625

it exists in a different range of

2442

01:48:16,625 --> 01:48:19,666

parameters. That was not the natural one.

2443

01:48:20,458 --> 01:48:23,083

And yet this person, this scientist is

2444

01:48:23,083 --> 01:48:25,791

proud of this paper. So that reminded me

2445

01:48:25,791 --> 01:48:28,958

of the Lubavitch community in Brooklyn.

2446

01:48:28,958 --> 01:48:32,291

They believed that their rabbi is the

2447

01:48:32,291 --> 01:48:36,125

Messiah. So they actually built a replica

2448

01:48:36,125 --> 01:48:40,375

of his apartment in Brooklyn and placed

2449

01:48:40,375 --> 01:48:43,333

it in Israel because the Messiah is

2450

01:48:43,333 --> 01:48:46,416

supposed to arrive after he dies,

2451

01:48:46,416 --> 01:48:48,708

supposed to get to Israel.

2452

01:48:49,625 --> 01:48:51,833

And they wanted him to find the toilets.

2453

01:48:51,833 --> 01:48:53,833

So they built a replica of his home in

2454

01:48:53,833 --> 01:48:57,166

Brooklyn of the apartment in Israel. They

2455

01:48:57,166 --> 01:49:02,250

so much believed in it. And then he died.

2456

01:49:02,250 --> 01:49:05,166

So that was an empirical fact. He died

2457

01:49:05,166 --> 01:49:07,291

just like the experiment by the Large

2458

01:49:07,291 --> 01:49:08,958

Hadron Collider. Super Symmetry is not

2459

01:49:08,958 --> 01:49:11,375

there. The rabbi died and

2460

01:49:11,375 --> 01:49:12,708

didn't come back as a Messiah.

2461

01:49:13,750 --> 01:49:16,208

Time for a new hypothesis. No. What they

2462

01:49:16,208 --> 01:49:20,458

said is we just need to wait. What did

2463

01:49:20,458 --> 01:49:23,041

this string theory say? We just need to

2464

01:49:23,041 --> 01:49:24,708

wait for the next accelerator.

2465

01:49:25,791 --> 01:49:33,333

So I asked you for 40 years, working on

2466

01:49:33,333 --> 01:49:37,208

extra dimensions, the multiverse ideas

2467

01:49:37,208 --> 01:49:40,750

that cannot be tested. And then when one

2468

01:49:40,750 --> 01:49:44,666

aspect of your castle is being tested,

2469

01:49:44,666 --> 01:49:45,708

it's not being found.

2470

01:49:45,791 --> 01:49:45,958

You're not going to be able to see the

2471

01:49:45,958 --> 01:49:48,291

symmetry. And yet you are proud of that.

2472

01:49:48,291 --> 01:49:50,416

And you say we just need to wait. How is

2473

01:49:50,416 --> 01:49:54,750

that different from a religious belief?

2474

01:49:54,750 --> 01:49:56,791

So what's going to fill the gap then?

2475

01:49:56,791 --> 01:50:00,958

Experiments. As far as extra dimensions?

2476

01:50:00,958 --> 01:50:02,416

Well, to fill the gap

2477

01:50:02,416 --> 01:50:04,083

from string theory, right?

2478

01:50:04,958 --> 01:50:07,083

I offered some of my colleagues that work

2479

01:50:07,083 --> 01:50:08,541

on string theory to test their theory.

2480

01:50:08,541 --> 01:50:10,875

They just need to get into a black hole.

2481

01:50:10,875 --> 01:50:12,625

And near the singularity, the curvature

2482

01:50:12,625 --> 01:50:14,583

of space time is so large

2483

01:50:14,583 --> 01:50:17,250

that they can test their theory.

2484

01:50:17,250 --> 01:50:19,708

But one of them said that I have an

2485

01:50:19,708 --> 01:50:21,041

ulterior motive of

2486

01:50:21,041 --> 01:50:22,958

sending them into a black hole.

2487

01:50:25,083 --> 01:50:27,208

Can we simulate any type of event horizon

2488

01:50:27,208 --> 01:50:29,250

with entropy or temperature or some type

2489

01:50:29,250 --> 01:50:31,958

of isolation and experiment with some of

2490

01:50:31,958 --> 01:50:35,083

the mechanics around an event horizon or

2491

01:50:35,083 --> 01:50:37,208

a black hole more specifically in a lab?

2492

01:50:37,208 --> 01:50:41,958

Yeah. So there are lab experiments that

2493

01:50:41,958 --> 01:50:43,958

produce environments analogous to a black

2494

01:50:43,958 --> 01:50:45,625

hole, but it's not a black hole because a

2495

01:50:45,625 --> 01:50:47,458

black hole is defined

2496

01:50:47,458 --> 01:50:48,708

by a curved space time.

2497

01:50:49,333 --> 01:50:51,916

That was the innovation of Albert

2498

01:50:51,916 --> 01:50:55,916

Einstein. What they do in the lab is

2499

01:50:55,916 --> 01:50:59,375

having some fluid mechanics that instead

2500

01:50:59,375 --> 01:51:04,791

of the speed of light, you represent

2501

01:51:04,791 --> 01:51:06,333

light by sound waves.

2502

01:51:06,333 --> 01:51:07,833

And there is a speed of sound and you

2503

01:51:07,833 --> 01:51:09,708

have a horizon of that and then you see

2504

01:51:09,708 --> 01:51:11,458

some effects related, but

2505

01:51:11,458 --> 01:51:12,708

it's not really gravity.

2506

01:51:13,333 --> 01:51:18,416

And the way Einstein, the pioneering idea

2507

01:51:18,416 --> 01:51:21,416

that Einstein had was based on Galileo.

2508

01:51:21,416 --> 01:51:23,791

Galileo realized that all objects fall

2509

01:51:23,791 --> 01:51:25,291

the same way under the

2510

01:51:25,291 --> 01:51:26,458

influence of gravity.

2511

01:51:26,458 --> 01:51:28,333

In fact, there was an astronaut that went

2512

01:51:28,333 --> 01:51:31,291

to the moon and since there is no

2513

01:51:31,291 --> 01:51:34,541

atmosphere there, he dropped a hammer and

2514

01:51:34,541 --> 01:51:37,625

a feather and they arrived to the ground

2515

01:51:37,625 --> 01:51:38,583

exactly at the same time.

2516

01:51:39,791 --> 01:51:42,791

In air, of course, there is friction that

2517

01:51:42,791 --> 01:51:43,458

prevents the feather

2518

01:51:43,458 --> 01:51:45,166

from falling as fast.

2519

01:51:45,166 --> 01:51:48,041

But that was the realization that Galileo

2520

01:51:48,041 --> 01:51:50,958

Galilei had in Pisa.

2521

01:51:50,958 --> 01:51:54,083

And by the way, I was invited for four

2522

01:51:54,083 --> 01:51:56,208

lectures at the Cool Normal Superior.

2523

01:51:56,208 --> 01:51:57,166

They were called

2524

01:51:57,166 --> 01:52:00,291

"Galleleo Cathedra Galileo".

2525

01:52:00,291 --> 01:52:01,916

That was my first introduction to

2526

01:52:01,916 --> 01:52:03,708

Galileo. It was about a decade ago.

2527

01:52:03,791 --> 01:52:06,458

I was the... They have it as a very

2528

01:52:06,458 --> 01:52:09,625

special event every several years. And

2529

01:52:09,625 --> 01:52:11,791

that is the most prestigious institution

2530

01:52:11,791 --> 01:52:14,916

for science in Italy.

2531

01:52:14,916 --> 01:52:17,208

And thinking back, my connection to

2532

01:52:17,208 --> 01:52:19,750

Galileo started long ago, actually.

2533

01:52:22,208 --> 01:52:27,166

And by the way, when "Oumuamua", the

2534

01:52:27,166 --> 01:52:31,333

paper about it came out and I went just a

2535

01:52:31,333 --> 01:52:34,791

few days later to an event in Berlin.

2536

01:52:34,791 --> 01:52:39,666

And there were so many reporters as I

2537

01:52:39,666 --> 01:52:42,250

arrived there wanting to speak with me.

2538

01:52:42,250 --> 01:52:43,333

They put everyone in one

2539

01:52:43,333 --> 01:52:44,708

room, like tens of reporters.

2540

01:52:45,166 --> 01:52:47,708

And an Italian reporter from the back of

2541

01:52:47,708 --> 01:52:50,000

the room shouted, "Do you think you are

2542

01:52:50,000 --> 01:52:51,916

Galileo?" And I said, "No, I'm not

2543

01:52:51,916 --> 01:52:52,875

pretending to be anyone.

2544

01:52:52,875 --> 01:52:55,375

I'm just talking about what I

2545

01:52:55,375 --> 01:52:57,708

think this object might be."

2546

01:52:57,708 --> 01:53:00,375

And of course, any discovery of a relic

2547

01:53:00,375 --> 01:53:01,958

from an extraterrestrial civilization

2548

01:53:01,958 --> 01:53:04,000

would be the most significant discovery

2549

01:53:04,000 --> 01:53:04,708

that humanity ever made.

2550

01:53:05,333 --> 01:53:10,291

So in a way, it will be just like the

2551  
01:53:10,291 --> 01:53:13,458  
Copernican Revolution, except this time

2552  
01:53:13,458 --> 01:53:15,333  
it's not about our physical place in the

2553  
01:53:15,333 --> 01:53:16,333  
universe, but our

2554  
01:53:16,333 --> 01:53:19,666  
intellectual space in the universe.

2555  
01:53:19,666 --> 01:53:23,250  
Anyway, coming back to

2556  
01:53:23,250 --> 01:53:25,708  
the issue of gravity.

2557  
01:53:27,333 --> 01:53:30,166  
So Albert Einstein realized that if all

2558  
01:53:30,166 --> 01:53:31,791  
objects fall the same way under the

2559  
01:53:31,791 --> 01:53:34,291  
influence of gravity, perhaps it's a

2560  
01:53:34,291 --> 01:53:36,166  
property of space and time because they

2561  
01:53:36,166 --> 01:53:38,666  
all respond to the same space-time.

2562  
01:53:38,666 --> 01:53:41,666  
And so he suggested that the curvature of

2563  
01:53:41,666 --> 01:53:44,875

space and time is gravity.

2564

01:53:44,875 --> 01:53:46,958

So space and time are not flat, the way

2565

01:53:46,958 --> 01:53:47,708

Newton thought about them.

2566

01:53:48,458 --> 01:53:50,666

And if you think about the sun, it curves

2567

01:53:50,666 --> 01:53:53,333

space-time just like a bowling ball that

2568

01:53:53,333 --> 01:53:56,333

you put in the middle of a trampoline.

2569

01:53:56,333 --> 01:53:58,833

So there is a rubber surface and the

2570

01:53:58,833 --> 01:54:01,333

bowling ball stretches the rubber

2571

01:54:01,333 --> 01:54:03,208

surface, makes it curved.

2572

01:54:03,208 --> 01:54:05,166

And so if you put a marble and give it a

2573

01:54:05,166 --> 01:54:07,125

kick at the right speed, it will move in

2574

01:54:07,125 --> 01:54:09,708

a circle around the bowling ball, right?

2575

01:54:10,416 --> 01:54:13,083

And on the trampoline. But now if you

2576

01:54:13,083 --> 01:54:15,541

remove the bowling ball and the

2577

01:54:15,541 --> 01:54:18,750

trampoline surface would be flat, this

2578

01:54:18,750 --> 01:54:21,666

same marble will move in a straight line.

2579

01:54:21,666 --> 01:54:24,250

In the same way, the Earth moves around

2580

01:54:24,250 --> 01:54:26,916

the sun in a circle under the influence

2581

01:54:26,916 --> 01:54:27,833

of gravity because it

2582

01:54:27,833 --> 01:54:29,583

has just the right speed.

2583

01:54:29,583 --> 01:54:34,291

It was created from a disk of gas debris

2584

01:54:34,291 --> 01:54:35,750

from the formation process of the sun

2585

01:54:35,750 --> 01:54:36,666

that was orbiting

2586

01:54:36,666 --> 01:54:37,708

around the sun in circles.

2587

01:54:38,583 --> 01:54:40,958

And the Earth condensed out of that and

2588

01:54:40,958 --> 01:54:43,041

therefore it moves in a circle.

2589

01:54:43,041 --> 01:54:45,666

But if you were to remove the sun, just

2590

01:54:45,666 --> 01:54:47,125

like with the bowling ball, the Earth

2591

01:54:47,125 --> 01:54:48,041

would continue on a

2592

01:54:48,041 --> 01:54:51,625

straight line like the marble does.

2593

01:54:51,625 --> 01:54:54,625

So that was Einstein's insight that

2594

01:54:54,625 --> 01:54:56,583

gravity is not a force, it's actually the

2595

01:54:56,583 --> 01:54:58,583

curvature of space and time.

2596

01:54:58,583 --> 01:55:01,166

And a black hole represents that to the

2597

01:55:01,166 --> 01:55:03,416

extreme in the sense that as soon as

2598

01:55:03,416 --> 01:55:04,333

Einstein came up with

2599

01:55:04,333 --> 01:55:05,666

his theory of gravity,

2600

01:55:06,625 --> 01:55:09,791

within a few months he received the

2601

01:55:09,791 --> 01:55:11,208

solution to his equations that he

2602

01:55:11,208 --> 01:55:13,583

couldn't derive, a fully non-linear

2603

01:55:13,583 --> 01:55:14,666

solution, a complete

2604

01:55:14,666 --> 01:55:16,000

solution to his equations.

2605

01:55:16,000 --> 01:55:19,375

It was derived by a physicist, an

2606

01:55:19,375 --> 01:55:20,791

astronomer named Carl

2607

01:55:20,791 --> 01:55:23,083

Schwarzschild, who was also Jewish.

2608

01:55:23,083 --> 01:55:24,791

But the difference between Einstein and

2609

01:55:24,791 --> 01:55:27,000

Schwarzschild is that Schwarzschild was a

2610

01:55:27,000 --> 01:55:29,416

patriot. Einstein was a pacifist.

2611

01:55:30,041 --> 01:55:31,666

And Carl Schwarzschild was the director

2612

01:55:31,666 --> 01:55:37,333

of the Potsdam Observatory and in 1915

2613

01:55:37,333 --> 01:55:39,458

decided to volunteer to take

2614

01:55:39,458 --> 01:55:41,083

part in the First World War,

2615

01:55:41,083 --> 01:55:43,708

to go to the front against the Russians.

2616

01:55:44,333 --> 01:55:51,833

And from there he wrote three important

2617

01:55:51,833 --> 01:55:57,500

papers and then died in the middle of

2618

01:55:57,500 --> 01:56:00,416

1916, so shortly afterwards.

2619

01:56:00,416 --> 01:56:02,208

But Einstein received a postcard from

2620

01:56:02,208 --> 01:56:04,291

Schwarzschild that had a solution to his

2621

01:56:04,291 --> 01:56:06,583

equations of a point mass, which is what

2622

01:56:06,583 --> 01:56:07,708

we now call a black hole.

2623

01:56:08,083 --> 01:56:09,750

Basically, if you take the mass, for

2624

01:56:09,750 --> 01:56:13,166

example, of a star and the star consumes

2625

01:56:13,166 --> 01:56:15,500

all of its nuclear fuel, because it's

2626

01:56:15,500 --> 01:56:16,625

basically a nuclear reactor.

2627

01:56:16,625 --> 01:56:18,416

You can think of the Sun as a nuclear

2628

01:56:18,416 --> 01:56:19,625

reactor held together

2629

01:56:19,625 --> 01:56:21,666

by gravity. That's all.

2630

01:56:21,666 --> 01:56:24,041

And once the fuel in the nuclear reactor

2631

01:56:24,041 --> 01:56:27,708

is exhausted, by the way, the Sun is

2632

01:56:27,708 --> 01:56:30,291

seven billion years away from that fate

2633

01:56:30,291 --> 01:56:31,708

of exhausting its nuclear fuel.

2634

01:56:32,000 --> 01:56:34,583

So roughly in the middle of its lifespan,

2635

01:56:34,583 --> 01:56:37,958

it's 4.6 billion years old and it has

2636

01:56:37,958 --> 01:56:41,458

seven billion years to go or so.

2637

01:56:41,458 --> 01:56:45,125

Once it consumes its nuclear fuel, it

2638

01:56:45,125 --> 01:56:47,833

contracts under gravity. The Sun doesn't

2639

01:56:47,833 --> 01:56:50,458

have a large mass, so it will become a

2640

01:56:50,458 --> 01:56:56,208

solid metal, basically,

2641

01:56:56,208 --> 01:56:58,333

which is called the white dwarf that is

2642

01:56:58,333 --> 01:57:00,041

roughly the size of the Earth.

2643

01:57:00,041 --> 01:57:00,708

Stabilized at some point?

2644

01:57:01,375 --> 01:57:06,250

Yeah, it will contract until the

2645

01:57:06,250 --> 01:57:07,958

Heisenberg uncertainty principle of

2646

01:57:07,958 --> 01:57:10,708

quantum mechanics will prevent electrons

2647

01:57:10,708 --> 01:57:12,458

from overlapping anymore.

2648

01:57:12,458 --> 01:57:14,166

So there would be a maximum density and

2649

01:57:14,166 --> 01:57:15,291

that's called the white dwarf.

2650

01:57:15,291 --> 01:57:17,875

It's basically a piece of metal the size

2651  
01:57:17,875 --> 01:57:21,000  
of the Earth with about 60%, two thirds

2652  
01:57:21,000 --> 01:57:23,166  
of the mass of the Sun in it.

2653  
01:57:23,166 --> 01:57:23,708  
That's the fate of the Sun.

2654  
01:57:24,291 --> 01:57:26,833  
We see a lot of white dwarfs, almost as

2655  
01:57:26,833 --> 01:57:29,875  
many as stars like the Sun because most

2656  
01:57:29,875 --> 01:57:32,625  
of the Sun-like stars formed billions of

2657  
01:57:32,625 --> 01:57:33,291  
years before the Sun.

2658  
01:57:33,291 --> 01:57:36,083  
By now they died and those civilizations

2659  
01:57:36,083 --> 01:57:38,333  
are somewhere else, by the way. However,

2660  
01:57:38,333 --> 01:57:43,458  
their star became basically a metallic

2661  
01:57:43,458 --> 01:57:46,916  
object the size of the Earth with 60% of

2662  
01:57:46,916 --> 01:57:48,208  
the mass of the Sun and

2663  
01:57:48,208 --> 01:57:49,708

the rest was dispersed.

2664

01:57:50,750 --> 01:57:52,250

So that's what would happen to the Sun.

2665

01:57:52,250 --> 01:57:54,916

But if you now take a star that has tens

2666

01:57:54,916 --> 01:57:57,375

of times the mass of the Sun, there is so

2667

01:57:57,375 --> 01:57:59,416

much gravity that the core of

2668

01:57:59,416 --> 01:58:01,833

the star makes a black hole.

2669

01:58:01,833 --> 01:58:04,541

And in fact, we see the events of the

2670

01:58:04,541 --> 01:58:06,833

formation of a black hole from the edge

2671

01:58:06,833 --> 01:58:08,875

of the universe because when this process

2672

01:58:08,875 --> 01:58:09,791

takes place and the

2673

01:58:09,791 --> 01:58:10,708

core of a star collapses,

2674

01:58:12,000 --> 01:58:14,958

some of the material is spewed out,

2675

01:58:14,958 --> 01:58:18,416

ejected into jets that drill a hole

2676

01:58:18,416 --> 01:58:20,333

through the envelope of the star.

2677

01:58:20,333 --> 01:58:22,500

And if we happen to be aligned with those

2678

01:58:22,500 --> 01:58:25,458

jets, we see so-called gamma ray flashes

2679

01:58:25,458 --> 01:58:27,041

or gamma ray bursts from

2680

01:58:27,041 --> 01:58:28,125

the edge of the universe.

2681

01:58:28,125 --> 01:58:29,916

This is another discovery that the US

2682

01:58:29,916 --> 01:58:32,458

government made first because they put

2683

01:58:32,458 --> 01:58:34,333

satellites to look for gamma rays from

2684

01:58:34,333 --> 01:58:37,250

nuclear explosions by the Soviets to make

2685

01:58:37,250 --> 01:58:38,708

sure that the Soviets do not

2686

01:58:40,500 --> 01:58:42,916

explode above the atmosphere. There was a

2687

01:58:42,916 --> 01:58:46,666

ban on the treaty to ban such explosions.

2688

01:58:46,666 --> 01:58:47,875

But the US wanted to make

2689

01:58:47,875 --> 01:58:49,000

sure that there aren't any.

2690

01:58:49,000 --> 01:58:53,375

So they put these gamma ray sensors above

2691

01:58:53,375 --> 01:58:55,875

the atmosphere and every

2692

01:58:55,875 --> 01:58:58,000

few days they saw something.

2693

01:58:58,000 --> 01:58:59,666

And I'm sure in the first few days in

2694

01:58:59,666 --> 01:59:01,500

Washington DC probably there was a lot of

2695

01:59:01,500 --> 01:59:03,625

alarm, but then they realized no, it

2696

01:59:03,625 --> 01:59:04,708

can't be the Russians.

2697

01:59:05,083 --> 01:59:06,875

And then the group in Los Alamos said,

2698

01:59:06,875 --> 01:59:10,291

well, it's actually coming from far away

2699

01:59:10,291 --> 01:59:12,166

based on the fact that the sources of the

2700

01:59:12,166 --> 01:59:14,958

gamma rays moved on the sky in the way

2701

01:59:14,958 --> 01:59:18,291

that you expect from a very distant.

2702

01:59:18,291 --> 01:59:19,750

And these are pulsars?

2703

01:59:19,750 --> 01:59:22,750

No. So at first people said, well, you

2704

01:59:22,750 --> 01:59:26,041

know, let's put them in our galaxy

2705

01:59:26,041 --> 01:59:27,458

because then you don't need as much

2706

01:59:27,458 --> 01:59:29,708

energy if they are relatively nearby.

2707

01:59:30,916 --> 01:59:34,833

But then it was realized that they are

2708

01:59:34,833 --> 01:59:38,750

distributed roughly uniformly around us.

2709

01:59:38,750 --> 01:59:42,583

And the less popular view was, oh, maybe

2710

01:59:42,583 --> 01:59:44,416

they come from the universe at large.

2711

01:59:44,416 --> 01:59:46,958

The more popular view was, oh, they come

2712

01:59:46,958 --> 01:59:48,208

from far away in the galaxy,

2713

01:59:48,208 --> 01:59:49,708

like the hell of the galaxy.

2714

01:59:49,708 --> 01:59:50,708

That was the popular view.

2715

01:59:51,833 --> 01:59:54,916

And NASA built, invested in a gamma ray

2716

01:59:54,916 --> 01:59:58,750

telescope to resolve the distance puzzle

2717

01:59:58,750 --> 01:59:59,833

of gamma ray bursts.

2718

01:59:59,833 --> 02:00:03,958

And they put state of the art gamma ray

2719

02:00:03,958 --> 02:00:07,458

sensors, but dismissed a suggestion to

2720

02:00:07,458 --> 02:00:09,916

put an X-ray sensor.

2721

02:00:09,916 --> 02:00:14,291

And the Italians and the Swiss for a much

2722

02:00:14,291 --> 02:00:15,208

lower budget said,

2723

02:00:15,208 --> 02:00:16,708

let's put an X-ray sensor.

2724

02:00:17,041 --> 02:00:18,916

That was on a BeppoSax

2725

02:00:18,916 --> 02:00:20,833

mission that they launched.

2726

02:00:20,833 --> 02:00:22,583

And they were the ones to make the big

2727

02:00:22,583 --> 02:00:26,500

discovery in 1997 that they saw an X-ray

2728

02:00:26,500 --> 02:00:28,916

flash coming from a gamma ray burst.

2729

02:00:28,916 --> 02:00:31,708

And the gamma rays are so few.

2730

02:00:31,708 --> 02:00:32,958

There are so few photons.

2731

02:00:32,958 --> 02:00:35,166

You can't localize the event with gamma

2732

02:00:35,166 --> 02:00:37,791

ray telescopes very well.

2733

02:00:37,791 --> 02:00:40,041

But in X-rays, they could localize it and

2734

02:00:40,041 --> 02:00:41,416

see that there is a galaxy

2735

02:00:41,416 --> 02:00:42,708

sitting on top very far away.

2736

02:00:42,708 --> 02:00:44,500

So they could tell the distance.

2737

02:00:45,000 --> 02:00:47,000

But they implied that gamma ray bursts

2738

02:00:47,000 --> 02:00:49,000

are at cosmological distances.

2739

02:00:49,000 --> 02:00:51,416

And they release as much energy in the

2740

02:00:51,416 --> 02:00:54,791

jet as you find in supernova explosions.

2741

02:00:54,791 --> 02:00:56,958

So that was a realization.

2742

02:00:56,958 --> 02:00:57,625

Once again, it shows

2743

02:00:57,625 --> 02:00:58,708

you how science is done.

2744

02:00:58,708 --> 02:01:00,083

It's done by iterations.

2745

02:01:00,083 --> 02:01:01,541

People make mistakes along the way.

2746

02:01:01,541 --> 02:01:03,291

And we need to accept that because that's

2747

02:01:03,291 --> 02:01:05,333

the only way, if you don't take risks,

2748

02:01:05,333 --> 02:01:08,166

you will never make discoveries.

2749

02:01:08,166 --> 02:01:10,791

And people that are risk averse, those

2750

02:01:10,791 --> 02:01:12,458

experts, quote-unquote, that do not want

2751

02:01:12,458 --> 02:01:13,708

to risk their reputation,

2752

02:01:14,625 --> 02:01:16,666

they reduce their chances of making an

2753

02:01:16,666 --> 02:01:19,666

important revelation, pushing our

2754

02:01:19,666 --> 02:01:21,875

scientific knowledge.

2755

02:01:21,875 --> 02:01:25,166

So now we can see those events that give

2756

02:01:25,166 --> 02:01:26,125

birth to black holes at

2757

02:01:26,125 --> 02:01:28,500

the edge of the universe.

2758

02:01:28,500 --> 02:01:29,250

So I was going to interrupt you.

2759

02:01:29,250 --> 02:01:30,833

I was going to ask, do you think we're on

2760

02:01:30,833 --> 02:01:33,875

the precipice of a paradigm change?

2761

02:01:33,875 --> 02:01:34,583

Yes.

2762

02:01:34,583 --> 02:01:37,583

But I think it requires hard work in

2763

02:01:37,583 --> 02:01:38,708

terms of getting evidence and data.

2764

02:01:39,500 --> 02:01:42,666

You know, the philosopher Schopenhauer

2765

02:01:42,666 --> 02:01:47,958

said that there are three phases for

2766

02:01:47,958 --> 02:01:50,000

truth to be unraveled.

2767

02:01:50,000 --> 02:01:52,208

And that is definitely true in science.

2768

02:01:52,208 --> 02:01:54,208

The first phase is one in

2769

02:01:54,208 --> 02:01:57,250

which the truth is ridiculed.

2770

02:01:57,250 --> 02:01:58,625

And obviously in the case of Gallivier,

2771

02:01:58,625 --> 02:02:00,500

we know that was the case.

2772

02:02:00,500 --> 02:02:03,750

In the case of UAP and more potentially,

2773

02:02:03,750 --> 02:02:04,833

or interstellar objects

2774

02:02:04,833 --> 02:02:05,708

being of artificial origin,

2775

02:02:06,500 --> 02:02:10,291

it was the case initially, you know, that

2776

02:02:10,291 --> 02:02:12,500

conversation was ridiculed.

2777

02:02:12,500 --> 02:02:17,333

The second phase is one in which people

2778

02:02:17,333 --> 02:02:18,708

find it necessary to

2779

02:02:18,708 --> 02:02:21,958

argue that it's wrong.

2780

02:02:21,958 --> 02:02:24,333

And I got an email last week from someone

2781

02:02:24,333 --> 02:02:25,666

who congratulated me for

2782

02:02:25,666 --> 02:02:27,083

getting to the second phase,

2783

02:02:27,083 --> 02:02:29,208

because there was this nature paper

2784

02:02:29,208 --> 02:02:31,791

trying to argue that UOMU was a hydrogen

2785

02:02:31,791 --> 02:02:32,666

iceberg and so forth.

2786

02:02:33,416 --> 02:02:36,250

So people argue that it's wrong.

2787

02:02:36,250 --> 02:02:38,583

The third phase is one in which the

2788

02:02:38,583 --> 02:02:41,500

evidence is so clear that people say, oh,

2789

02:02:41,500 --> 02:02:43,583

obviously it's self-evident.

2790

02:02:43,583 --> 02:02:47,291

And in fact, when that will happen, if

2791

02:02:47,291 --> 02:02:49,125

that will happen in the context of

2792

02:02:49,125 --> 02:02:50,208

objects from a

2793

02:02:50,208 --> 02:02:53,500

technological origin near Earth,

2794

02:02:53,500 --> 02:02:56,250

then I'm quite confident that the SETI

2795

02:02:56,250 --> 02:02:59,583

community will say, oh, this idea was

2796

02:02:59,583 --> 02:03:00,708

discussed for decades.

2797

02:03:01,208 --> 02:03:02,916

It was obviously a

2798

02:03:02,916 --> 02:03:04,583

possibility for all of us.

2799

02:03:04,583 --> 02:03:05,500

There is nothing

2800

02:03:05,500 --> 02:03:08,291

really new in this finding.

2801  
02:03:08,291 --> 02:03:11,250  
And we said it first.

2802  
02:03:11,250 --> 02:03:13,583  
That would not surprise me.

2803  
02:03:13,583 --> 02:03:14,833  
There is an interesting

2804  
02:03:14,833 --> 02:03:17,833  
anecdote about black holes.

2805  
02:03:17,833 --> 02:03:19,875  
Under us, where we sit right now, there

2806  
02:03:19,875 --> 02:03:21,708  
is a basement, a very

2807  
02:03:21,708 --> 02:03:23,791  
big basement of my home.

2808  
02:03:23,791 --> 02:03:25,833  
And my home is old.

2809  
02:03:25,833 --> 02:03:28,375  
And at some point a decade ago, the

2810  
02:03:28,375 --> 02:03:29,666  
basement was flooded.

2811  
02:03:32,083 --> 02:03:35,500  
And a plumber came over and I went with

2812  
02:03:35,500 --> 02:03:36,791  
him to the basement,

2813  
02:03:36,791 --> 02:03:38,458

and we realized that the

2814

02:03:38,458 --> 02:03:42,791

sewer is clogged by tree roots.

2815

02:03:42,791 --> 02:03:44,666

And it took a while for

2816

02:03:44,666 --> 02:03:46,583

us to fix the problem.

2817

02:03:46,583 --> 02:03:50,208

And during those hours when we had our

2818

02:03:50,208 --> 02:03:51,583

conversations, and this was a real

2819

02:03:51,583 --> 02:03:54,458

plumber, he actually solved the problem.

2820

02:03:54,458 --> 02:03:55,708

A caveat.

2821

02:03:56,750 --> 02:03:58,916

During those hours, well, first he told

2822

02:03:58,916 --> 02:04:00,875

me about his personal life.

2823

02:04:00,875 --> 02:04:04,250

I really, you know, I have no hierarchy

2824

02:04:04,250 --> 02:04:06,875

in terms of people I speak with, and I

2825

02:04:06,875 --> 02:04:08,500

enjoy conversations.

2826  
02:04:08,500 --> 02:04:11,083  
And, you know, I don't pay more attention

2827  
02:04:11,083 --> 02:04:12,375  
to senior colleagues

2828  
02:04:12,375 --> 02:04:14,291  
than to junior colleagues.

2829  
02:04:14,291 --> 02:04:16,708  
And the plumber was as interesting as my

2830  
02:04:16,708 --> 02:04:18,750  
colleagues in academia.

2831  
02:04:18,750 --> 02:04:22,375  
And during that conversation I realized,

2832  
02:04:22,375 --> 02:04:24,708  
well, isn't that similar to what happens

2833  
02:04:25,291 --> 02:04:27,708  
near the center of a black hole? Because

2834  
02:04:27,708 --> 02:04:30,125  
there are these theories that when matter

2835  
02:04:30,125 --> 02:04:31,041  
falls into a black hole,

2836  
02:04:31,041 --> 02:04:33,708  
I mean, we know there is a point near the

2837  
02:04:33,708 --> 02:04:36,375  
center where Einstein's theory breaks

2838  
02:04:36,375 --> 02:04:37,791

down, we call it a singularity,

2839

02:04:37,791 --> 02:04:38,416

because the curvature

2840

02:04:38,416 --> 02:04:40,750

of space-time blows up.

2841

02:04:40,750 --> 02:04:44,875

The density of matter goes to infinity.

2842

02:04:44,875 --> 02:04:46,708

And then people speculate, I mean, we

2843

02:04:46,708 --> 02:04:48,666

know that the reason that Einstein's

2844

02:04:48,666 --> 02:04:49,541

theory is incomplete

2845

02:04:49,541 --> 02:04:50,958

is because it doesn't

2846

02:04:50,958 --> 02:04:51,708

incorporate quantum mechanics.

2847

02:04:52,166 --> 02:04:53,500

That's what string theorists are trying

2848

02:04:53,500 --> 02:04:55,375

to do, unify, marry

2849

02:04:55,375 --> 02:04:58,375

quantum mechanics and gravity.

2850

02:04:58,375 --> 02:05:02,083

But as of now, we don't have a predictive

2851  
02:05:02,083 --> 02:05:03,458  
theory that combines

2852  
02:05:03,458 --> 02:05:05,750  
quantum mechanics and gravity

2853  
02:05:05,750 --> 02:05:07,000  
and says what happens

2854  
02:05:07,000 --> 02:05:08,250  
near the singularity.

2855  
02:05:08,250 --> 02:05:09,041  
What is the

2856  
02:05:09,041 --> 02:05:10,125  
replacement for the singularity?

2857  
02:05:10,125 --> 02:05:11,916  
So some people speculate, maybe the

2858  
02:05:11,916 --> 02:05:13,958  
matter that flows in

2859  
02:05:13,958 --> 02:05:15,375  
goes into another universe.

2860  
02:05:15,375 --> 02:05:17,833  
Maybe it's a pathway somewhere else.

2861  
02:05:20,375 --> 02:05:25,208  
After witnessing the clog in my basement,

2862  
02:05:25,208 --> 02:05:26,500  
I realized maybe

2863  
02:05:26,500 --> 02:05:28,666

matter just collects there.

2864

02:05:28,666 --> 02:05:32,208

Just like the water, I thought it goes...

2865

02:05:32,208 --> 02:05:34,416

I didn't think actually where it goes.

2866

02:05:34,416 --> 02:05:38,458

There is a reservoir that the town owns,

2867

02:05:38,458 --> 02:05:40,541

but once it was clogged, then it started

2868

02:05:40,541 --> 02:05:41,583

collecting in the basement.

2869

02:05:41,583 --> 02:05:44,500

So in much the same way, perhaps there is

2870

02:05:44,500 --> 02:05:46,708

an object at the center of a black hole

2871

02:05:47,791 --> 02:05:49,291

and matter that falls

2872

02:05:49,291 --> 02:05:51,333

onto it collects around it.

2873

02:05:51,333 --> 02:05:53,916

And this object can have the highest

2874

02:05:53,916 --> 02:05:56,583

density that is possible in nature, which

2875

02:05:56,583 --> 02:05:59,333

is called the Planck density.

2876

02:05:59,333 --> 02:06:02,291

And we will never know whether an object

2877

02:06:02,291 --> 02:06:05,500

exists because it's hidden from us by the

2878

02:06:05,500 --> 02:06:06,583

horizon of the black hole.

2879

02:06:06,583 --> 02:06:09,541

The black hole is the ultimate prison.

2880

02:06:11,125 --> 02:06:13,208

According to Carl Schwarzschild, it has a

2881

02:06:13,208 --> 02:06:16,666

region around it from where light cannot

2882

02:06:16,666 --> 02:06:17,875

escape, nothing can escape.

2883

02:06:17,875 --> 02:06:19,958

So you can check into that region, but

2884

02:06:19,958 --> 02:06:21,791

you can never check out.

2885

02:06:21,791 --> 02:06:23,708

Hotel California.

2886

02:06:23,708 --> 02:06:25,375

I had to do it.

2887

02:06:25,375 --> 02:06:29,791

Well, yeah, it's also like Las Vegas,

2888

02:06:29,791 --> 02:06:33,500

what happens in a black hole stays there.

2889

02:06:34,541 --> 02:06:39,583

But it's possible that there is near the

2890

02:06:39,583 --> 02:06:42,875

center a star like object.

2891

02:06:42,875 --> 02:06:46,583

And in fact, I'm currently working on a

2892

02:06:46,583 --> 02:06:49,083

paper that relates to this idea.

2893

02:06:49,083 --> 02:06:51,166

And it was all inspired by

2894

02:06:51,166 --> 02:06:54,041

the sewer in the basement.

2895

02:06:54,041 --> 02:06:56,750

Just to show you that, you know, the

2896

02:06:56,750 --> 02:06:59,708

ideas that I have first

2897

02:06:59,708 --> 02:07:00,708

are not difficult to explain.

2898

02:07:00,916 --> 02:07:02,625

They are relatively simple minded

2899

02:07:02,625 --> 02:07:06,041

because, you know, I'm a farm boy.

2900

02:07:06,041 --> 02:07:10,041

Second, you know, they are not

2901

02:07:10,041 --> 02:07:10,708

necessarily the

2902

02:07:10,708 --> 02:07:12,583

direction that other people take.

2903

02:07:12,583 --> 02:07:16,791

And the only way to verify reality,

2904

02:07:16,791 --> 02:07:20,291

whether it agrees with my notion of it or

2905

02:07:20,291 --> 02:07:23,208

someone else's, is by experimentation.

2906

02:07:23,208 --> 02:07:25,791

And that is the part that I'm taking with

2907

02:07:25,791 --> 02:07:26,708

the Galilio project.

2908

02:07:26,791 --> 02:07:30,083

I completely surrender my pride, my ego

2909

02:07:30,083 --> 02:07:33,166

to whatever nature tells us.

2910

02:07:33,166 --> 02:07:34,791

It's a learning experience and we

2911

02:07:34,791 --> 02:07:35,833

shouldn't assume that we

2912

02:07:35,833 --> 02:07:38,041

know the answers in advance.

2913

02:07:38,041 --> 02:07:41,041

And therefore, you know, I very much hope

2914

02:07:41,041 --> 02:07:43,041

to see a tweet from Elon Musk when the

2915

02:07:43,041 --> 02:07:45,083

Galilio project finds evidence for an

2916

02:07:45,083 --> 02:07:48,375

extraterrestrial device in our backyard.

2917

02:07:48,375 --> 02:07:49,791

I hope he does.

2918

02:07:49,791 --> 02:07:51,583

Abiy, are you familiar with Chaim Ashad?

2919

02:07:51,583 --> 02:07:54,583

He's the former director of Israelis

2920

02:07:54,583 --> 02:07:55,708

equivalent to NASA, essentially.

2921

02:07:56,583 --> 02:07:58,041

Chaim Ashad wrote an

2922

02:07:58,041 --> 02:08:01,250

email to me at some point.

2923

02:08:01,250 --> 02:08:05,125

He made a statement to a major Israeli

2924

02:08:05,125 --> 02:08:07,875

newspaper that he knows that there is

2925

02:08:07,875 --> 02:08:11,458

some classified information that

2926

02:08:11,458 --> 02:08:15,041

indicates a galactic federation of

2927

02:08:15,041 --> 02:08:16,958

intelligent civilizations.

2928

02:08:16,958 --> 02:08:19,666

Now, my take on this is that it's not

2929

02:08:19,666 --> 02:08:21,916

supported by any

2930

02:08:21,916 --> 02:08:24,708

documents or any direct evidence.

2931

02:08:25,458 --> 02:08:27,208

And the problem I have is there are many

2932

02:08:27,208 --> 02:08:30,666

people who claim that they are Napoleon.

2933

02:08:30,666 --> 02:08:33,125

And when you ask them for their idea,

2934

02:08:33,125 --> 02:08:33,875

they cannot provide

2935

02:08:33,875 --> 02:08:35,083

you an idea of Napoleon.

2936

02:08:35,083 --> 02:08:36,041

Also, I know that

2937

02:08:36,041 --> 02:08:40,625

Napoleon, the true Napoleon, died.

2938

02:08:40,625 --> 02:08:41,958

So it's unlikely that

2939

02:08:41,958 --> 02:08:44,041

those people are Napoleon.

2940

02:08:44,041 --> 02:08:48,625

OK. And if they keep insisting on that,

2941

02:08:48,625 --> 02:08:49,500

you know, there are places

2942

02:08:49,500 --> 02:08:50,500

where you put such people.

2943

02:08:51,583 --> 02:08:55,916

So if you insist on a notion that you can

2944

02:08:55,916 --> 02:08:58,750

provide no evidence for,

2945

02:08:58,750 --> 02:09:01,666

that's not a good place to be.

2946

02:09:01,666 --> 02:09:09,416

What you want to say is something is

2947

02:09:09,416 --> 02:09:13,458

known and I have a way of proving it or

2948

02:09:13,458 --> 02:09:16,958

you say nothing or you say I'm seeking

2949

02:09:16,958 --> 02:09:17,708

the evidence for it.

2950

02:09:18,250 --> 02:09:20,416

That's also legitimate if you say it's

2951  
02:09:20,416 --> 02:09:22,291  
possible and I'm seeking the but he was

2952  
02:09:22,291 --> 02:09:24,291  
claiming that there is evidence, but he

2953  
02:09:24,291 --> 02:09:27,333  
can't provide any evidence for it.

2954  
02:09:27,333 --> 02:09:29,666  
And so I just don't

2955  
02:09:29,666 --> 02:09:30,875  
know what to make of it.

2956  
02:09:30,875 --> 02:09:33,625  
It's not very different from eyewitness

2957  
02:09:33,625 --> 02:09:34,500  
testimonies or people that

2958  
02:09:34,500 --> 02:09:37,833  
claim that they were abducted.

2959  
02:09:37,833 --> 02:09:39,833  
I'm not certainly not expecting or asking

2960  
02:09:39,833 --> 02:09:41,916  
you to justify or defend anything he

2961  
02:09:41,916 --> 02:09:43,416  
said, but I was curious just due to your

2962  
02:09:43,416 --> 02:09:44,000  
background, whether

2963  
02:09:44,000 --> 02:09:44,708

there was any communication.

2964

02:09:45,375 --> 02:09:46,708

Actually, you did mention a letter. Could

2965

02:09:46,708 --> 02:09:49,416

you perhaps speak to that?

2966

02:09:49,416 --> 02:09:52,750

Well, I should say, Haim Hashed has a

2967

02:09:52,750 --> 02:09:57,875

very reputable career background in the

2968

02:09:57,875 --> 02:09:59,375

Israeli intelligence agencies.

2969

02:09:59,375 --> 02:10:02,791

So he's very respectable, but I was just

2970

02:10:02,791 --> 02:10:04,708

surprised that he speaks about it without showing any evidence.

2971

02:10:05,625 --> 02:10:09,041

And, you know, it's possible the

2972

02:10:09,041 --> 02:10:15,291

government has data that was not released

2973

02:10:15,291 --> 02:10:19,041

to the public, but I prefer to believe

2974

02:10:19,041 --> 02:10:20,250

that the government is

2975

02:10:20,250 --> 02:10:22,291

simply incompetent scientifically.

2976

02:10:22,291 --> 02:10:23,916

They don't know what to make of whatever

2977

02:10:23,916 --> 02:10:27,708

data they have and to non-specialists, it

2978

02:10:27,708 --> 02:10:28,708

may look very unusual.

2979

02:10:29,916 --> 02:10:33,208

But the only way to advance our knowledge

2980

02:10:33,208 --> 02:10:35,583

is to get better data ourselves so that

2981

02:10:35,583 --> 02:10:38,208

we are not at the mercy of government

2982

02:10:38,208 --> 02:10:41,791

officials telling us what the sky has.

2983

02:10:41,791 --> 02:10:43,916

This is the sky is not classified.

2984

02:10:43,916 --> 02:10:46,625

We can look at it. So we

2985

02:10:46,625 --> 02:10:49,000

have access to the source.

2986

02:10:49,000 --> 02:10:50,625

So why should we rely on the government

2987

02:10:50,625 --> 02:10:52,708

to tell us what the source is?

2988

02:10:53,625 --> 02:10:55,458

Do you think there's any policy or

2989

02:10:55,458 --> 02:10:59,208

legislation that would help enable that

2990

02:10:59,208 --> 02:11:02,666

more public conversation?

2991

02:11:02,666 --> 02:11:05,500

Yeah, I do think that Senator Gillibrand,

2992

02:11:05,500 --> 02:11:08,083

Kirsten Gillibrand, is promoting

2993

02:11:08,083 --> 02:11:12,416

important initiatives, including the

2994

02:11:12,416 --> 02:11:15,000

establishment of the old domain

2995

02:11:15,000 --> 02:11:17,541

resolution office, AERO,

2996

02:11:18,458 --> 02:11:23,000

and also making sure that it gets funded

2997

02:11:23,000 --> 02:11:27,333

and opening the path for people to report

2998

02:11:27,333 --> 02:11:28,375

about things that they

2999

02:11:28,375 --> 02:11:29,375

saw that were unusual.

3000

02:11:29,375 --> 02:11:32,791

But I also think that this approach will

3001

02:11:32,791 --> 02:11:35,791

not bring us closer to scientific

3002

02:11:35,791 --> 02:11:36,708

understanding of what these objects mean.

3003

02:11:37,250 --> 02:11:42,541

All it will do is, at best, identify some

3004

02:11:42,541 --> 02:11:45,541

balloons and tell us some other objects

3005

02:11:45,541 --> 02:11:47,166

have been noticed that

3006

02:11:47,166 --> 02:11:49,166

are strange and unusual.

3007

02:11:49,166 --> 02:11:50,541

But in order to figure

3008

02:11:50,541 --> 02:11:52,875

them out, we need better data.

3009

02:11:52,875 --> 02:11:57,750

And I think the only way for us to get

3010

02:11:57,750 --> 02:12:00,083

that data is to collect it ourselves and

3011

02:12:00,083 --> 02:12:02,000

make it open and have the

3012

02:12:02,000 --> 02:12:02,708

analysis being transparent.

3013

02:12:03,791 --> 02:12:06,625

Because if it's a matter of national

3014

02:12:06,625 --> 02:12:07,875

security, then it's not

3015

02:12:07,875 --> 02:12:08,791

interesting scientifically.

3016

02:12:08,791 --> 02:12:09,958

I don't care what the

3017

02:12:09,958 --> 02:12:14,250

Chinese are making as a scientist.

3018

02:12:14,250 --> 02:12:17,625

But if it's extraterrestrial, then

3019

02:12:17,625 --> 02:12:19,791

national borders are irrelevant.

3020

02:12:19,791 --> 02:12:20,708

It should be knowledge

3021

02:12:20,708 --> 02:12:22,916

that is shared by all humans.

3022

02:12:22,916 --> 02:12:26,250

It shouldn't be the preview of President

3023

02:12:26,250 --> 02:12:26,708

Biden to know about it first,

3024

02:12:27,666 --> 02:12:29,708

for the same reason that when Cecilia

3025

02:12:29,708 --> 02:12:32,000

Paine Kopaschkin found that the Sun is

3026

02:12:32,000 --> 02:12:34,291

made of hydrogen, it wasn't the US

3027

02:12:34,291 --> 02:12:36,291

president who knew it first.

3028

02:12:36,291 --> 02:12:38,166

It was the entire scientific community.

3029

02:12:38,166 --> 02:12:40,500

So this is knowledge that should be

3030

02:12:40,500 --> 02:12:42,250

shared by all humans because it will

3031

02:12:42,250 --> 02:12:44,583

change our perspective

3032

02:12:44,583 --> 02:12:46,208

about our place in the universe.

3033

02:12:46,208 --> 02:12:48,666

And for one thing, my hope is that if we

3034

02:12:48,666 --> 02:12:50,000

find evidence for a

3035

02:12:50,000 --> 02:12:52,708

smarter civilization out there,

3036

02:12:53,125 --> 02:12:55,166

then we would realize that the small

3037

02:12:55,166 --> 02:12:56,833

differences among us

3038

02:12:56,833 --> 02:12:59,583

humans are meaningless.

3039

02:12:59,583 --> 02:13:01,666

And we should treat each other as equal

3040

02:13:01,666 --> 02:13:03,625

members of the human species.

3041

02:13:03,625 --> 02:13:05,666

Because if you look at all the atrocities

3042

02:13:05,666 --> 02:13:07,541

throughout human history, they were

3043

02:13:07,541 --> 02:13:09,916

shaped by groups of people feeling

3044

02:13:09,916 --> 02:13:11,708

superior relative to other people,

3045

02:13:11,708 --> 02:13:15,875

which makes very little sense given the

3046

02:13:15,875 --> 02:13:18,541

perspective of the universe at large.

3047

02:13:20,791 --> 02:13:23,083

I think I agree with you. I don't know if

3048

02:13:23,083 --> 02:13:25,333

really the United States is the vehicle

3049

02:13:25,333 --> 02:13:28,750

that could be the agency

3050

02:13:28,750 --> 02:13:30,291

to make such a proclamation,

3051

02:13:30,291 --> 02:13:32,541

to draw a conclusion about such a data.

3052

02:13:32,541 --> 02:13:34,500

I'm personally of the opinion that this

3053

02:13:34,500 --> 02:13:36,125

is a conversation that we can really

3054

02:13:36,125 --> 02:13:38,125

never reach a conclusion to until we have

3055

02:13:38,125 --> 02:13:41,583

a full worldwide international

3056

02:13:41,583 --> 02:13:41,708

conversation about it.

3057

02:13:42,750 --> 02:13:44,791

Right. And the one thing that is

3058

02:13:44,791 --> 02:13:46,375

interesting is that I

3059

02:13:46,375 --> 02:13:49,208

had visits to this home.

3060

02:13:49,208 --> 02:13:50,000

The sea?

3061

02:13:50,000 --> 02:13:55,291

Yeah. By people from Washington, D.C.

3062

02:13:55,291 --> 02:14:00,416

And to me, that illustrates that there is

3063

02:14:00,416 --> 02:14:02,041

something they don't fully understand,

3064

02:14:02,041 --> 02:14:04,500

that they need the help of scientists.

3065

02:14:04,500 --> 02:14:06,625

And the way I see it is that the work of

3066

02:14:06,625 --> 02:14:07,666

scientists is complementary

3067

02:14:07,666 --> 02:14:08,708

to the work of government.

3068

02:14:09,250 --> 02:14:13,208

I don't want to have access to classified

3069

02:14:13,208 --> 02:14:15,583

information because it will tie my hands

3070

02:14:15,583 --> 02:14:20,083

in doing my scientific work and

3071

02:14:20,083 --> 02:14:24,791

disclosing the results we get openly.

3072

02:14:24,791 --> 02:14:28,208

But I also don't want classified

3073

02:14:28,208 --> 02:14:32,166

information because in principle, we can

3074

02:14:32,166 --> 02:14:33,958

design instruments and put them together

3075

02:14:33,958 --> 02:14:36,791

and get better data than the anecdotal

3076

02:14:36,791 --> 02:14:37,416

reports that the

3077

02:14:37,416 --> 02:14:37,708

government has access to.

3078

02:14:38,875 --> 02:14:43,666

And we heard the hearing in the Senate by

3079

02:14:43,666 --> 02:14:46,750

Dr. Sean Kirkpatrick that he established

3080

02:14:46,750 --> 02:14:50,833

two teams that go over 650 reports.

3081

02:14:50,833 --> 02:14:56,041

And one team is populated by intelligence

3082

02:14:56,041 --> 02:14:57,708

experts and another by scientists and engineers.

3083

02:14:58,333 --> 02:15:02,833

And the best you can expect from this

3084

02:15:02,833 --> 02:15:07,333

kind of an exercise is that they would

3085

02:15:07,333 --> 02:15:10,791

identify some objects, some of them would

3086

02:15:10,791 --> 02:15:13,250

be of national security interest, some

3087

02:15:13,250 --> 02:15:15,500

may be of national security interest and

3088

02:15:15,500 --> 02:15:16,708

some would be, we don't know.

3089

02:15:18,166 --> 02:15:19,833

Those that we don't know are of most

3090

02:15:19,833 --> 02:15:23,958

interest to me. However, we can't revisit

3091

02:15:23,958 --> 02:15:27,000

those events, we can't get better data,

3092

02:15:27,000 --> 02:15:28,000

that's all we have, so

3093

02:15:28,000 --> 02:15:29,750

they will remain unknown.

3094

02:15:29,750 --> 02:15:31,458

The only way to make progress is get

3095

02:15:31,458 --> 02:15:33,000

better data in the future, not do it

3096

02:15:33,000 --> 02:15:36,958

anecdotally, but just monitor the sky

3097

02:15:36,958 --> 02:15:39,375

systematically, 24/7 from many locations,

3098

02:15:39,375 --> 02:15:40,708

see what we find and figure it out.

3099

02:15:41,791 --> 02:15:43,041

And that's what you're doing. That's what

3100

02:15:43,041 --> 02:15:44,833

I'm doing. And I don't need anyone to

3101

02:15:44,833 --> 02:15:45,833

help me in that regard,

3102

02:15:45,833 --> 02:15:48,375

except we just need some funding.

3103

02:15:48,375 --> 02:15:53,791

And I hope that there would be curious

3104

02:15:53,791 --> 02:15:56,083

wealthy individuals like Elon Musk,

3105

02:15:56,083 --> 02:15:57,500

investing in the Galileo Project so that

3106

02:15:57,500 --> 02:15:59,708

we can figure it once and for all.

3107

02:16:00,208 --> 02:16:05,250

And we would reveal the results in an

3108

02:16:05,250 --> 02:16:07,916

open fashion, remove the stigma on the

3109

02:16:07,916 --> 02:16:10,791

subject. And if there is something

3110

02:16:10,791 --> 02:16:12,958

outstanding out there, we will talk about

3111

02:16:12,958 --> 02:16:16,208

it in an open way and publish

3112

02:16:16,208 --> 02:16:18,583

it in peer reviewed journals.

3113

02:16:18,583 --> 02:16:21,208

If there is nothing, if everything looks

3114

02:16:21,208 --> 02:16:24,166

like balloons, we can move on. Why waste

3115

02:16:24,166 --> 02:16:25,333

more time on it? So I

3116

02:16:25,333 --> 02:16:26,708

think it's a win-win situation.

3117

02:16:27,833 --> 02:16:29,625

I agree with you. I'm really happy you're

3118

02:16:29,625 --> 02:16:31,958

looking into this and applying your skill

3119

02:16:31,958 --> 02:16:34,250

set and all the experience that you've

3120

02:16:34,250 --> 02:16:36,333

garnered an incredible life that you've

3121

02:16:36,333 --> 02:16:38,208

lived to bring all that

3122

02:16:38,208 --> 02:16:39,458

expertise onto this topic.

3123

02:16:39,458 --> 02:16:40,916

So thank you, Avi.

3124

02:16:40,916 --> 02:16:43,041

Thanks for having me. And I hope that

3125

02:16:43,041 --> 02:16:45,000

within a year or two, we'll have

3126

02:16:45,000 --> 02:16:46,750

something interesting to report because,

3127

02:16:46,750 --> 02:16:49,208

you know, this is a path that was not

3128

02:16:49,208 --> 02:16:51,333

taken, the road not taken in the spirit

3129

02:16:51,333 --> 02:16:53,708

of the words of Robert Frost in his poem.

3130

02:16:54,583 --> 02:16:57,166

And the one advantage of taking a road

3131

02:16:57,166 --> 02:16:59,750

that was not taken is that there may be

3132

02:16:59,750 --> 02:17:01,916

low hanging fruit since

3133

02:17:01,916 --> 02:17:04,291

nobody picked them up.

3134

02:17:04,291 --> 02:17:06,708

And obviously we'll put them on display

3135

02:17:06,708 --> 02:17:08,625

and everyone would see them. I promised

3136

02:17:08,625 --> 02:17:11,083

the curator of Museum of Modern Art that

3137

02:17:11,083 --> 02:17:13,500

if we find any technological gadget in

3138

02:17:13,500 --> 02:17:16,125

the Pacific Ocean, I'll bring it for

3139

02:17:16,125 --> 02:17:18,750

display in New York City because it

3140

02:17:18,750 --> 02:17:20,708

represents modernity for us.

3141

02:17:21,958 --> 02:17:23,833

And someone wrote an email to me and

3142

02:17:23,833 --> 02:17:26,833

said, please don't press a button because

3143

02:17:26,833 --> 02:17:29,375

it will affect all of us if you find a

3144

02:17:29,375 --> 02:17:31,625

gadget. And I said, don't worry about it.

3145

02:17:31,625 --> 02:17:33,833

I will not press any button.

3146

02:17:35,625 --> 02:17:38,500

And also it's unlikely that we will find

3147

02:17:38,500 --> 02:17:41,500

iPhone 100 at the bottom of the Pacific

3148

02:17:41,500 --> 02:17:44,708

Ocean. But, you know, if you ask me what

3149

02:17:44,708 --> 02:17:48,958

my dream is, it's very different from the

3150

02:17:48,958 --> 02:17:51,500

dream of Elon Musk to die on Mars.

3151

02:17:52,583 --> 02:17:57,000

My dream is to die in interstellar space.

3152

02:17:57,000 --> 02:18:00,291

I just imagine myself being on a mission

3153

02:18:00,291 --> 02:18:04,333

to space and then the mission fails and

3154

02:18:04,333 --> 02:18:07,083

my body drifts into interstellar space,

3155

02:18:07,083 --> 02:18:08,625

maybe kicked by Jupiter

3156

02:18:08,625 --> 02:18:09,708

into interstellar space.

3157

02:18:10,250 --> 02:18:12,291

And then I spend a billion years there

3158

02:18:12,291 --> 02:18:17,291

before I collide with an exoplanet. And

3159

02:18:17,291 --> 02:18:19,958

then I would appear as a meteor in the

3160

02:18:19,958 --> 02:18:22,458

sky of if that planet has an

3161

02:18:22,458 --> 02:18:25,500

atmosphere and is habitable.

3162

02:18:25,500 --> 02:18:27,166

My hope is that there would be an

3163

02:18:27,166 --> 02:18:29,541

astronomer over there looking at the sky

3164

02:18:29,541 --> 02:18:30,541

and saying, look at

3165

02:18:30,541 --> 02:18:32,458

this interstellar meteor.

3166

02:18:33,500 --> 02:18:37,125

Let's figure out what it was made of. And

3167

02:18:37,125 --> 02:18:41,125

that astronomer goes to the ocean on that

3168

02:18:41,125 --> 02:18:45,250

planet and connects the pieces of my body

3169

02:18:45,250 --> 02:18:48,875

and the spacesuit or whatever was left

3170

02:18:48,875 --> 02:18:52,250

and puts them on display in a museum.

3171

02:18:52,250 --> 02:18:54,750

That would be the greatest honor for me

3172

02:18:54,750 --> 02:18:57,208

to be recognized that I existed by

3173

02:18:57,208 --> 02:18:59,708

another civilization in a billion years.

3174

02:19:00,625 --> 02:19:02,291

Incredible. That would be quite the

3175

02:19:02,291 --> 02:19:04,708

honor. And your DNA would be there for

3176

02:19:04,708 --> 02:19:08,458

study. Maybe replication.

3177

02:19:08,458 --> 02:19:11,291

Yeah, that's not. I mean, I don't see

3178

02:19:11,291 --> 02:19:15,500

ourselves, humans, as the pinnacle of

3179

02:19:15,500 --> 02:19:17,666

creation. I think that the AI systems

3180

02:19:17,666 --> 02:19:19,000

will supersede our abilities

3181

02:19:19,000 --> 02:19:19,708

in the not so distant future.

3182

02:19:20,833 --> 02:19:23,791

So, you know, I'm very proud of our

3183

02:19:23,791 --> 02:19:26,125

technological kids as much as I'm proud

3184

02:19:26,125 --> 02:19:29,333

of my biological girls. I have two

3185

02:19:29,333 --> 02:19:31,458

daughters and very proud of them.

3186

02:19:31,458 --> 02:19:33,000

And I don't fully understand them. I

3187

02:19:33,000 --> 02:19:34,458

think we are now at a stage where we

3188

02:19:34,458 --> 02:19:37,583

don't fully understand GPT-4.

3189

02:19:37,583 --> 02:19:40,291

But we should be proud of whatever those

3190

02:19:40,291 --> 02:19:43,416

future AI systems accomplish, including

3191

02:19:43,416 --> 02:19:44,791

venturing into space and

3192

02:19:44,791 --> 02:19:46,666

becoming AI astronauts.

3193

02:19:47,458 --> 02:19:49,208

Speaking of siblings, they may not be AI,

3194

02:19:49,208 --> 02:19:49,708

but what do your

3195

02:19:49,708 --> 02:19:51,875

children think of this topic?

3196

02:19:51,875 --> 02:19:54,291

Your daughters?

3197

02:19:54,291 --> 02:19:59,083

They are excited about it, but I'm still

3198

02:19:59,083 --> 02:20:01,291

hopeful that they will follow my

3199

02:20:01,291 --> 02:20:02,416

footsteps in science.

3200

02:20:02,416 --> 02:20:03,708

It's not at all clear.

3201

02:20:05,000 --> 02:20:09,291

But I don't force myself on anyone. And,

3202

02:20:09,291 --> 02:20:13,500

you know, my hope is that during my

3203

02:20:13,500 --> 02:20:15,125

lifetime, we'll know the answer to the

3204

02:20:15,125 --> 02:20:15,666

questions that we

3205

02:20:15,666 --> 02:20:17,833

were just talking about.