105: Priorities & Strategies for Technosignature Detection I

1
00:00:04,870 --> 00:00:01,990
to open this

2
00:00:08,230 --> 00:00:04,880
session on techno signatures

3
00:00:10,470 --> 00:00:08,240
unfortunately our first speaker is ill

4
00:00:14,549 --> 00:00:10,480
and will not be able to to give this

5
00:00:18,230 --> 00:00:14,559
first talk on artificial illumination

6
00:00:19,830 --> 00:00:18,240
so uh we propose that for the the first

7
00:00:22,630 --> 00:00:19,840
15 minutes we

8
00:00:25,429 --> 00:00:22,640
we open a discussion on um

9
00:00:27,589 --> 00:00:25,439
on the search for biosignatures and

10
00:00:28,550 --> 00:00:27,599
techno signatures and what what are

11
00:00:33,830 --> 00:00:28,560
their

12
00:00:38,310 --> 00:00:35,510
so

13
00:00:40,790 --> 00:00:38,320

the people on zuma are welcome to

14
00:00:43,750 --> 00:00:40,800
contribute of course

15
00:00:52,310 --> 00:00:45,670
yes adam hello

16
00:00:56,310 --> 00:00:54,389
so what do you think what do you think

17
00:00:59,349 --> 00:00:56,320
it's more likely that we would first

18
00:01:00,950 --> 00:00:59,359
find a bio signature or techno signature

19
00:01:02,950 --> 00:01:00,960
and and why

20
00:01:04,070 --> 00:01:02,960
does anybody want to say something yes i

21
00:01:05,670 --> 00:01:04,080
don't

22
00:01:09,750 --> 00:01:05,680
well i just want to bring up the paper

23
00:01:12,149 --> 00:01:09,760
that uh our group um the the cats group

24
00:01:13,590 --> 00:01:12,159
just put out jason was the first author

25
00:01:15,030 --> 00:01:13,600
where we looked at the difference

26
00:01:16,469 --> 00:01:15,040
between those and looked particularly at

27
00:01:20,230 --> 00:01:16,479
the priors

28
00:01:22,550 --> 00:01:20,240
that go into it because of that the um

29
00:01:25,270 --> 00:01:22,560
the way that the drake equation is set

30
00:01:28,070 --> 00:01:25,280
up which is sort of linear from you know

31
00:01:30,149 --> 00:01:28,080
stellar evolution all the way through

32
00:01:32,950 --> 00:01:30,159
societal evolution there's this sense

33
00:01:35,190 --> 00:01:32,960
that oh well techno signatures will come

34
00:01:37,350 --> 00:01:35,200
after we'll have to come later after the

35
00:01:39,510 --> 00:01:37,360
evolution of life which of course on one

36
00:01:41,190 --> 00:01:39,520
level is true but we tried to show there

37
00:01:43,670 --> 00:01:41,200
is that there's a fundamental

38
00:01:45,910 --> 00:01:43,680

distinction between techno signatures

39
00:01:47,910 --> 00:01:45,920
and biosignatures which is that

40
00:01:50,550 --> 00:01:47,920
biosignatures always go with their

41
00:01:52,469 --> 00:01:50,560
biospheres if the biosphere dies the

42
00:01:54,389 --> 00:01:52,479
biosignature goes away and you're not

43
00:01:55,270 --> 00:01:54,399
going to find biosignatures someplace

44
00:01:58,149 --> 00:01:55,280
else

45
00:01:59,990 --> 00:01:58,159
other than where the biosphere is but

46
00:02:01,590 --> 00:02:00,000
technospheres if we think of them as

47
00:02:04,709 --> 00:02:01,600
this as the planet where the

48
00:02:06,709 --> 00:02:04,719
civilization that created the technology

49
00:02:08,150 --> 00:02:06,719
uh was and techno signatures are totally

50
00:02:09,830 --> 00:02:08,160
different because we already earth

51
00:02:13,030 --> 00:02:09,840
already has techno signatures

52
00:02:14,790 --> 00:02:13,040
distributed across the the solar system

53
00:02:16,869 --> 00:02:14,800
we have five of them that have left the

54
00:02:18,550 --> 00:02:16,879
solar system so what that shows is with

55
00:02:21,750 --> 00:02:18,560
even with a single

56
00:02:23,350 --> 00:02:21,760
uh with a single civilization a single

57
00:02:26,070 --> 00:02:23,360
technosphere could produce you know

58
00:02:27,350 --> 00:02:26,080
untold numbers of techno signatures that

59
00:02:30,309 --> 00:02:27,360
could be distributed throughout the

60
00:02:32,710 --> 00:02:30,319
galaxy that will will be still

61
00:02:35,110 --> 00:02:32,720
potentially detectable even after the

62
00:02:36,630 --> 00:02:35,120
civilization dies so this is not to say

63
00:02:38,869 --> 00:02:36,640

the techno signatures you should search

64
00:02:41,190 --> 00:02:38,879
for them instead of biosignatures it's

65
00:02:43,190 --> 00:02:41,200
just that it's quite possible you know

66
00:02:46,150 --> 00:02:43,200
that techno signatures will be easier to

67
00:02:47,270 --> 00:02:46,160
find and will be more numerous than bio

68
00:02:57,350 --> 00:02:47,280
signatures so we're just throwing that

69
00:03:00,550 --> 00:02:59,110
yeah there is a microphone uh at the

70
00:03:05,670 --> 00:03:00,560
back of the room so you can just raise

71
00:03:09,830 --> 00:03:07,270
so i guess while you're all thinking of

72
00:03:11,830 --> 00:03:09,840
questions um even though i'm a co-author

73
00:03:13,430 --> 00:03:11,840
on the paper adam just mentioned i'll

74
00:03:14,949 --> 00:03:13,440
just for sake of discussion you know the

75
00:03:17,110 --> 00:03:14,959
other problem with techno signatures

76
00:03:19,270 --> 00:03:17,120
then front up is how could these be

77
00:03:21,430 --> 00:03:19,280
long-lived or what are long-lived

78
00:03:24,229 --> 00:03:21,440
technical signatures and so even

79
00:03:27,110 --> 00:03:24,239
uh you know the idea that a civilization

80
00:03:28,869 --> 00:03:27,120
could leave its home planet um you could

81
00:03:31,430 --> 00:03:28,879
imagine that that's possible but then

82
00:03:34,229 --> 00:03:31,440
it's not sustainable um so in order to

83
00:03:35,830 --> 00:03:34,239
find technology it has to be something

84
00:03:38,149 --> 00:03:35,840
for astronomy it's hard to find things

85
00:03:39,589 --> 00:03:38,159
that are transient uh when you're doing

86
00:03:41,509 --> 00:03:39,599
long integration times you can find

87
00:03:43,190 --> 00:03:41,519
something that's kind of in a steady

88
00:03:44,710 --> 00:03:43,200

state and so

89
00:03:46,710 --> 00:03:44,720
things like combustion might not be the

90
00:03:48,149 --> 00:03:46,720
best technical signatures uh you know we

91
00:03:50,309 --> 00:03:48,159
have a paper where we talked about

92
00:03:51,750 --> 00:03:50,319
farming because maybe a longer lived

93
00:03:53,750 --> 00:03:51,760
technical signature we've talked about

94
00:03:56,070 --> 00:03:53,760
chlorofluorocarbons

95
00:03:57,429 --> 00:03:56,080
which might not be long-lived but maybe

96
00:04:00,149 --> 00:03:57,439
they are long-lived if you're using it

97
00:04:01,589 --> 00:04:00,159
to terraform a planet um so you know

98
00:04:02,869 --> 00:04:01,599
these are some of the questions that i

99
00:04:05,110 --> 00:04:02,879
think are research questions like what

100
00:04:07,110 --> 00:04:05,120
what are long-lived type of signatures

101
00:04:08,390 --> 00:04:07,120
um because i think you know adam's right

102
00:04:11,110 --> 00:04:08,400
they can leave their planet check their

103
00:04:12,070 --> 00:04:11,120
signatures and um they could potentially

104
00:04:14,550 --> 00:04:12,080
be

105
00:04:16,229 --> 00:04:14,560
uh less ambiguous than bio signatures

106
00:04:17,670 --> 00:04:16,239
but if they're not long-lived then it

107
00:04:19,509 --> 00:04:17,680
might be hard to find so that's that's

108
00:04:20,789 --> 00:04:19,519
one of the questions that uh

109
00:04:22,550 --> 00:04:20,799
hopefully you'll come up with some new

110
00:04:24,710 --> 00:04:22,560
ideas

111
00:04:26,230 --> 00:04:24,720
jacob i was actually wondering how long

112
00:04:29,670 --> 00:04:26,240
is the

113
00:04:31,510 --> 00:04:29,680

farming by signature that you guys

114
00:04:33,990 --> 00:04:31,520
what's the time skill for that the

115
00:04:36,950 --> 00:04:34,000
that's one of the ones that we like for

116
00:04:39,670 --> 00:04:36,960
being long lived uh you could farm a

117
00:04:42,710 --> 00:04:39,680
planet as long as there's a

118
00:04:45,990 --> 00:04:42,720
hydrological cycle and a carbon cycle

119
00:04:48,310 --> 00:04:46,000
um farming the technology of farming is

120
00:04:50,230 --> 00:04:48,320
adding nitrogen to the soil and the

121
00:04:52,550 --> 00:04:50,240
technology you do that through today is

122
00:04:54,790 --> 00:04:52,560
behavior loss process so you take

123
00:04:57,350 --> 00:04:54,800
nitrogen out of the air to make ammonia

124
00:05:00,070 --> 00:04:57,360
through an industrial reaction and you

125
00:05:01,909 --> 00:05:00,080
can power that with you know solar power

126
00:05:02,870 --> 00:05:01,919
uh you can get natural gas or other

127
00:05:05,270 --> 00:05:02,880
speeding

128
00:05:06,950 --> 00:05:05,280
electrolysis from uh water to get the

129
00:05:08,469 --> 00:05:06,960
hydrogen

130
00:05:11,670 --> 00:05:08,479
it's essentially an unlimited reservoir

131
00:05:12,950 --> 00:05:11,680
of nitrogen so um yeah you could really

132
00:05:15,830 --> 00:05:12,960
technically have you know

133
00:05:18,550 --> 00:05:15,840
technologically supported farming as

134
00:05:20,230 --> 00:05:18,560
long as your population stays uh

135
00:05:21,670 --> 00:05:20,240
sustainable you can't have population

136
00:05:23,350 --> 00:05:21,680
growth indefinitely but you could have

137
00:05:33,990 --> 00:05:23,360
farming as long as the plan is

138
00:05:37,350 --> 00:05:34,950

so you could probably say something

139
00:05:39,830 --> 00:05:37,360
about the delphi hey

140
00:05:41,510 --> 00:05:39,840
i just wanted to ask you and the

141
00:05:43,590 --> 00:05:41,520
audience here that we

142
00:05:44,629 --> 00:05:43,600
thought about some techno signatures

143
00:05:46,870 --> 00:05:44,639
that we could

144
00:05:50,070 --> 00:05:46,880
potentially detect with the

145
00:05:51,909 --> 00:05:50,080
upcoming and or planned telescopes

146
00:05:55,430 --> 00:05:51,919
i just wanted to ask the audience or

147
00:05:57,670 --> 00:05:55,440
anyone they have any ideas about what

148
00:05:59,110 --> 00:05:57,680
kinds of technologies that you can think

149
00:06:01,350 --> 00:05:59,120
about

150
00:06:03,029 --> 00:06:01,360
that humanity right now is producing

151
00:06:05,990 --> 00:06:03,039
that we would be able to

152
00:06:09,029 --> 00:06:06,000
detect if we place a third that you know

153
00:06:17,029 --> 00:06:11,270
do you do you happen to know oh there

154
00:06:20,390 --> 00:06:19,110
um so i remember i think the last

155
00:06:22,390 --> 00:06:20,400
episode

156
00:06:25,110 --> 00:06:22,400
i'm tessa fisher the phd candidate at

157
00:06:26,629 --> 00:06:25,120
asu um i remember at the

158
00:06:29,990 --> 00:06:26,639
last episode

159
00:06:31,670 --> 00:06:30,000
um when giada arnie was giving a plenary

160
00:06:33,670 --> 00:06:31,680
that

161
00:06:36,150 --> 00:06:33,680
depending on the design they go for

162
00:06:37,830 --> 00:06:36,160
plato may be able to pick up

163
00:06:39,350 --> 00:06:37,840

um

164
00:06:41,510 --> 00:06:39,360
city lights

165
00:06:43,590 --> 00:06:41,520
like on alpha safari and i i don't

166
00:06:45,590 --> 00:06:43,600
remember within a five light year one

167
00:06:49,189 --> 00:06:45,600
year radius so that was the first one

168
00:06:51,110 --> 00:06:49,199
that comes to my mind anyways

169
00:06:54,629 --> 00:06:51,120
it was exactly the time was supposed to

170
00:06:56,950 --> 00:06:54,639
be in the first the first time thomas

171
00:06:59,350 --> 00:06:56,960
uh unfortunately otherwise we would have

172
00:07:03,510 --> 00:07:01,270
sleep prof uc berkeley i mean sorry

173
00:07:04,469 --> 00:07:03,520
about old passion here but uh radio

174
00:07:06,230 --> 00:07:04,479
signals

175
00:07:08,629 --> 00:07:06,240
and lasers of course as well i mean this

176
00:07:11,430 --> 00:07:08,639
has been you know the classical um

177
00:07:12,950 --> 00:07:11,440
uh search methodology for radio steady

178
00:07:14,469 --> 00:07:12,960
going back looking for narrowband

179
00:07:16,230 --> 00:07:14,479
signals

180
00:07:17,830 --> 00:07:16,240
there's been some work that's been done

181
00:07:19,749 --> 00:07:17,840
that that i'll mention briefly in my

182
00:07:21,670 --> 00:07:19,759
talk this afternoon by my colleague

183
00:07:23,189 --> 00:07:21,680
michelle gajar herbert collaborators

184
00:07:26,710 --> 00:07:23,199
about broadband

185
00:07:28,309 --> 00:07:26,720
uh pulse signals mimicking frbs but with

186
00:07:30,390 --> 00:07:28,319
you know sort of classical dispersion

187
00:07:31,830 --> 00:07:30,400
suite for is you can sort of mess around

188
00:07:33,990 --> 00:07:31,840

with the direction of that sweep and

189
00:07:35,029 --> 00:07:34,000
have things that would show up in

190
00:07:38,150 --> 00:07:35,039
searches for air properties that

191
00:07:39,830 --> 00:07:38,160
obviously look artificial so um uh

192
00:07:41,589 --> 00:07:39,840
you know radio's still a good way to go

193
00:07:43,110 --> 00:07:41,599
it's still a very um sort of energy

194
00:07:45,110 --> 00:07:43,120
efficient way to go and i think you know

195
00:07:46,390 --> 00:07:45,120
we also have a couple of students here

196
00:07:47,510 --> 00:07:46,400
who've been working on laser line

197
00:07:49,430 --> 00:07:47,520
searches with the automated planet

198
00:07:51,189 --> 00:07:49,440
planner that was the closest downstairs

199
00:07:52,710 --> 00:07:51,199
today so let's um you know while we're

200
00:07:54,230 --> 00:07:52,720
thinking of all this

201
00:07:56,230 --> 00:07:54,240
other cool stuff that we could be

202
00:07:57,990 --> 00:07:56,240
looking for let's not um you know forget

203
00:07:59,510 --> 00:07:58,000
that even though radio searches and

204
00:08:00,950 --> 00:07:59,520
optional searches haven't succeeded thus

205
00:08:04,150 --> 00:08:00,960
far it doesn't mean that they're not

206
00:08:06,070 --> 00:08:04,160
going to especially without

207
00:08:07,670 --> 00:08:06,080
expanding the perimeter space um that

208
00:08:09,749 --> 00:08:07,680
we're looking through i have a question

209
00:08:11,670 --> 00:08:09,759
about radio just what we were thinking

210
00:08:14,150 --> 00:08:11,680
about it do you think that there could

211
00:08:17,110 --> 00:08:14,160
be any false positives for a narrow band

212
00:08:22,070 --> 00:08:19,749
um i think you know the the main issue

213
00:08:23,670 --> 00:08:22,080

as we saw with the blc1 signal the

214
00:08:25,430 --> 00:08:23,680
signal that was picked up at the parks

215
00:08:28,230 --> 00:08:25,440
telescope in breakthrough observations

216
00:08:31,990 --> 00:08:28,240
last year is that we're sort of deafened

217
00:08:33,829 --> 00:08:32,000
by our own technology um so i think

218
00:08:35,269 --> 00:08:33,839
that's still going to be the main

219
00:08:37,990 --> 00:08:35,279
problem that we could be sort of

220
00:08:40,790 --> 00:08:38,000
confused um by something of terrestrial

221
00:08:41,909 --> 00:08:40,800
origin that just happens to mimic the

222
00:08:43,269 --> 00:08:41,919
kind of signal that we're looking for

223
00:08:44,310 --> 00:08:43,279
and i mean you know one sort of analogy

224
00:08:46,070 --> 00:08:44,320
that i've come up with you're walking

225
00:08:47,750 --> 00:08:46,080
along a gravel path

226
00:08:49,269 --> 00:08:47,760
um you know you go back to your house

227
00:08:51,590 --> 00:08:49,279
there's a stone in your shoe that's like

228
00:08:53,190 --> 00:08:51,600
the exact right size for the you know

229
00:08:55,190 --> 00:08:53,200
the little kind of gap in the tread of

230
00:08:56,470 --> 00:08:55,200
your soul well you know that stone

231
00:08:58,310 --> 00:08:56,480
wasn't just waiting for you to come

232
00:08:59,829 --> 00:08:58,320
along you know it just happened that you

233
00:09:01,750 --> 00:08:59,839
walked over a million of them and that

234
00:09:04,150 --> 00:09:01,760
was the one will fit right so you have a

235
00:09:05,829 --> 00:09:04,160
match filter you're looking for you know

236
00:09:07,190 --> 00:09:05,839
a narrow band signal for example that

237
00:09:08,710 --> 00:09:07,200
only appears in observations for a

238
00:09:10,150 --> 00:09:08,720

particular star and every once in a

239
00:09:11,430 --> 00:09:10,160
while just from sort of the trials

240
00:09:13,430 --> 00:09:11,440
factor basically you're going to get

241
00:09:16,389 --> 00:09:13,440
something that looks pretty convincing

242
00:09:19,269 --> 00:09:16,399
um i think it's sort of encouraging that

243
00:09:20,310 --> 00:09:19,279
the techniques that we have um to sort

244
00:09:22,389 --> 00:09:20,320
of do

245
00:09:23,990 --> 00:09:22,399
interference rejection

246
00:09:25,829 --> 00:09:24,000
are i mean maybe they're even sort of a

247
00:09:28,870 --> 00:09:25,839
little bit too overzealous we've thrown

248
00:09:30,790 --> 00:09:28,880
everything out um and things like dlc

249
00:09:33,750 --> 00:09:30,800
ones that have made it through you know

250
00:09:37,910 --> 00:09:33,760
um very careful uh examination by by

251
00:09:40,630 --> 00:09:38,949
um

252
00:09:43,110 --> 00:09:40,640
ultimately you know it's consistent with

253
00:09:45,190 --> 00:09:43,120
being human-generated interference

254
00:09:46,710 --> 00:09:45,200
um but i think you know if we got to the

255
00:09:48,310 --> 00:09:46,720
next stage where

256
00:09:49,910 --> 00:09:48,320
we say okay this is still interesting

257
00:09:51,750 --> 00:09:49,920
we're going to put it out for follow-up

258
00:09:53,110 --> 00:09:51,760
um somebody else some other team with a

259
00:09:54,870 --> 00:09:53,120
completely different instrument is going

260
00:09:55,829 --> 00:09:54,880
to go and look at the same target if you

261
00:09:57,269 --> 00:09:55,839
observe

262
00:09:58,949 --> 00:09:57,279
you know proxima sand whether there

263
00:10:01,190 --> 00:09:58,959

could be a telescope in a different day

264
00:10:03,110 --> 00:10:01,200
and saw a line at the same frequency in

265
00:10:04,710 --> 00:10:03,120
the same drift right then i think that's

266
00:10:06,710 --> 00:10:04,720
when people start getting excited we've

267
00:10:08,550 --> 00:10:06,720
not sort of reached that stage yeah so

268
00:10:11,350 --> 00:10:08,560
maybe it's a big problem and so if you

269
00:10:13,750 --> 00:10:11,360
found that would there be any other like

270
00:10:15,110 --> 00:10:13,760
non-rfi false positives that you could

271
00:10:17,269 --> 00:10:15,120
think of like why are we seeing this

272
00:10:19,750 --> 00:10:17,279
narrow bay radio signal for proxima c

273
00:10:21,190 --> 00:10:19,760
and we've ruled out all rfi like

274
00:10:23,269 --> 00:10:21,200
i mean i think it seems convincing to me

275
00:10:24,630 --> 00:10:23,279
i'm just kind of here i mean you know

276
00:10:26,150 --> 00:10:24,640
there could be some other new physics

277
00:10:27,910 --> 00:10:26,160
out there i mean i guess when you know

278
00:10:29,509 --> 00:10:27,920
one pulsar's refers to scale but maybe

279
00:10:31,269 --> 00:10:29,519
jokingly they labeled the little green

280
00:10:33,590 --> 00:10:31,279
men but um you know what could be

281
00:10:34,550 --> 00:10:33,600
something at this regular pulse

282
00:10:36,630 --> 00:10:34,560
we don't know we don't know it's a

283
00:10:37,750 --> 00:10:36,640
rotating neutron star um the the

284
00:10:39,990 --> 00:10:37,760
narrower slides if you're doing an

285
00:10:41,910 --> 00:10:40,000
airline search the narrowest lines are

286
00:10:44,710 --> 00:10:41,920
uh extraterrestrial mazes that are you

287
00:10:45,990 --> 00:10:44,720
know that they're narrower 700 hertz

288
00:10:47,590 --> 00:10:46,000

wide but if you're looking at something

289
00:10:49,910 --> 00:10:47,600
that's a few birds wide

290
00:10:52,949 --> 00:10:49,920
that has some sort of nice clean

291
00:10:54,870 --> 00:10:52,959
uh doppler signal um associated with it

292
00:10:56,470 --> 00:10:54,880
then i think it's it's hard to come up

293
00:10:59,030 --> 00:10:56,480
with an actual process that makes it

294
00:10:59,040 --> 00:11:05,269
thanks

295
00:11:09,670 --> 00:11:07,910
i want to ask if anyone else have any

296
00:11:10,470 --> 00:11:09,680
comments on it

297
00:11:20,069 --> 00:11:10,480
on

298
00:11:23,190 --> 00:11:21,990
um actually i would just like to ask for

299
00:11:25,509 --> 00:11:23,200
a discussion about the difference

300
00:11:27,030 --> 00:11:25,519
between you know classic seti i mean

301
00:11:27,750 --> 00:11:27,040
going back to the beginning was looking

302
00:11:29,670 --> 00:11:27,760
for

303
00:11:31,829 --> 00:11:29,680
in some sense beacons like there was the

304
00:11:33,509 --> 00:11:31,839
idea so much at least in the popular

305
00:11:35,590 --> 00:11:33,519
mind people think of seti as being about

306
00:11:38,310 --> 00:11:35,600
like communication and in fact that was

307
00:11:40,710 --> 00:11:38,320
of course the title of the of the the

308
00:11:43,350 --> 00:11:40,720
meeting that the government asked drake

309
00:11:44,550 --> 00:11:43,360
to organize interstellar communications

310
00:11:46,550 --> 00:11:44,560
but it seems like we're really

311
00:11:47,910 --> 00:11:46,560
especially with exoplanets now that's

312
00:11:49,829 --> 00:11:47,920
not really what we're thinking about

313
00:11:51,590 --> 00:11:49,839

anymore and i just wanted to get some

314
00:11:52,550 --> 00:11:51,600
sense from people about the distinction

315
00:11:55,110 --> 00:11:52,560
between

316
00:11:57,030 --> 00:11:55,120
looking for you know

317
00:11:59,269 --> 00:11:57,040
it just feels like techno even the idea

318
00:12:00,790 --> 00:11:59,279
of techno signatures takes us beyond

319
00:12:03,350 --> 00:12:00,800
really thinking about communication the

320
00:12:05,030 --> 00:12:03,360
communication is not really the emphasis

321
00:12:06,310 --> 00:12:05,040
on what we're doing now i just don't

322
00:12:07,829 --> 00:12:06,320
know if anybody has any comments about

323
00:12:09,509 --> 00:12:07,839
that or how should we be thinking about

324
00:12:11,829 --> 00:12:09,519
it is that a message we should be you

325
00:12:13,269 --> 00:12:11,839
know sort of making clear because bio

326
00:12:15,430 --> 00:12:13,279
signatures clearly aren't we don't

327
00:12:19,030 --> 00:12:15,440
expect bio signatures to be sending us

328
00:12:19,040 --> 00:12:26,870
anyone want to comment on them

329
00:12:29,829 --> 00:12:28,550
um yeah i mean i think we're pretty

330
00:12:31,590 --> 00:12:29,839
agnostic you know with breakthrough

331
00:12:34,310 --> 00:12:31,600
lists as to whether it's sort of

332
00:12:35,990 --> 00:12:34,320
intentional whether it's a beacon or not

333
00:12:37,350 --> 00:12:36,000
um and

334
00:12:39,110 --> 00:12:37,360
uh

335
00:12:40,470 --> 00:12:39,120
to sort of push the analogy maybe in a

336
00:12:42,710 --> 00:12:40,480
different direction about sort of stones

337
00:12:45,030 --> 00:12:42,720
in your shoe i mean sometimes people say

338
00:12:46,629 --> 00:12:45,040

city's a fishing expedition and i say

339
00:12:48,230 --> 00:12:46,639
yeah great you know let's go fishing i

340
00:12:49,990 --> 00:12:48,240
mean let's go fishing with a net and

341
00:12:52,069 --> 00:12:50,000
with a rod wine and different kinds of

342
00:12:54,310 --> 00:12:52,079
bait and you know different sort of

343
00:12:56,870 --> 00:12:54,320
sizes of net of mesh and whatever and

344
00:12:58,310 --> 00:12:56,880
and see what we control up um and it's

345
00:13:00,150 --> 00:12:58,320
definitely important as well to sort of

346
00:13:02,470 --> 00:13:00,160
motivate this with hypothesis testing i

347
00:13:03,829 --> 00:13:02,480
mean i think um you know mentioning what

348
00:13:06,230 --> 00:13:03,839
kind of signals might be out there

349
00:13:08,790 --> 00:13:06,240
imagining whether there might be um you

350
00:13:09,990 --> 00:13:08,800
know deliberate beacons or uh or whether

351
00:13:14,470 --> 00:13:10,000
we're sort of eavesdropping on

352
00:13:17,750 --> 00:13:16,389
planetary transits or alignments where

353
00:13:19,829 --> 00:13:17,760
one planet could be talking to another

354
00:13:22,629 --> 00:13:19,839
and we might end up just sort of picking

355
00:13:24,310 --> 00:13:22,639
up signals that one intended for us

356
00:13:26,710 --> 00:13:24,320
so getting yourself at et's head i think

357
00:13:27,910 --> 00:13:26,720
is is a little hard um

358
00:13:30,389 --> 00:13:27,920
and you know it's something that we

359
00:13:32,310 --> 00:13:30,399
spent a lot of time doing and obviously

360
00:13:34,230 --> 00:13:32,320
sort of um you know as i'm saying that

361
00:13:35,590 --> 00:13:34,240
the ideas that you and others have come

362
00:13:36,870 --> 00:13:35,600
up with for

363
00:13:39,030 --> 00:13:36,880

um

364
00:13:41,189 --> 00:13:39,040
uh this is non-communication

365
00:13:42,550 --> 00:13:41,199
study um you know including um

366
00:13:44,230 --> 00:13:42,560
modification of planetary atmospheres

367
00:13:46,629 --> 00:13:44,240
and that kind of thing is is very

368
00:13:47,990 --> 00:13:46,639
interesting and very motivating because

369
00:13:50,470 --> 00:13:48,000
of the piggybacking those kind of

370
00:13:51,910 --> 00:13:50,480
searches on um biosignature searches as

371
00:13:52,949 --> 00:13:51,920
well on the kind of atmospheric studies

372
00:13:54,949 --> 00:13:52,959
that are going to be done by the next

373
00:13:57,189 --> 00:13:54,959
generation of telescopes but uh you know

374
00:13:58,629 --> 00:13:57,199
i'm also happy personally and again sort

375
00:14:00,870 --> 00:13:58,639
of betraying my bias here just to kind

376
00:14:02,389 --> 00:14:00,880
of cast a white net and see what comes

377
00:14:04,310 --> 00:14:02,399
off right and maybe they're beacons

378
00:14:06,150 --> 00:14:04,320
intended for us or maybe they're you

379
00:14:07,910 --> 00:14:06,160
know the galactic internet or something

380
00:14:09,670 --> 00:14:07,920
that we just happen to kind of end up in

381
00:14:11,110 --> 00:14:09,680
the theme

382
00:14:13,269 --> 00:14:11,120
yeah that's an interesting point because

383
00:14:14,949 --> 00:14:13,279
it's the idea that uh it may be

384
00:14:20,790 --> 00:14:14,959
communications that we detect it's just

385
00:14:22,629 --> 00:14:21,509
yes

386
00:14:25,350 --> 00:14:22,639
so

387
00:14:26,949 --> 00:14:25,360
it's 15 past

388
00:14:29,350 --> 00:14:26,959

maybe

389
00:14:34,710 --> 00:14:29,360
so we will go to the

390
00:14:36,310 --> 00:14:35,509
and

391
00:14:39,189 --> 00:14:36,320
it's

392
00:14:42,470 --> 00:14:39,199
the talk by ravi

393
00:14:44,949 --> 00:14:42,480
koparapu on nitrogen dioxide pollution

394
00:14:48,790 --> 00:14:44,959
as a signature of extraterrestrial

395
00:14:48,800 --> 00:14:57,430
yes

396
00:15:00,710 --> 00:14:58,870
all right thank you

397
00:15:03,350 --> 00:15:00,720
uh jacob and clemo

398
00:15:04,389 --> 00:15:03,360
we uh and thank you for coming here

399
00:15:06,230 --> 00:15:04,399
um

400
00:15:08,550 --> 00:15:06,240
i'm going to briefly discuss about a

401
00:15:11,269 --> 00:15:08,560
paper that we published last year on

402
00:15:12,949 --> 00:15:11,279
how atmospheric pollution can be used

403
00:15:15,590 --> 00:15:12,959
to detect

404
00:15:17,430 --> 00:15:15,600
extraterrestrial technology

405
00:15:19,829 --> 00:15:17,440
i'm going to go ahead and advance a

406
00:15:22,310 --> 00:15:19,839
slide here these are my collaborators

407
00:15:25,350 --> 00:15:22,320
and co-authors on this paper some of you

408
00:15:27,590 --> 00:15:25,360
are here and thank you for

409
00:15:31,269 --> 00:15:27,600
providing your input here and

410
00:15:32,069 --> 00:15:31,279
making this paper a really fun project

411
00:15:34,629 --> 00:15:32,079
um

412
00:15:37,350 --> 00:15:34,639
this is a class of

413
00:15:38,550 --> 00:15:37,360

techno signatures that i think

414
00:15:40,310 --> 00:15:38,560
we've had

415
00:15:41,670 --> 00:15:40,320
mentioned some time ago in in the

416
00:15:42,870 --> 00:15:41,680
literature

417
00:15:45,509 --> 00:15:42,880
but not

418
00:15:47,509 --> 00:15:45,519
in the way that we we discussed it in

419
00:15:49,670 --> 00:15:47,519
the in

420
00:15:51,509 --> 00:15:49,680
the the reason for that was that

421
00:15:52,550 --> 00:15:51,519
the paper in in this paper we were

422
00:15:55,269 --> 00:15:52,560
thinking to

423
00:15:57,990 --> 00:15:55,279
discuss about how we can use the

424
00:16:00,389 --> 00:15:58,000
atmospheric pollution as a detectable

425
00:16:02,150 --> 00:16:00,399
means of technology uh rather than just

426
00:16:04,629 --> 00:16:02,160
discussing that oh okay you know there's

427
00:16:05,910 --> 00:16:04,639
pollution so they you know aliens can

428
00:16:08,069 --> 00:16:05,920
potentially

429
00:16:10,629 --> 00:16:08,079
emit this atmospheric uh techno

430
00:16:12,389 --> 00:16:10,639
signatures so gases from this industrial

431
00:16:14,470 --> 00:16:12,399
activity observed in the atmospheres of

432
00:16:16,310 --> 00:16:14,480
exoplanets are one of the

433
00:16:19,030 --> 00:16:16,320
uh things that atmospheric techno

434
00:16:21,430 --> 00:16:19,040
signatures and one and this is a passive

435
00:16:23,829 --> 00:16:21,440
search we just discussed with steve and

436
00:16:26,150 --> 00:16:23,839
jacob you they don't have to do anything

437
00:16:28,310 --> 00:16:26,160
they just can go on about their lives

438
00:16:30,790 --> 00:16:28,320

and we just need to point our telescopes

439
00:16:32,870 --> 00:16:30,800
to that planet and then see if there is

440
00:16:35,030 --> 00:16:32,880
any atmospheric techno signature in

441
00:16:37,350 --> 00:16:35,040
there

442
00:16:39,350 --> 00:16:37,360
my thinking is that a planet with a

443
00:16:40,949 --> 00:16:39,360
radio technology may also be an

444
00:16:43,590 --> 00:16:40,959
industrialized one

445
00:16:45,590 --> 00:16:43,600
and so if you detect one you might want

446
00:16:48,550 --> 00:16:45,600
to look for the other as well just like

447
00:16:51,670 --> 00:16:48,560
you know based on our earth's example

448
00:16:53,189 --> 00:16:51,680
and why is uh at example good because

449
00:16:55,590 --> 00:16:53,199
that is the example we take even for

450
00:16:57,509 --> 00:16:55,600
biosignature searches too we we are

451
00:17:00,069 --> 00:16:57,519
looking for biosignature earth-like

452
00:17:01,590 --> 00:17:00,079
biosignatures as a standard template

453
00:17:03,910 --> 00:17:01,600
because that's the only known example we

454
00:17:05,669 --> 00:17:03,920
have and so similarly if we want to do a

455
00:17:08,069 --> 00:17:05,679
similar search for techno signatures we

456
00:17:12,309 --> 00:17:08,079
can take example of earth and look for

457
00:17:16,870 --> 00:17:14,630
so why atmospheric techno signatures

458
00:17:19,669 --> 00:17:16,880
well the upcoming space facilities

459
00:17:21,669 --> 00:17:19,679
telescope facilities are focused on the

460
00:17:23,510 --> 00:17:21,679
characterizations of atmospheres using

461
00:17:26,150 --> 00:17:23,520
spectroscopy and observation of

462
00:17:28,069 --> 00:17:26,160
exoplanets and so the search for

463
00:17:30,230 --> 00:17:28,079

biosignatures on these exoplanets

464
00:17:33,270 --> 00:17:30,240
utilizes this technology and this

465
00:17:36,630 --> 00:17:33,280
methodology to detect uh signals of

466
00:17:38,950 --> 00:17:36,640
biology or habitability or inhabitants

467
00:17:40,950 --> 00:17:38,960
and so the idea here is that can we use

468
00:17:42,789 --> 00:17:40,960
the same telescopes the same techniques

469
00:17:44,310 --> 00:17:42,799
and the same instruments

470
00:17:45,830 --> 00:17:44,320
to absorb any potential techno

471
00:17:48,230 --> 00:17:45,840
signatures we don't have to do anything

472
00:17:50,549 --> 00:17:48,240
special with that we just need to you

473
00:17:52,630 --> 00:17:50,559
know if the data is there can we look

474
00:17:54,310 --> 00:17:52,640
for the signals that we want to look for

475
00:17:56,710 --> 00:17:54,320
that can give a

476
00:17:58,310 --> 00:17:56,720
sign of technology is it even possible

477
00:18:01,029 --> 00:17:58,320
to do that there were studies that were

478
00:18:03,029 --> 00:18:01,039
done on biosignatures gases to take the

479
00:18:04,470 --> 00:18:03,039
biosignature gases with these telescopes

480
00:18:06,630 --> 00:18:04,480
so we just wanted to see if we can do

481
00:18:08,470 --> 00:18:06,640
the techno signatures as well

482
00:18:11,430 --> 00:18:08,480
and one of that

483
00:18:12,950 --> 00:18:11,440
techno signature

484
00:18:14,630 --> 00:18:12,960
gases that we want to look for are the

485
00:18:16,870 --> 00:18:14,640
nitrogen dioxide

486
00:18:18,150 --> 00:18:16,880
we had this paper last year

487
00:18:19,830 --> 00:18:18,160
and why

488
00:18:22,070 --> 00:18:19,840

nitrogen dioxide

489
00:18:24,470 --> 00:18:22,080
well the nitrogen oxides are among the

490
00:18:27,510 --> 00:18:24,480
main pollutants of an industrialized

491
00:18:28,950 --> 00:18:27,520
civilization at least for earth

492
00:18:31,350 --> 00:18:28,960
here

493
00:18:33,190 --> 00:18:31,360
they are fossil fuel generated

494
00:18:35,909 --> 00:18:33,200
okay so if there is if it is a fossil

495
00:18:39,110 --> 00:18:35,919
fuel it must emit nitrogen dioxide

496
00:18:41,190 --> 00:18:39,120
uh there are non-anthropogenic non-human

497
00:18:43,270 --> 00:18:41,200
ways of producing nitrogen dioxide and

498
00:18:45,590 --> 00:18:43,280
human generated

499
00:18:47,909 --> 00:18:45,600
ways as well

500
00:18:50,789 --> 00:18:47,919
biology produces it lightening produces

501
00:18:52,470 --> 00:18:50,799
nitrogen dioxide wildfires

502
00:18:56,549 --> 00:18:52,480
and

503
00:18:58,470 --> 00:18:56,559
non-biology together

504
00:19:00,630 --> 00:18:58,480
well if we consider ourselves biology

505
00:19:03,190 --> 00:19:00,640
yes that should also be included in the

506
00:19:05,430 --> 00:19:03,200
nitrogen axis pollution but if we focus

507
00:19:07,830 --> 00:19:05,440
only on human generated ones the vehicle

508
00:19:09,669 --> 00:19:07,840
emissions industrial activity factories

509
00:19:11,669 --> 00:19:09,679
wherever we burn fossil fuels that's

510
00:19:13,590 --> 00:19:11,679
where the nitrogen acid as well

511
00:19:16,549 --> 00:19:13,600
it produces as well so

512
00:19:18,470 --> 00:19:16,559
these are fossil fuel power plants so if

513
00:19:21,270 --> 00:19:18,480

if we can do that then that would be a

514
00:19:23,750 --> 00:19:21,280
good thing to do to detect

515
00:19:25,350 --> 00:19:23,760
currently the anthropogenic emissions

516
00:19:27,190 --> 00:19:25,360
dominate the production of nitrogen

517
00:19:30,870 --> 00:19:27,200
dioxide in our atmosphere by a factor of

518
00:19:34,070 --> 00:19:30,880
three compared to non-anthropogenic ones

519
00:19:36,789 --> 00:19:34,080
and so in this study we just took the

520
00:19:39,510 --> 00:19:36,799
only the the human generated

521
00:19:41,270 --> 00:19:39,520
nitrogen dioxides because we want to

522
00:19:43,990 --> 00:19:41,280
build a threshold

523
00:19:46,549 --> 00:19:44,000
at the minimum if you want to detect a

524
00:19:49,029 --> 00:19:46,559
nitrogen access signal of only human

525
00:19:50,870 --> 00:19:49,039
generator or an advanced industrialized

526
00:19:52,549 --> 00:19:50,880
technology can generate what would the

527
00:19:54,710 --> 00:19:52,559
signal would look like is it even

528
00:19:56,870 --> 00:19:54,720
possible to detect that kind of a signal

529
00:19:59,430 --> 00:19:56,880
on top of that you can add any

530
00:20:01,669 --> 00:19:59,440
biological or non-biological sources and

531
00:20:03,590 --> 00:20:01,679
that would give even larger signal but

532
00:20:06,310 --> 00:20:03,600
you wouldn't know if it's coming from

533
00:20:08,310 --> 00:20:06,320
biology or not and so we just took the

534
00:20:09,750 --> 00:20:08,320
anthropogenic one and tried to do it now

535
00:20:12,310 --> 00:20:09,760
why did we do this

536
00:20:13,669 --> 00:20:12,320
well the industrial pollution

537
00:20:18,549 --> 00:20:13,679
uh

538
00:20:19,350 --> 00:20:18,559

change when during the covet pandemic

539
00:20:21,830 --> 00:20:19,360
when

540
00:20:23,990 --> 00:20:21,840
the global concentration of no2 were

541
00:20:26,390 --> 00:20:24,000
observed to decrease by a factor of

542
00:20:28,870 --> 00:20:26,400
about uh well 20 to 30

543
00:20:31,190 --> 00:20:28,880
40 percent or urban areas i wish i could

544
00:20:32,789 --> 00:20:31,200
show you an animation of this plot

545
00:20:35,029 --> 00:20:32,799
but believe me wherever you see these

546
00:20:37,590 --> 00:20:35,039
hot spots in the industrialized

547
00:20:40,789 --> 00:20:37,600
locations in the united states that was

548
00:20:42,710 --> 00:20:40,799
in january 2020 and because i converted

549
00:20:45,909 --> 00:20:42,720
this into a pdf i cannot show you the

550
00:20:47,270 --> 00:20:45,919
animation but by march 2020 those hot

551
00:20:48,950 --> 00:20:47,280
spots

552
00:20:51,190 --> 00:20:48,960
just disappeared because there were

553
00:20:54,390 --> 00:20:51,200
lockdowns at the time and these these

554
00:20:56,789 --> 00:20:54,400
are the no2 emissions uh map

555
00:20:58,470 --> 00:20:56,799
and so the amount of no2 decreased uh

556
00:21:00,630 --> 00:20:58,480
over the last couple months so this is

557
00:21:02,549 --> 00:21:00,640
where we got the idea from hey you know

558
00:21:04,149 --> 00:21:02,559
what happens can we even detect these

559
00:21:06,470 --> 00:21:04,159
minimal amount of no2 that we are

560
00:21:10,390 --> 00:21:06,480
generating not localized to united

561
00:21:12,310 --> 00:21:10,400
states but global no2 emissions uh from

562
00:21:14,070 --> 00:21:12,320
our civilization

563
00:21:16,390 --> 00:21:14,080

uh so would

564
00:21:18,070 --> 00:21:16,400
these are the questions that came up is

565
00:21:19,990 --> 00:21:18,080
it even detectable by any technique

566
00:21:22,070 --> 00:21:20,000
would we buy signature gases dominate

567
00:21:24,149 --> 00:21:22,080
the spectra are they long live we just

568
00:21:26,310 --> 00:21:24,159
talked about and how much telescope time

569
00:21:27,750 --> 00:21:26,320
we need most critical one

570
00:21:29,909 --> 00:21:27,760
right we can't use we don't have

571
00:21:32,549 --> 00:21:29,919
unlimited telescope time and so where

572
00:21:34,390 --> 00:21:32,559
does a no2 absorb

573
00:21:36,950 --> 00:21:34,400
the x-axis here is the wavelength in

574
00:21:39,190 --> 00:21:36,960
microns and the y-axis is the strength

575
00:21:40,070 --> 00:21:39,200
of the absorption of an auto molecule

576
00:21:42,149 --> 00:21:40,080
and the

577
00:21:43,669 --> 00:21:42,159
rainbow region is the roughly the

578
00:21:45,190 --> 00:21:43,679
optical wavelength region that you know

579
00:21:46,070 --> 00:21:45,200
we are sensitive to

580
00:21:48,149 --> 00:21:46,080
um

581
00:21:51,190 --> 00:21:48,159
no2 has a very strong absorption if you

582
00:21:53,990 --> 00:21:51,200
look at the right plot uh i've plotted

583
00:21:54,710 --> 00:21:54,000
both nitrogen dioxide and other gases as

584
00:21:58,230 --> 00:21:54,720
well

585
00:21:59,750 --> 00:21:58,240
carbon dioxide water ozone and oxygen

586
00:22:01,750 --> 00:21:59,760
there's also methane i didn't do it

587
00:22:03,750 --> 00:22:01,760
because a little bit even more cluttered

588
00:22:05,430 --> 00:22:03,760

the point of this plot is to show that

589
00:22:07,270 --> 00:22:05,440
if you look at the mid-infrared part of

590
00:22:09,430 --> 00:22:07,280
the spectrum there are a lot of gases

591
00:22:11,270 --> 00:22:09,440
that overlap with nitrogen dioxide so it

592
00:22:13,830 --> 00:22:11,280
becomes a little bit confusing but if

593
00:22:15,029 --> 00:22:13,840
you look in the optical and uv part of

594
00:22:15,990 --> 00:22:15,039
the spectrum

595
00:22:18,470 --> 00:22:16,000
which is

596
00:22:20,789 --> 00:22:18,480
where the blue curve is nitrogen dioxide

597
00:22:22,789 --> 00:22:20,799
there is very very little overlap with

598
00:22:25,029 --> 00:22:22,799
any other gas except for ozone and even

599
00:22:28,149 --> 00:22:25,039
in that case there is a sweet spot

600
00:22:30,710 --> 00:22:28,159
between 0.3 to 0.5 micron where the blue

601
00:22:32,070 --> 00:22:30,720
has a peak the and that's where we want

602
00:22:35,350 --> 00:22:32,080
to look at

603
00:22:38,230 --> 00:22:35,360
uh guess what that's where the

604
00:22:41,029 --> 00:22:38,240
future uh plant telescopes flagship like

605
00:22:43,430 --> 00:22:41,039
luar or havocs are going to look

606
00:22:45,110 --> 00:22:43,440
in that wavelength bands and so this we

607
00:22:47,669 --> 00:22:45,120
thought this would be a nice thing to

608
00:22:49,029 --> 00:22:47,679
look at and see if it okay the molecule

609
00:22:51,110 --> 00:22:49,039
absorbs in the right wavelength region

610
00:22:53,029 --> 00:22:51,120
for the telescope can we even detect

611
00:22:55,510 --> 00:22:53,039
this is the detection strong enough to

612
00:22:57,510 --> 00:22:55,520
do that okay so this is the this is what

613
00:22:59,430 --> 00:22:57,520

i just said the direct image technique

614
00:23:01,270 --> 00:22:59,440
in the visible band would be the most

615
00:23:03,990 --> 00:23:01,280
optimal one to detect this sick and this

616
00:23:05,830 --> 00:23:04,000
kind of uh uh no2 emission

617
00:23:09,029 --> 00:23:05,840
all right so we took the

618
00:23:10,390 --> 00:23:09,039
at that time uh the luau a architecture

619
00:23:11,830 --> 00:23:10,400
which is about a 15 meter class

620
00:23:14,070 --> 00:23:11,840
telescope

621
00:23:17,190 --> 00:23:14,080
and then try to see if we want to detect

622
00:23:20,149 --> 00:23:17,200
the current earth level no2

623
00:23:21,590 --> 00:23:20,159
uh the only human-generated one not the

624
00:23:23,669 --> 00:23:21,600
including the biology and everything

625
00:23:25,510 --> 00:23:23,679
else what would it look look like and

626
00:23:27,430 --> 00:23:25,520
what kind of a signal to noise ratio we

627
00:23:28,870 --> 00:23:27,440
can get so the x axis is the amount of

628
00:23:31,350 --> 00:23:28,880
observation time you would need with the

629
00:23:34,230 --> 00:23:31,360
lower 15 meter class telescope and the y

630
00:23:36,149 --> 00:23:34,240
axis is the m the signal to noise ratio

631
00:23:37,110 --> 00:23:36,159
uh so it's a signal significant of three

632
00:23:41,190 --> 00:23:37,120
and i

633
00:23:43,990 --> 00:23:41,200
put a horizontal line um at snr of five

634
00:23:45,750 --> 00:23:44,000
okay uh so for earth like uh planets

635
00:23:47,430 --> 00:23:45,760
around sunlight starts at 10 pasc

636
00:23:49,669 --> 00:23:47,440
roughly around 30 light years away from

637
00:23:51,750 --> 00:23:49,679
us we would need about 600 hours of

638
00:23:53,990 --> 00:23:51,760

lower 15 meter class telescope to reach

639
00:23:54,950 --> 00:23:54,000
signal to noise ratio of five

640
00:23:59,269 --> 00:23:54,960
if you

641
00:24:01,590 --> 00:23:59,279
noise ratio of three you would need

642
00:24:03,750 --> 00:24:01,600
about 300 hours of observation time

643
00:24:04,950 --> 00:24:03,760
i'll come to you i know you may have

644
00:24:07,269 --> 00:24:04,960
some questions about wow this is

645
00:24:08,710 --> 00:24:07,279
hundreds of hours uh i have a slide a

646
00:24:10,470 --> 00:24:08,720
backup slide if we have time in the

647
00:24:12,390 --> 00:24:10,480
discussion section i can come back to

648
00:24:14,950 --> 00:24:12,400
that and compare that with how much time

649
00:24:16,870 --> 00:24:14,960
we spent with hubble space telescope or

650
00:24:19,750 --> 00:24:16,880
space space telescope to observe the

651
00:24:21,830 --> 00:24:19,760
deep sphere deep field views the ultra

652
00:24:23,350 --> 00:24:21,840
deep field views and then we can compare

653
00:24:26,630 --> 00:24:23,360
that with the amount of time that we use

654
00:24:28,789 --> 00:24:26,640
for this uh kind of signature

655
00:24:30,149 --> 00:24:28,799
uh so okay that's good that was the plot

656
00:24:33,510 --> 00:24:30,159
i showed you before was the present

657
00:24:36,149 --> 00:24:33,520
earth level to industrialize pollution

658
00:24:38,549 --> 00:24:36,159
but the amount of no2 has decreased over

659
00:24:41,029 --> 00:24:38,559
the last 40 years globally so if you

660
00:24:42,149 --> 00:24:41,039
want to detect earth 40 years ago what

661
00:24:44,230 --> 00:24:42,159
kind of a

662
00:24:47,110 --> 00:24:44,240
time observation time you would need

663
00:24:48,789 --> 00:24:47,120

right so and that's not too different

664
00:24:50,950 --> 00:24:48,799
you would probably need

665
00:24:52,950 --> 00:24:50,960
less than 600 hours probably around 500

666
00:24:54,310 --> 00:24:52,960
or 400 hours to reach a signal to noise

667
00:24:57,029 --> 00:24:54,320
ratio of five

668
00:24:59,510 --> 00:24:57,039
with the lower 50 meter class telescope

669
00:25:01,990 --> 00:24:59,520
uh and that's the that's actually the

670
00:25:05,029 --> 00:25:02,000
twice the amount uh earth had three

671
00:25:07,350 --> 00:25:05,039
times over the no2 uh 40 years ago so

672
00:25:10,310 --> 00:25:07,360
the time needed to observe this signal

673
00:25:11,590 --> 00:25:10,320
would be even less probably around 300

674
00:25:13,590 --> 00:25:11,600
hours or so

675
00:25:17,750 --> 00:25:13,600
if you want to detect earth at 40 years

676
00:25:18,950 --> 00:25:17,760
ago with this kind of a pollution

677
00:25:20,549 --> 00:25:18,960
um so

678
00:25:21,990 --> 00:25:20,559
what i wanted to point out is industrial

679
00:25:24,149 --> 00:25:22,000
pollutant like anode is possibly

680
00:25:25,750 --> 00:25:24,159
detectable with upcoming telescope

681
00:25:27,669 --> 00:25:25,760
facilities it is not impossible the

682
00:25:29,350 --> 00:25:27,679
signal was not so small that we would

683
00:25:31,430 --> 00:25:29,360
need like thousands of hours of

684
00:25:33,990 --> 00:25:31,440
observation time it was within within

685
00:25:35,990 --> 00:25:34,000
the reach of hundreds of hours and no

686
00:25:37,590 --> 00:25:36,000
like like just like biosignatures there

687
00:25:41,269 --> 00:25:37,600
is no single

688
00:25:43,590 --> 00:25:41,279

gas signature is a sign of technology or

689
00:25:45,269 --> 00:25:43,600
biology you would need the context you

690
00:25:46,630 --> 00:25:45,279
would need the combination of gases you

691
00:25:47,430 --> 00:25:46,640
would need

692
00:25:54,870 --> 00:25:47,440
the

693
00:25:57,350 --> 00:25:54,880
so just like biosignatures we would need

694
00:25:59,350 --> 00:25:57,360
multiple molecular features to

695
00:26:02,470 --> 00:25:59,360
observe techno signatures so for example

696
00:26:04,310 --> 00:26:02,480
no2 cfc radio for example you we would

697
00:26:06,549 --> 00:26:04,320
need all of them together radio is an

698
00:26:09,269 --> 00:26:06,559
unambiguous one in fact i would say if

699
00:26:11,830 --> 00:26:09,279
we can remove the false position that we

700
00:26:13,830 --> 00:26:11,840
discu you know we were thinking about

701
00:26:16,390 --> 00:26:13,840
so

702
00:26:18,310 --> 00:26:16,400
i'm going to end this here uh the

703
00:26:20,710 --> 00:26:18,320
question are we alone which has been a

704
00:26:22,470 --> 00:26:20,720
driving force to search for life is a

705
00:26:24,470 --> 00:26:22,480
question posed by a technological

706
00:26:27,269 --> 00:26:24,480
civilization which is us

707
00:26:29,190 --> 00:26:27,279
so it's a it's a matter of uh what kind

708
00:26:31,669 --> 00:26:29,200
of a technology that we want to detect

709
00:26:33,669 --> 00:26:31,679
it and and how long a technology such

710
00:26:34,789 --> 00:26:33,679
kind of technology can live on

711
00:26:38,310 --> 00:26:34,799
um

712
00:26:40,549 --> 00:26:38,320
i there are some uh caveats about this

713
00:26:43,190 --> 00:26:40,559

plot and also some good things about

714
00:26:44,470 --> 00:26:43,200
this plot so i could discuss this if you

715
00:26:46,470 --> 00:26:44,480
have time

716
00:26:49,110 --> 00:26:46,480
but i want to advertise a

717
00:26:51,430 --> 00:26:49,120
techno signature poster in the

718
00:26:53,430 --> 00:26:51,440
by daniel angerhausen a machine learning

719
00:26:56,390 --> 00:26:53,440
assisted search for techno signals on

720
00:26:58,789 --> 00:26:56,400
the moon using the lro data uh any kind

721
00:26:59,830 --> 00:26:58,799
of anomaly is what you can find and uh

722
00:27:02,310 --> 00:26:59,840
you can see

723
00:27:05,269 --> 00:27:02,320
this on wednesday 11 11 15 or talk sorry

724
00:27:12,870 --> 00:27:05,279
it's not a poster it's talk 11 to 11 15.

725
00:27:16,789 --> 00:27:15,190
so we'll have a discussion section uh

726
00:27:18,389 --> 00:27:16,799
discussion time at the end of the

727
00:27:19,990 --> 00:27:18,399
session

728
00:27:21,510 --> 00:27:20,000
so we'll give you questions for ravi

729
00:27:23,430 --> 00:27:21,520
just keep them in mind and then we'll

730
00:27:26,470 --> 00:27:23,440
have questions for all the speakers and

731
00:27:42,630 --> 00:27:28,389
oh you're just good lady so should i

732
00:27:44,950 --> 00:27:44,070
yes

733
00:27:47,110 --> 00:27:44,960
so

734
00:27:50,950 --> 00:27:47,120
we are heading to the next presentation

735
00:27:53,110 --> 00:27:50,960
by adam frank who will speak about

736
00:27:54,549 --> 00:27:53,120
triggering a climate change dominated

737
00:28:00,149 --> 00:27:54,559
anthropocene

738
00:28:03,430 --> 00:28:01,269

all right

739
00:28:04,710 --> 00:28:03,440
can everyone hear me

740
00:28:06,710 --> 00:28:04,720
yes we can

741
00:28:08,470 --> 00:28:06,720
good okay and you can see my screen so

742
00:28:10,070 --> 00:28:08,480
let me begin let me start my little

743
00:28:11,909 --> 00:28:10,080
timer so i don't go over

744
00:28:14,710 --> 00:28:11,919
okay so the question for today that

745
00:28:17,190 --> 00:28:14,720
we're asking is one uh that can go under

746
00:28:19,110 --> 00:28:17,200
the idea of the at the astrobiology of

747
00:28:20,470 --> 00:28:19,120
the anthropocene which is of interest

748
00:28:22,789 --> 00:28:20,480
both for us

749
00:28:25,029 --> 00:28:22,799
as a you know civilization facing an

750
00:28:27,029 --> 00:28:25,039
anthropocene but we can also ask whether

751
00:28:28,950 --> 00:28:27,039
or not these kinds of transitions are

752
00:28:31,430 --> 00:28:28,960
generic i mean i want to show you some

753
00:28:33,190 --> 00:28:31,440
research uh that we have done this is

754
00:28:35,590 --> 00:28:33,200
work that actually was really

755
00:28:37,350 --> 00:28:35,600
spearheaded by an undergraduate ethan

756
00:28:39,110 --> 00:28:37,360
savage who's now at the going to the

757
00:28:40,630 --> 00:28:39,120
university of florida did amazing work

758
00:28:43,190 --> 00:28:40,640
and then also jonathan carroll

759
00:28:45,750 --> 00:28:43,200
nellenbach my longtime collaborator and

760
00:28:46,950 --> 00:28:45,760
uh jacob was part of this uh as well um

761
00:28:49,190 --> 00:28:46,960
so we had a lot of fun with this

762
00:28:50,950 --> 00:28:49,200
together and then also axel plyden maria

763
00:28:53,029 --> 00:28:50,960

marina alberti

764
00:28:54,549 --> 00:28:53,039
okay so um what we're talking about here

765
00:28:57,830 --> 00:28:54,559
is you know falls under the idea of

766
00:28:59,669 --> 00:28:57,840
co-evolution that life and the planet

767
00:29:01,830 --> 00:28:59,679
evolve together so this is something

768
00:29:04,389 --> 00:29:01,840
that is uh discussed quite a bit in

769
00:29:05,990 --> 00:29:04,399
earth systems science and you can look

770
00:29:09,190 --> 00:29:06,000
back to the history of the earth and see

771
00:29:11,029 --> 00:29:09,200
many examples where life is affecting

772
00:29:12,630 --> 00:29:11,039
the evolution of the planet and the

773
00:29:14,310 --> 00:29:12,640
evolution of the planet is affecting

774
00:29:16,870 --> 00:29:14,320
life so we really don't want to think of

775
00:29:19,510 --> 00:29:16,880
these as two separate systems but that

776
00:29:21,350 --> 00:29:19,520
actually one co-evolving system

777
00:29:23,350 --> 00:29:21,360
and the idea should be that once you get

778
00:29:25,510 --> 00:29:23,360
a technological civilization that is

779
00:29:27,909 --> 00:29:25,520
just another example of this you know

780
00:29:30,470 --> 00:29:27,919
billion year evolution and interchange

781
00:29:31,830 --> 00:29:30,480
between life and uh life in the planet

782
00:29:34,310 --> 00:29:31,840
now it's just you know what we might

783
00:29:36,470 --> 00:29:34,320
call technological life um

784
00:29:38,630 --> 00:29:36,480
so uh now you know there's a great deal

785
00:29:41,909 --> 00:29:38,640
of discussion about whether or not there

786
00:29:45,029 --> 00:29:41,919
are going to be generic classes of

787
00:29:47,029 --> 00:29:45,039
trajectory for um the evolution of

788
00:29:50,070 --> 00:29:47,039

biospheres the evolution of life right

789
00:29:53,029 --> 00:29:50,080
so will there be um uh will should we

790
00:29:55,510 --> 00:29:53,039
expect biospheres to develop forms of

791
00:29:58,149 --> 00:29:55,520
life even you know molecular you know

792
00:29:59,510 --> 00:29:58,159
metabolisms um that will be in some

793
00:30:01,350 --> 00:29:59,520
sense similar to anything that's

794
00:30:04,789 --> 00:30:01,360
happened on earth and this is an ongoing

795
00:30:06,070 --> 00:30:04,799
debate of course um you know people um

796
00:30:07,990 --> 00:30:06,080
so there's this question about wings so

797
00:30:10,630 --> 00:30:08,000
i give these two examples of wings right

798
00:30:13,190 --> 00:30:10,640
nature on earth has stumbled upon wings

799
00:30:16,310 --> 00:30:13,200
um through a lot of phylogenetic uh

800
00:30:17,909 --> 00:30:16,320
pathways um or genetic pathways

801
00:30:20,789 --> 00:30:17,919
now uh people like david katlin would

802
00:30:22,870 --> 00:30:20,799
argue that you know there one example of

803
00:30:24,710 --> 00:30:22,880
this would be just oxygen that uh his

804
00:30:26,310 --> 00:30:24,720
claim is that oxygen molecular oxygen is

805
00:30:27,430 --> 00:30:26,320
really the most powerful and potent kind

806
00:30:29,110 --> 00:30:27,440
of chemical you're going to use for

807
00:30:30,950 --> 00:30:29,120
building life and that should happen

808
00:30:32,070 --> 00:30:30,960
anywhere uh and this may also this

809
00:30:33,590 --> 00:30:32,080
doesn't necessarily have to be about

810
00:30:36,630 --> 00:30:33,600
chemicals or structures can also be

811
00:30:38,870 --> 00:30:36,640
about information um kim at all the

812
00:30:40,950 --> 00:30:38,880
arizona um group uh which is

813
00:30:43,190 --> 00:30:40,960

extraordinary has done work looking at

814
00:30:44,870 --> 00:30:43,200
um uh to sort of how the the

815
00:30:47,430 --> 00:30:44,880
informational topologies the network

816
00:30:49,110 --> 00:30:47,440
topologies for life and earth at

817
00:30:50,710 --> 00:30:49,120
different scales are very similar and

818
00:30:51,750 --> 00:30:50,720
perhaps that's an indicator that that

819
00:30:54,310 --> 00:30:51,760
that you can think of that is a

820
00:30:56,230 --> 00:30:54,320
convergent uh evolution to evolutionary

821
00:30:58,310 --> 00:30:56,240
check uh trajectory and then of course

822
00:31:00,549 --> 00:30:58,320
in techno signatures the most obvious

823
00:31:02,070 --> 00:31:00,559
example of this is the kardashev scale

824
00:31:03,830 --> 00:31:02,080
claiming that there was these types type

825
00:31:06,630 --> 00:31:03,840
one type two type 3 and these would be a

826
00:31:09,509 --> 00:31:06,640
natural progression for any civilization

827
00:31:11,750 --> 00:31:09,519
in terms of energy harvesting

828
00:31:15,350 --> 00:31:11,760
all right now on earth our energy

829
00:31:16,950 --> 00:31:15,360
harvesting uh among other things has led

830
00:31:18,389 --> 00:31:16,960
us into what has been called the

831
00:31:20,389 --> 00:31:18,399
anthropocene

832
00:31:22,549 --> 00:31:20,399
which is uh you know we are currently in

833
00:31:24,310 --> 00:31:22,559
the epoch the geological epoch known as

834
00:31:27,029 --> 00:31:24,320
the holocene which is the current last

835
00:31:28,789 --> 00:31:27,039
ten thousand years interglacial period

836
00:31:30,950 --> 00:31:28,799
um but it really looks like human beings

837
00:31:33,990 --> 00:31:30,960
through their activity uh are going to

838
00:31:36,389 --> 00:31:34,000

arrest that are ending the uh uh the and

839
00:31:37,750 --> 00:31:36,399
the uh holocene um and that we're

840
00:31:39,590 --> 00:31:37,760
entering something called the uh

841
00:31:41,430 --> 00:31:39,600
anthropocene which is marked by human

842
00:31:44,310 --> 00:31:41,440
activity where human activity is the

843
00:31:46,549 --> 00:31:44,320
principal driver for the um the earth

844
00:31:48,389 --> 00:31:46,559
systems for their functions and their uh

845
00:31:49,909 --> 00:31:48,399
you know what is pushing them around and

846
00:31:51,269 --> 00:31:49,919
there's you know lots and lots and lots

847
00:31:53,190 --> 00:31:51,279
of evidence for this i don't need to go

848
00:31:54,549 --> 00:31:53,200
into this so um i will take it as a

849
00:31:57,590 --> 00:31:54,559
given that we have entered the

850
00:32:00,230 --> 00:31:57,600
anthropocene and then the question is um

851
00:32:02,070 --> 00:32:00,240
this topic that um jacob and i and

852
00:32:04,310 --> 00:32:02,080
others have looked at is this idea of

853
00:32:06,549 --> 00:32:04,320
the astrobiology of the anthropocene if

854
00:32:08,789 --> 00:32:06,559
we think of the anthropocene as being a

855
00:32:10,310 --> 00:32:08,799
planetary transition then we can ask

856
00:32:12,870 --> 00:32:10,320
whether or not this is something that

857
00:32:14,310 --> 00:32:12,880
any civilization might drive and so the

858
00:32:16,070 --> 00:32:14,320
questions that come up if you want to

859
00:32:18,149 --> 00:32:16,080
ask about the astrobiology of the

860
00:32:19,750 --> 00:32:18,159
anthropocene and eventually the techno

861
00:32:21,669 --> 00:32:19,760
signatures that might be associated with

862
00:32:23,029 --> 00:32:21,679
it are how common are they and of course

863
00:32:24,710 --> 00:32:23,039

we're putting this in quote right

864
00:32:27,830 --> 00:32:24,720
because if it's a difference you know it

865
00:32:30,710 --> 00:32:27,840
would have to be a borgo scene or um or

866
00:32:32,789 --> 00:32:30,720
a klingono scene or whatever

867
00:32:35,190 --> 00:32:32,799
how fatal are these do anthropocenes

868
00:32:37,029 --> 00:32:35,200
always truncate uh evolution or do they

869
00:32:39,029 --> 00:32:37,039
uh the evolution of a civilization or do

870
00:32:41,029 --> 00:32:39,039
they just delay it for long periods of

871
00:32:43,750 --> 00:32:41,039
time and then from the techno signature

872
00:32:46,630 --> 00:32:43,760
side what properties might we expect um

873
00:32:48,310 --> 00:32:46,640
these uh civilizations that have have

874
00:32:50,310 --> 00:32:48,320
undergone anthropocenes and gotten

875
00:32:51,430 --> 00:32:50,320
through them what properties might they

876
00:32:56,389 --> 00:32:51,440
have

877
00:32:58,149 --> 00:32:56,399
before so what i'm going to show you is

878
00:33:00,710 --> 00:32:58,159
a new work on it but i want to remind

879
00:33:03,590 --> 00:33:00,720
you of the old work um this paper uh

880
00:33:05,350 --> 00:33:03,600
frank at all 2018 where we did uh a

881
00:33:07,110 --> 00:33:05,360
popul we did a modeling where we had a

882
00:33:09,590 --> 00:33:07,120
model for the population of the

883
00:33:11,509 --> 00:33:09,600
civilization that's n here and then the

884
00:33:12,870 --> 00:33:11,519
model for the environment as well which

885
00:33:15,350 --> 00:33:12,880
is e here you can think of it as

886
00:33:17,350 --> 00:33:15,360
temperature and we did population

887
00:33:19,509 --> 00:33:17,360
coupled modeling between the population

888
00:33:22,549 --> 00:33:19,519

and the planet with the planet

889
00:33:23,909 --> 00:33:22,559
responding to the population's feedback

890
00:33:26,470 --> 00:33:23,919
and what we found is that there were

891
00:33:28,789 --> 00:33:26,480
three classes of trajectory that uh in

892
00:33:31,590 --> 00:33:28,799
the models there was a green here is the

893
00:33:33,269 --> 00:33:31,600
population and red is the planetary we

894
00:33:34,950 --> 00:33:33,279
can think of it as temperature um

895
00:33:36,950 --> 00:33:34,960
there's what's called the smooth landing

896
00:33:38,870 --> 00:33:36,960
where the planet responds to the

897
00:33:41,110 --> 00:33:38,880
population but everybody comes into a

898
00:33:43,029 --> 00:33:41,120
new equilibrium um

899
00:33:45,190 --> 00:33:43,039
there was also the die off which i'm

900
00:33:47,029 --> 00:33:45,200
pointing to here where the population

901
00:33:49,909 --> 00:33:47,039
overshoots the planet's carrying

902
00:33:52,149 --> 00:33:49,919
capacity and then drops you know quite

903
00:33:53,830 --> 00:33:52,159
strongly and you may lose you know a

904
00:33:55,269 --> 00:33:53,840
considerable amount of your civilization

905
00:33:57,669 --> 00:33:55,279
and you can ask whether or not

906
00:33:59,750 --> 00:33:57,679
a technological civilization could still

907
00:34:01,350 --> 00:33:59,760
function under those conditions and then

908
00:34:02,789 --> 00:34:01,360
finally we also had complete collapse

909
00:34:04,950 --> 00:34:02,799
which is really what you're hoping to

910
00:34:06,470 --> 00:34:04,960
avoid but now these models were pretty

911
00:34:09,190 --> 00:34:06,480
simple in the sense that you know

912
00:34:10,950 --> 00:34:09,200
especially the environment the model for

913
00:34:13,589 --> 00:34:10,960

the environment was really it was a toy

914
00:34:16,550 --> 00:34:13,599
model so what we want to do now

915
00:34:18,470 --> 00:34:16,560
is um go forward and this is the new

916
00:34:19,589 --> 00:34:18,480
paper and what we're going to the main

917
00:34:21,270 --> 00:34:19,599
thing we're going to add here is we're

918
00:34:23,829 --> 00:34:21,280
going to think about civilizations that

919
00:34:25,909 --> 00:34:23,839
use combustion in one form another and

920
00:34:27,109 --> 00:34:25,919
ask about how they are going to change

921
00:34:30,149 --> 00:34:27,119
their um

922
00:34:31,349 --> 00:34:30,159
uh their planets using a 1d climate

923
00:34:33,270 --> 00:34:31,359
model so

924
00:34:35,270 --> 00:34:33,280
the model we use jacob

925
00:34:36,710 --> 00:34:35,280
provided it um

926
00:34:38,950 --> 00:34:36,720
these are the authors who sort of you

927
00:34:41,990 --> 00:34:38,960
know used developed and used it and it's

928
00:34:44,470 --> 00:34:42,000
basically uh it's a a

929
00:34:46,470 --> 00:34:44,480
latitudinal model um but we're going to

930
00:34:48,389 --> 00:34:46,480
average over over the model we're going

931
00:34:49,990 --> 00:34:48,399
to get it just a one planetary

932
00:34:52,550 --> 00:34:50,000
temperature but at least it allows us to

933
00:34:54,230 --> 00:34:52,560
actually you know do a climate model

934
00:34:55,750 --> 00:34:54,240
have get a temperature out of that have

935
00:34:58,550 --> 00:34:55,760
that temperature feed back into our

936
00:35:00,150 --> 00:34:58,560
population model so down here is just we

937
00:35:02,230 --> 00:35:00,160
are this is just temperature versus

938
00:35:05,030 --> 00:35:02,240

distance on co2 what we're really

939
00:35:07,190 --> 00:35:05,040
showing is we recover the um

940
00:35:09,190 --> 00:35:07,200
uh the habitable zone basically this

941
00:35:11,510 --> 00:35:09,200
model does a nice job of recovering what

942
00:35:13,589 --> 00:35:11,520
everybody knows as the habitable zone so

943
00:35:15,510 --> 00:35:13,599
okay that's our starting point

944
00:35:17,670 --> 00:35:15,520
to this we're going to add a population

945
00:35:19,349 --> 00:35:17,680
model n is the number the population of

946
00:35:21,030 --> 00:35:19,359
the civilization we don't need to look

947
00:35:23,349 --> 00:35:21,040
at this in detail just that there is

948
00:35:26,390 --> 00:35:23,359
going to be um we're going to have an

949
00:35:28,550 --> 00:35:26,400
enhanced growth rate due to technology

950
00:35:32,310 --> 00:35:28,560
where p which is the partial pressure of

951
00:35:33,990 --> 00:35:32,320
co2 is going to be indicative of that

952
00:35:35,670 --> 00:35:34,000
enhanced growth rate and then there's

953
00:35:38,550 --> 00:35:35,680
also going to be a diminished growth

954
00:35:40,950 --> 00:35:38,560
rate due to temperature so basically if

955
00:35:42,630 --> 00:35:40,960
you creating co2 that's indicative of

956
00:35:44,630 --> 00:35:42,640
the fact that you're harvesting energy

957
00:35:46,630 --> 00:35:44,640
harvesting energy is good for increasing

958
00:35:48,630 --> 00:35:46,640
your population but as your temperature

959
00:35:50,470 --> 00:35:48,640
as that feedback's on the planet and the

960
00:35:52,470 --> 00:35:50,480
temperature rises you're going to start

961
00:35:55,109 --> 00:35:52,480
beginning you get once you get past the

962
00:35:57,109 --> 00:35:55,119
delta t the range of temperature that

963
00:36:00,150 --> 00:35:57,119

the population can handle you're going

964
00:36:03,589 --> 00:36:00,160
to start having increased death rates

965
00:36:05,030 --> 00:36:03,599
uh and we note that the the uh the co2 p

966
00:36:06,790 --> 00:36:05,040
is the partial pressure is going to

967
00:36:08,950 --> 00:36:06,800
depend on the population so the

968
00:36:11,270 --> 00:36:08,960
population is going to generate co2 and

969
00:36:12,470 --> 00:36:11,280
co2 is going to feed back

970
00:36:14,710 --> 00:36:12,480
all right i won't go into this in any

971
00:36:16,150 --> 00:36:14,720
detail i'll just note these are just the

972
00:36:17,750 --> 00:36:16,160
the uh

973
00:36:19,190 --> 00:36:17,760
important parameters of the model and

974
00:36:21,510 --> 00:36:19,200
what we're going to call a climate

975
00:36:24,310 --> 00:36:21,520
dominated anthropocene is one where you

976
00:36:26,230 --> 00:36:24,320
see strong population decline before

977
00:36:27,349 --> 00:36:26,240
you've hit the natural the carrying

978
00:36:28,230 --> 00:36:27,359
capacity

979
00:36:29,510 --> 00:36:28,240
okay

980
00:36:30,870 --> 00:36:29,520
um and what we're also going to be

981
00:36:33,589 --> 00:36:30,880
interested in is what's called the

982
00:36:35,270 --> 00:36:33,599
complex life habitable zone and we can

983
00:36:37,430 --> 00:36:35,280
talk about this in the discussions which

984
00:36:39,030 --> 00:36:37,440
is basically you know co2 for life on

985
00:36:41,829 --> 00:36:39,040
earth is pretty dangerous once you get

986
00:36:43,109 --> 00:36:41,839
past about 5 000 parts per million and

987
00:36:45,190 --> 00:36:43,119
so we're not going to be interested in

988
00:36:46,550 --> 00:36:45,200

planets that go beyond this so we're

989
00:36:49,109 --> 00:36:46,560
only going to do our models we're going

990
00:36:52,870 --> 00:36:49,119
to apply our models to that ring of

991
00:36:54,710 --> 00:36:52,880
orbits where you um can increase co2 to

992
00:36:56,950 --> 00:36:54,720
make your planet habitable but if you

993
00:36:59,109 --> 00:36:56,960
have to increase your co2 by dumping

994
00:37:00,630 --> 00:36:59,119
huge amounts into it to get the planet

995
00:37:03,190 --> 00:37:00,640
to be get the temperature to be warm

996
00:37:04,790 --> 00:37:03,200
enough for uh life for liquid water to

997
00:37:07,190 --> 00:37:04,800
form then we're not going to include

998
00:37:09,190 --> 00:37:07,200
those in our models

999
00:37:11,430 --> 00:37:09,200
i will note that we use the models we

1000
00:37:14,550 --> 00:37:11,440
first tuned the models to the population

1001
00:37:16,230 --> 00:37:14,560
growth uh on temperature rise on earth

1002
00:37:18,310 --> 00:37:16,240
uh for the last hundred or so years and

1003
00:37:19,349 --> 00:37:18,320
we got a very nice uh response so that

1004
00:37:21,190 --> 00:37:19,359
was good

1005
00:37:22,390 --> 00:37:21,200
um and then now let me show you the

1006
00:37:24,150 --> 00:37:22,400
models where the most important

1007
00:37:26,550 --> 00:37:24,160
parameter in the models is this factor

1008
00:37:28,550 --> 00:37:26,560
gamma which is the

1009
00:37:31,510 --> 00:37:28,560
the growth time of the civilization

1010
00:37:33,910 --> 00:37:31,520
divided by the the response time of the

1011
00:37:35,829 --> 00:37:33,920
climate and so if gamma is low that

1012
00:37:37,430 --> 00:37:35,839
means the civilization can grow very

1013
00:37:39,510 --> 00:37:37,440

quickly and the climate's not going to

1014
00:37:41,670 --> 00:37:39,520
know about it and here is one of those

1015
00:37:43,430 --> 00:37:41,680
models population on one side and

1016
00:37:45,349 --> 00:37:43,440
temperature and co2 on the other and

1017
00:37:47,710 --> 00:37:45,359
what you see is the population grows up

1018
00:37:50,550 --> 00:37:47,720
to its um carrying

1019
00:37:52,550 --> 00:37:50,560
capacity of 20 billion okay and then

1020
00:37:54,150 --> 00:37:52,560
slowly starts to decline we can talk

1021
00:37:55,829 --> 00:37:54,160
about why this is but basically this

1022
00:37:57,030 --> 00:37:55,839
civilization is not going through an

1023
00:38:00,470 --> 00:37:57,040
ants at the scene

1024
00:38:02,710 --> 00:38:00,480
this civilization with gamma of 181

1025
00:38:04,470 --> 00:38:02,720
is very sensitive and it is going as you

1026
00:38:06,150 --> 00:38:04,480
can see it's going to go through an uh a

1027
00:38:09,030 --> 00:38:06,160
climate driven anthropocene the

1028
00:38:10,550 --> 00:38:09,040
population rises and never gets to 20

1029
00:38:13,430 --> 00:38:10,560
billion you can see it gets to much less

1030
00:38:15,109 --> 00:38:13,440
than 20 billion and then drops um to the

1031
00:38:17,750 --> 00:38:15,119
point where you know

1032
00:38:20,230 --> 00:38:17,760
you've lost a fairly large

1033
00:38:22,390 --> 00:38:20,240
fraction of your population so we do see

1034
00:38:24,950 --> 00:38:22,400
anthropocenes in our models and this is

1035
00:38:27,670 --> 00:38:24,960
sort of the important takeaway

1036
00:38:30,310 --> 00:38:27,680
here is distance versus temperature uh

1037
00:38:32,150 --> 00:38:30,320
for two va two um

1038
00:38:34,230 --> 00:38:32,160

parameters for the model this is the

1039
00:38:36,790 --> 00:38:34,240
time to decline by 20

1040
00:38:39,670 --> 00:38:36,800
of peak population um and you can see

1041
00:38:41,750 --> 00:38:39,680
that in this entire band here um you

1042
00:38:44,550 --> 00:38:41,760
know after a few hundred years you lose

1043
00:38:46,710 --> 00:38:44,560
20 percent of your population um and so

1044
00:38:49,750 --> 00:38:46,720
uh also we can also calculate the

1045
00:38:51,430 --> 00:38:49,760
collapse time which uh is another

1046
00:38:53,190 --> 00:38:51,440
indicative feature of how

1047
00:38:54,870 --> 00:38:53,200
quickly you're dropping

1048
00:38:57,270 --> 00:38:54,880
your population is dropping and what you

1049
00:38:59,670 --> 00:38:57,280
can see here is that the collapse time

1050
00:39:01,990 --> 00:38:59,680
is less than a few hundred years in this

1051
00:39:04,550 --> 00:39:02,000
entire band so pretty much anywhere

1052
00:39:07,190 --> 00:39:04,560
that's the in the complex life habitable

1053
00:39:08,630 --> 00:39:07,200
zone you almost always trigger an

1054
00:39:11,270 --> 00:39:08,640
anthropocene so it's actually pretty

1055
00:39:13,190 --> 00:39:11,280
hard to avoid triggering an anthropocene

1056
00:39:15,430 --> 00:39:13,200
now just to conclude i'll note that this

1057
00:39:18,310 --> 00:39:15,440
delta t is an important function because

1058
00:39:19,750 --> 00:39:18,320
we know that delta t is what um

1059
00:39:20,950 --> 00:39:19,760
you know we and we don't know really

1060
00:39:22,790 --> 00:39:20,960
that we don't know the climate

1061
00:39:24,550 --> 00:39:22,800
sensitivity for our own planet right we

1062
00:39:25,910 --> 00:39:24,560
know that probably human beings once the

1063
00:39:28,470 --> 00:39:25,920

temperature gets too high human beings

1064
00:39:29,990 --> 00:39:28,480
will die but what just as the climate

1065
00:39:32,790 --> 00:39:30,000
changes we don't know whether or not the

1066
00:39:35,589 --> 00:39:32,800
civilization we can really hold together

1067
00:39:38,150 --> 00:39:35,599
so here's what you see is the log time

1068
00:39:40,310 --> 00:39:38,160
to decline by 20

1069
00:39:43,510 --> 00:39:40,320
um as a function of delta t and you can

1070
00:39:45,589 --> 00:39:43,520
see when delta t is small just 0.5 k

1071
00:39:47,990 --> 00:39:45,599
that after 100 years you lose a huge

1072
00:39:49,750 --> 00:39:48,000
amount of population um

1073
00:39:51,510 --> 00:39:49,760
and for 10k if you're more if you're

1074
00:39:53,030 --> 00:39:51,520
less sensitive then you can get out

1075
00:39:54,710 --> 00:39:53,040
almost to a thousand years without

1076
00:39:56,550 --> 00:39:54,720
having a lot of

1077
00:40:00,710 --> 00:39:56,560
civilization being lost

1078
00:40:02,790 --> 00:40:00,720
so um so our conclusion is that yeah you

1079
00:40:05,190 --> 00:40:02,800
know for civilizations or for creatures

1080
00:40:06,870 --> 00:40:05,200
like ours the it's going to be hard to

1081
00:40:09,910 --> 00:40:06,880
avoid an anthropocene it's going to be

1082
00:40:12,470 --> 00:40:09,920
hard to avoid triggering some kind of

1083
00:40:14,630 --> 00:40:12,480
climate feedback if the energy that

1084
00:40:16,550 --> 00:40:14,640
you're using is combustion based which

1085
00:40:18,710 --> 00:40:16,560
we would argue is probably where you're

1086
00:40:21,349 --> 00:40:18,720
going to start most civilizations would

1087
00:40:22,390 --> 00:40:21,359
argue fire burning biomass is going to

1088
00:40:23,990 --> 00:40:22,400

be something that's going to be very

1089
00:40:26,470 --> 00:40:24,000
easy to find if you're a young

1090
00:40:28,710 --> 00:40:26,480
civilization and so um we would argue

1091
00:40:30,309 --> 00:40:28,720
that there's there that that is a likely

1092
00:40:32,470 --> 00:40:30,319
candidate to start your civilization

1093
00:40:35,589 --> 00:40:32,480
with and that means it may be hard to

1094
00:40:38,069 --> 00:40:35,599
not to maybe difficult to avoid a um

1095
00:40:39,910 --> 00:40:38,079
anthropocene but finally i just want to

1096
00:40:42,950 --> 00:40:39,920
end on this note uh looking at these two

1097
00:40:45,030 --> 00:40:42,960
different books uh sapiens and the dawn

1098
00:40:47,030 --> 00:40:45,040
of everything because these are two very

1099
00:40:49,430 --> 00:40:47,040
very different books in their telling of

1100
00:40:51,829 --> 00:40:49,440
the story of human civilization

1101
00:40:54,069 --> 00:40:51,839
trajectory sapiens kind of has this

1102
00:40:56,630 --> 00:40:54,079
usual big history argument that there's

1103
00:40:59,270 --> 00:40:56,640
an inevitable uh path from

1104
00:41:01,589 --> 00:40:59,280
hunter-gatherers the gala egalitarian

1105
00:41:04,550 --> 00:41:01,599
hunter-gatherers to you know industrial

1106
00:41:06,630 --> 00:41:04,560
uh complex top-down civilizations and

1107
00:41:08,390 --> 00:41:06,640
this new book by graber and wengrow

1108
00:41:11,829 --> 00:41:08,400
argues that actually there's been a

1109
00:41:13,910 --> 00:41:11,839
plethora of uh kinds of forms of human

1110
00:41:15,829 --> 00:41:13,920
political and technological forms

1111
00:41:17,190 --> 00:41:15,839
so this book was i don't know what to

1112
00:41:18,150 --> 00:41:17,200
make of it but i think it's something

1113
00:41:20,950 --> 00:41:18,160

when we try and think about the

1114
00:41:23,190 --> 00:41:20,960
evolution of civilizations we may want

1115
00:41:25,349 --> 00:41:23,200
to be we may want to think about ergotic

1116
00:41:27,670 --> 00:41:25,359
uh possibilities um that you explore a

1117
00:41:29,510 --> 00:41:27,680
lot of parameter space so i'll end there

1118
00:41:32,150 --> 00:41:29,520
just my conclusions are complex life

1119
00:41:34,309 --> 00:41:32,160
habitable zone um uh they'll probably be

1120
00:41:37,270 --> 00:41:34,319
common temperatures temperature

1121
00:41:38,710 --> 00:41:37,280
sensitivity matters a lot um and in

1122
00:41:40,069 --> 00:41:38,720
terms of techno signatures it may be

1123
00:41:42,470 --> 00:41:40,079
that we're looking for evidence of

1124
00:41:44,470 --> 00:41:42,480
planetary system changes over time that

1125
00:41:46,550 --> 00:41:44,480
may be a techno signature and then this

1126
00:41:50,150 --> 00:41:46,560
also for me raises general questions

1127
00:41:51,190 --> 00:41:50,160
about um about the problem so i will end

1128
00:41:52,710 --> 00:41:51,200
there

1129
00:41:54,390 --> 00:41:52,720
paid within time

1130
00:41:56,870 --> 00:41:54,400
and stop sharing

1131
00:42:03,109 --> 00:41:56,880
comments

1132
00:42:06,550 --> 00:42:04,630
so again take your questions for the

1133
00:42:16,550 --> 00:42:06,560
discussion session at the end

1134
00:42:21,510 --> 00:42:19,829
well um so the order here on the screen

1135
00:42:23,270 --> 00:42:21,520
is not the correct one

1136
00:42:24,870 --> 00:42:23,280
it's uh

1137
00:42:26,870 --> 00:42:24,880
it's first uh

1138
00:42:31,109 --> 00:42:26,880

timaraju who will

1139
00:42:34,150 --> 00:42:31,119
speak now about uh

1140
00:42:35,910 --> 00:42:34,160
way to classify techno signatures that

1141
00:42:37,190 --> 00:42:35,920
is called techno signatures gap study

1142
00:42:42,069 --> 00:42:37,200
list

1143
00:42:48,790 --> 00:42:44,390
hi everyone uh

1144
00:42:53,670 --> 00:42:51,270
uh i'm virisha tim

1145
00:42:55,510 --> 00:42:53,680
and i'm a data scientist at the jet

1146
00:42:56,390 --> 00:42:55,520
propulsion laboratory

1147
00:42:59,190 --> 00:42:56,400
um

1148
00:43:01,670 --> 00:42:59,200
and i'm my collaborators for this uh

1149
00:43:03,670 --> 00:43:01,680
project are nick siegler who's the chief

1150
00:43:05,910 --> 00:43:03,680
scientist of the chief technologist for

1151
00:43:08,069 --> 00:43:05,920
the exoplanet exploration program and

1152
00:43:08,950 --> 00:43:08,079
eric mamajek the deputy chief scientist

1153
00:43:12,309 --> 00:43:08,960
for

1154
00:43:15,510 --> 00:43:12,319
uh accept so today i'll be presenting on

1155
00:43:18,069 --> 00:43:15,520
the techno signatures gapless study uh

1156
00:43:20,470 --> 00:43:18,079
which has been uh funded by the nasa

1157
00:43:23,430 --> 00:43:20,480
exoplanet exploration program

1158
00:43:26,630 --> 00:43:23,440
so except is a has been chartered to

1159
00:43:29,510 --> 00:43:26,640
search for habitable worlds and identify

1160
00:43:31,270 --> 00:43:29,520
the required technologies to enable that

1161
00:43:33,589 --> 00:43:31,280
so um

1162
00:43:37,190 --> 00:43:33,599
as as since techno signatures is a part

1163
00:43:38,829 --> 00:43:37,200

of that goal uh we like except was

1164
00:43:43,030 --> 00:43:38,839
interested

1165
00:43:45,510 --> 00:43:43,040
in like creating this fact-finding study

1166
00:43:47,270 --> 00:43:45,520
to look for um

1167
00:43:49,589 --> 00:43:47,280
like to

1168
00:43:51,109 --> 00:43:49,599
to inform themselves of the techno

1169
00:43:53,349 --> 00:43:51,119
signatures overall technical signatures

1170
00:43:54,470 --> 00:43:53,359
landscape and i've been tasked to lead

1171
00:43:56,390 --> 00:43:54,480
the study

1172
00:43:58,950 --> 00:43:56,400
to ultimately create a publicly

1173
00:44:00,470 --> 00:43:58,960
accessible unified database uh that

1174
00:44:02,150 --> 00:44:00,480
would essentially also serve as a

1175
00:44:03,990 --> 00:44:02,160
repository of information for the techno

1176
00:44:06,550 --> 00:44:04,000
signatures community

1177
00:44:11,670 --> 00:44:08,630
in order to do that initially at the

1178
00:44:13,030 --> 00:44:11,680
start of the task a panel of experts was

1179
00:44:15,030 --> 00:44:13,040
assembled to

1180
00:44:17,109 --> 00:44:15,040
continuously review and provide feedback

1181
00:44:18,950 --> 00:44:17,119
on the process and

1182
00:44:20,710 --> 00:44:18,960
to jump into the approach itself we

1183
00:44:23,030 --> 00:44:20,720
started by

1184
00:44:25,829 --> 00:44:23,040
putting together like a set of potential

1185
00:44:27,670 --> 00:44:25,839
extraterrestrial activities and the

1186
00:44:30,470 --> 00:44:27,680
uh techno signature search approaches

1187
00:44:32,069 --> 00:44:30,480
associated with it so across across that

1188
00:44:33,990 --> 00:44:32,079

identifying

1189
00:44:37,190 --> 00:44:34,000
what are some of the data fields that

1190
00:44:39,109 --> 00:44:37,200
can help the users um

1191
00:44:41,990 --> 00:44:39,119
use this database to answer some

1192
00:44:45,109 --> 00:44:42,000
questions uh related to

1193
00:44:47,349 --> 00:44:45,119
their interests in the field so two

1194
00:44:49,670 --> 00:44:47,359
primary types of data fields descriptors

1195
00:44:51,670 --> 00:44:49,680
and assessors descriptors would be all

1196
00:44:53,750 --> 00:44:51,680
the informational fields like

1197
00:44:55,349 --> 00:44:53,760
um that would describe the

1198
00:44:57,109 --> 00:44:55,359
possible extraterrestrial activity

1199
00:44:59,190 --> 00:44:57,119
itself or the approach

1200
00:45:00,950 --> 00:44:59,200
and the assessors would help them sort

1201
00:45:03,349 --> 00:45:00,960
through the database to

1202
00:45:04,470 --> 00:45:03,359
um get get like a filtered view of

1203
00:45:05,270 --> 00:45:04,480
everything

1204
00:45:08,069 --> 00:45:05,280
so

1205
00:45:11,349 --> 00:45:08,079
going beyond that and completing or like

1206
00:45:13,589 --> 00:45:11,359
compiling the entire list of peters and

1207
00:45:14,790 --> 00:45:13,599
the search approaches would would be the

1208
00:45:17,190 --> 00:45:14,800
next step

1209
00:45:19,829 --> 00:45:17,200
and uh of course like filling out the

1210
00:45:22,150 --> 00:45:19,839
entire uh data fields for all of these

1211
00:45:25,270 --> 00:45:22,160
speakers and search approaches so that

1212
00:45:26,710 --> 00:45:25,280
the database can be made complete

1213
00:45:29,589 --> 00:45:26,720

so

1214
00:45:31,190 --> 00:45:29,599
in doing this like we um

1215
00:45:32,950 --> 00:45:31,200
we wanted to

1216
00:45:35,349 --> 00:45:32,960
kind of start with

1217
00:45:37,109 --> 00:45:35,359
uh the descriptors and this is but what

1218
00:45:40,309 --> 00:45:37,119
are some of the most interesting

1219
00:45:42,470 --> 00:45:40,319
findings that came out of the study was

1220
00:45:44,790 --> 00:45:42,480
uh the possible extraterrestrial

1221
00:45:46,870 --> 00:45:44,800
activities so uh it was interesting to

1222
00:45:48,710 --> 00:45:46,880
find that most of them

1223
00:45:50,390 --> 00:45:48,720
can be broadly categorized into one of

1224
00:45:53,030 --> 00:45:50,400
these four categories

1225
00:45:55,430 --> 00:45:53,040
going from uh just alien generator like

1226
00:45:56,390 --> 00:45:55,440
technological remnants to

1227
00:45:58,710 --> 00:45:56,400
um

1228
00:46:01,430 --> 00:45:58,720
just byproducts of everyday

1229
00:46:03,270 --> 00:46:01,440
activities by the aliens or

1230
00:46:06,870 --> 00:46:03,280
artificial megastructures that are built

1231
00:46:09,270 --> 00:46:06,880
by them to communicating

1232
00:46:10,710 --> 00:46:09,280
communicating to their counterparts

1233
00:46:12,950 --> 00:46:10,720
across the universe

1234
00:46:15,109 --> 00:46:12,960
so it was interesting to see that most

1235
00:46:17,670 --> 00:46:15,119
of the reviewed pts repeaters fall into

1236
00:46:21,430 --> 00:46:17,680
one of these categories but now how do

1237
00:46:23,349 --> 00:46:21,440
we take these and uh map them into like

1238
00:46:26,309 --> 00:46:23,359

all of the search approaches that exist

1239
00:46:28,950 --> 00:46:26,319
to detect these activities

1240
00:46:30,950 --> 00:46:28,960
sophia suggested uh

1241
00:46:32,790 --> 00:46:30,960
this this way to kind of

1242
00:46:34,230 --> 00:46:32,800
look at the techno signature search

1243
00:46:36,950 --> 00:46:34,240
approaches was that

1244
00:46:39,510 --> 00:46:36,960
in each search approach would be mapped

1245
00:46:42,069 --> 00:46:39,520
to some activities so let's say there is

1246
00:46:42,950 --> 00:46:42,079
uh the dyson sphere technology which

1247
00:46:45,349 --> 00:46:42,960
would

1248
00:46:46,630 --> 00:46:45,359
uh have several tsas that can detect it

1249
00:46:49,829 --> 00:46:46,640
but they're all

1250
00:46:52,150 --> 00:46:49,839
derived from a certain motivation so

1251
00:46:55,270 --> 00:46:52,160
depending on the motivation we can take

1252
00:46:56,390 --> 00:46:55,280
the tsas down to the uh technology level

1253
00:46:58,550 --> 00:46:56,400
and

1254
00:47:01,750 --> 00:46:58,560
make them very specific so

1255
00:47:05,270 --> 00:47:01,760
we incorporated this framework and

1256
00:47:07,829 --> 00:47:05,280
created the technology motivation tsa

1257
00:47:10,550 --> 00:47:07,839
framework for the database which starts

1258
00:47:12,309 --> 00:47:10,560
with uh just as an example the

1259
00:47:13,510 --> 00:47:12,319
interstellar artifacts let's say which

1260
00:47:15,430 --> 00:47:13,520
would be the

1261
00:47:17,589 --> 00:47:15,440
possible extraterrestrial activity so

1262
00:47:20,870 --> 00:47:17,599
the first step would be to identify

1263
00:47:23,030 --> 00:47:20,880

which category the activity falls into

1264
00:47:24,549 --> 00:47:23,040
and then moving into what is the

1265
00:47:27,430 --> 00:47:24,559
motivation

1266
00:47:29,030 --> 00:47:27,440
behind the peta um

1267
00:47:31,030 --> 00:47:29,040
either exploring the universe or

1268
00:47:32,069 --> 00:47:31,040
observing activities on the earth as an

1269
00:47:33,109 --> 00:47:32,079
example

1270
00:47:35,829 --> 00:47:33,119
for this

1271
00:47:38,390 --> 00:47:35,839
and then identifying the tech the search

1272
00:47:41,109 --> 00:47:38,400
approaches associated with that whether

1273
00:47:43,990 --> 00:47:41,119
it's like detecting flybys using direct

1274
00:47:46,069 --> 00:47:44,000
imaging or spectrophotometry so

1275
00:47:47,750 --> 00:47:46,079
seeing that difference in uh different

1276
00:47:50,230 --> 00:47:47,760
technologies associated with the such

1277
00:47:52,870 --> 00:47:50,240
approaches or detecting lurkers versus

1278
00:47:54,710 --> 00:47:52,880
looking for surface technological

1279
00:47:56,150 --> 00:47:54,720
remnants this is still a work in

1280
00:47:57,670 --> 00:47:56,160
progress but

1281
00:47:59,990 --> 00:47:57,680
and what is presented on the slide is

1282
00:48:03,030 --> 00:48:00,000
just a subset of all the various

1283
00:48:05,270 --> 00:48:03,040
motivations and peters and tsas that

1284
00:48:07,349 --> 00:48:05,280
exist in the database

1285
00:48:10,230 --> 00:48:07,359
um so

1286
00:48:12,069 --> 00:48:10,240
for the uh for the uh tsas that have

1287
00:48:13,750 --> 00:48:12,079
been identified what is the information

1288
00:48:16,790 --> 00:48:13,760

that we can provide

1289
00:48:19,910 --> 00:48:16,800
in the database that the users can make

1290
00:48:22,069 --> 00:48:19,920
can utilize so two types of data fields

1291
00:48:25,430 --> 00:48:22,079
like i mentioned earlier the descriptors

1292
00:48:28,069 --> 00:48:25,440
and the sss the descriptors would be any

1293
00:48:30,309 --> 00:48:28,079
any activity that the et is doing and

1294
00:48:31,829 --> 00:48:30,319
the what the humans are doing to detect

1295
00:48:33,990 --> 00:48:31,839
it so

1296
00:48:35,910 --> 00:48:34,000
just as an example for the previous

1297
00:48:37,510 --> 00:48:35,920
interstellar artifact case

1298
00:48:38,950 --> 00:48:37,520
it could be what is the motivation

1299
00:48:41,430 --> 00:48:38,960
behind the peta

1300
00:48:43,990 --> 00:48:41,440
whether what is the intention in being

1301
00:48:45,589 --> 00:48:44,000
found and the longevity of the signal

1302
00:48:47,270 --> 00:48:45,599
that jacob talked about a little bit

1303
00:48:50,390 --> 00:48:47,280
earlier in the discussion

1304
00:48:52,870 --> 00:48:50,400
um like how long-lived does it is the

1305
00:48:56,549 --> 00:48:52,880
signal itself and is it continuous or

1306
00:48:58,950 --> 00:48:56,559
discrete and for the humans detecting uh

1307
00:49:00,870 --> 00:48:58,960
et that would be the search approach

1308
00:49:02,150 --> 00:49:00,880
what is the observable what are some of

1309
00:49:03,990 --> 00:49:02,160
the technical challenges that are

1310
00:49:06,549 --> 00:49:04,000
plaguing the field right now

1311
00:49:09,109 --> 00:49:06,559
and what is the search location uh or

1312
00:49:11,589 --> 00:49:09,119
what are the upper limits of the tsa

1313
00:49:14,309 --> 00:49:11,599

would be some example descriptors that

1314
00:49:15,430 --> 00:49:14,319
we have incorporated and the assessors

1315
00:49:17,750 --> 00:49:15,440
will be

1316
00:49:20,710 --> 00:49:17,760
anything that the user can

1317
00:49:22,549 --> 00:49:20,720
uh sort the database on and get answers

1318
00:49:24,470 --> 00:49:22,559
to things that they are most interested

1319
00:49:25,910 --> 00:49:24,480
in finding out and just getting like a

1320
00:49:28,630 --> 00:49:25,920
filtered view

1321
00:49:30,549 --> 00:49:28,640
so some examples would be the ancillary

1322
00:49:32,069 --> 00:49:30,559
science benefits for someone in a

1323
00:49:33,910 --> 00:49:32,079
different field scientists in different

1324
00:49:35,510 --> 00:49:33,920
fields kind of looking for

1325
00:49:37,910 --> 00:49:35,520
what other

1326
00:49:39,829 --> 00:49:37,920
techniques uh what are the

1327
00:49:41,270 --> 00:49:39,839
like benefits could uh technically

1328
00:49:42,630 --> 00:49:41,280
within the techno signature field that

1329
00:49:43,430 --> 00:49:42,640
they can address

1330
00:49:45,430 --> 00:49:43,440
and

1331
00:49:48,549 --> 00:49:45,440
what is the technology state of the art

1332
00:49:51,030 --> 00:49:48,559
like and to kind of then derive the gaps

1333
00:49:52,710 --> 00:49:51,040
in technology and uh look for where the

1334
00:49:55,109 --> 00:49:52,720
most needs are

1335
00:49:58,230 --> 00:49:55,119
and any other needs beyond beyond the

1336
00:50:01,030 --> 00:49:58,240
technology like funding or workforce or

1337
00:50:04,950 --> 00:50:01,040
even like facility needs etc

1338
00:50:07,589 --> 00:50:04,960

so all of these fields have been um like

1339
00:50:09,270 --> 00:50:07,599
so here this is just a subset of all the

1340
00:50:10,549 --> 00:50:09,280
data fields that have been identified in

1341
00:50:14,069 --> 00:50:10,559
total there are

1342
00:50:16,309 --> 00:50:14,079
14 descriptors and about 18 assessors um

1343
00:50:17,190 --> 00:50:16,319
in the in the database

1344
00:50:20,870 --> 00:50:17,200
so

1345
00:50:21,910 --> 00:50:20,880
like this

1346
00:50:23,990 --> 00:50:21,920
where

1347
00:50:26,549 --> 00:50:24,000
every column would be a unique techno

1348
00:50:29,589 --> 00:50:26,559
signature search approach and

1349
00:50:32,549 --> 00:50:29,599
that would be mapped to a broad category

1350
00:50:34,390 --> 00:50:32,559
of beta and every approach would then be

1351
00:50:36,150 --> 00:50:34,400
tied to several descriptors and

1352
00:50:39,589 --> 00:50:36,160
assessors

1353
00:50:43,990 --> 00:50:42,549
so how can how can one benefit from this

1354
00:50:46,630 --> 00:50:44,000
so there are

1355
00:50:49,670 --> 00:50:46,640
broad categories of users that this can

1356
00:50:52,069 --> 00:50:49,680
really help um from new researchers in

1357
00:50:54,390 --> 00:50:52,079
the field to philanthropists to nasa

1358
00:50:55,670 --> 00:50:54,400
program managers general public

1359
00:50:57,109 --> 00:50:55,680
based on the questions that they're

1360
00:51:00,069 --> 00:50:57,119
trying to answer

1361
00:51:02,950 --> 00:51:00,079
um they can sort the database using the

1362
00:51:05,510 --> 00:51:02,960
assessors and descriptors and derive

1363
00:51:08,710 --> 00:51:05,520

derive like a filtered view like i said

1364
00:51:11,270 --> 00:51:08,720
like i mentioned earlier for example um

1365
00:51:14,549 --> 00:51:11,280
if there was like a future

1366
00:51:17,030 --> 00:51:14,559
mission design uh mission designer for

1367
00:51:19,190 --> 00:51:17,040
the decadal survey for the decadal uh

1368
00:51:20,950 --> 00:51:19,200
flagship mission they could look through

1369
00:51:23,270 --> 00:51:20,960
this database and

1370
00:51:25,990 --> 00:51:23,280
identify which detector signature search

1371
00:51:26,790 --> 00:51:26,000
approach could be like concomitant to

1372
00:51:29,190 --> 00:51:26,800
the

1373
00:51:31,589 --> 00:51:29,200
so

1374
00:51:34,549 --> 00:51:31,599
this could be really valuable to

1375
00:51:35,589 --> 00:51:34,559
many types of users and

1376
00:51:38,309 --> 00:51:35,599
so

1377
00:51:40,549 --> 00:51:38,319
looking forward we would like to finish

1378
00:51:42,630 --> 00:51:40,559
compiling this list of ps approaches

1379
00:51:44,470 --> 00:51:42,640
across all the extraterrestrial

1380
00:51:46,870 --> 00:51:44,480
activities that have been identified

1381
00:51:48,710 --> 00:51:46,880
while that while we still um are

1382
00:51:51,109 --> 00:51:48,720
challenging ourselves to find peters

1383
00:51:53,910 --> 00:51:51,119
that don't fit into the four categories

1384
00:51:55,670 --> 00:51:53,920
that we've identified and also to go

1385
00:51:57,270 --> 00:51:55,680
ahead and like complete the full

1386
00:51:59,349 --> 00:51:57,280
database and

1387
00:52:01,030 --> 00:51:59,359
fill in all the information about each

1388
00:52:03,670 --> 00:52:01,040

of the

1389
00:52:04,950 --> 00:52:03,680
approaches and peters

1390
00:52:06,390 --> 00:52:04,960
so

1391
00:52:08,710 --> 00:52:06,400
this uh

1392
00:52:11,030 --> 00:52:08,720
i would like to conclude by saying that

1393
00:52:13,750 --> 00:52:11,040
uh since this is a database that is

1394
00:52:16,390 --> 00:52:13,760
being made for the community we would

1395
00:52:18,470 --> 00:52:16,400
love to hear from the community and

1396
00:52:20,470 --> 00:52:18,480
i will reach out to some of you in the

1397
00:52:22,069 --> 00:52:20,480
coming months as well but if you have

1398
00:52:25,589 --> 00:52:22,079
any input or

1399
00:52:27,270 --> 00:52:25,599
resources or comments or feedback on um

1400
00:52:29,030 --> 00:52:27,280
any any of this please feel free to

1401
00:52:31,349 --> 00:52:29,040
reach out to us and

1402
00:52:35,580 --> 00:52:31,359
uh it would be we would love to hear

1403
00:52:35,590 --> 00:52:44,870
[Applause]

1404
00:52:49,829 --> 00:52:47,670
so our next speaker is george

1405
00:52:51,510 --> 00:52:49,839
profitiliotis

1406
00:52:53,510 --> 00:52:51,520
and he

1407
00:52:55,750 --> 00:52:53,520
will speak about

1408
00:52:57,910 --> 00:52:55,760
and and demonstrate

1409
00:53:02,630 --> 00:52:57,920
uh

1410
00:53:04,069 --> 00:53:02,640
previous talk a delphi approach to

1411
00:53:05,390 --> 00:53:04,079
techno signature

1412
00:53:09,190 --> 00:53:05,400
priority

1413
00:53:18,390 --> 00:53:12,870

yes thank you um you hear me it's fine

1414
00:53:28,950 --> 00:53:25,109
all right

1415
00:53:31,990 --> 00:53:28,960
me great

1416
00:53:34,230 --> 00:53:32,000
um so yeah i'm going to present today uh

1417
00:53:36,630 --> 00:53:34,240
an idea that originally

1418
00:53:39,510 --> 00:53:36,640
was developed during the that

1419
00:53:41,430 --> 00:53:39,520
was first discussed during the technical

1420
00:53:43,910 --> 00:53:41,440
conference and that's why

1421
00:53:46,309 --> 00:53:43,920
uh it was initiated

1422
00:53:48,950 --> 00:53:46,319
together with colleagues sophia and

1423
00:53:52,069 --> 00:53:48,960
clement vidal who is also there

1424
00:53:54,710 --> 00:53:52,079
so i'm going to speak on behalf of

1425
00:53:58,710 --> 00:53:54,720
of my collaborators as well

1426
00:54:00,390 --> 00:53:58,720
and i will try to um to present um a

1427
00:54:03,589 --> 00:54:00,400
tool that could be used both in real

1428
00:54:06,950 --> 00:54:03,599
time and uh synchronously uh to give

1429
00:54:09,030 --> 00:54:06,960
experts in the technology community uh

1430
00:54:10,950 --> 00:54:09,040
um

1431
00:54:13,510 --> 00:54:10,960
an opportunity to participate in

1432
00:54:15,670 --> 00:54:13,520
prioritizing uh technical nature

1433
00:54:18,150 --> 00:54:15,680
research strategies so as you might

1434
00:54:20,309 --> 00:54:18,160
already know there is a large number of

1435
00:54:21,670 --> 00:54:20,319
potential technology targets and

1436
00:54:24,309 --> 00:54:21,680
strategies that

1437
00:54:25,430 --> 00:54:24,319
are being proposed in the literature and

1438
00:54:27,829 --> 00:54:25,440

um

1439
00:54:29,270 --> 00:54:27,839
you may have already uh

1440
00:54:31,430 --> 00:54:29,280
seen the brain release and exhaust the

1441
00:54:33,430 --> 00:54:31,440
catalog that

1442
00:54:35,589 --> 00:54:33,440
more than 800 distinct

1443
00:54:37,670 --> 00:54:35,599
targets and in

1444
00:54:39,670 --> 00:54:37,680
in an effort to

1445
00:54:41,990 --> 00:54:39,680
facilitate the prioritization of the

1446
00:54:43,190 --> 00:54:42,000
potential searches of proposed techno

1447
00:54:45,829 --> 00:54:43,200
signatures

1448
00:54:48,150 --> 00:54:45,839
since the resources are very limited

1449
00:54:49,910 --> 00:54:48,160
sophia say here i need to put forward a

1450
00:54:52,390 --> 00:54:49,920
conceptual framework

1451
00:54:55,109 --> 00:54:52,400
with nine fingers of merit that was

1452
00:54:56,870 --> 00:54:55,119
called the nine axis of merit

1453
00:54:58,870 --> 00:54:56,880
noting that

1454
00:55:01,270 --> 00:54:58,880
the axes should not be used entirely

1455
00:55:03,270 --> 00:55:01,280
exclude areas of research but to

1456
00:55:04,230 --> 00:55:03,280
prioritize

1457
00:55:06,390 --> 00:55:04,240
some

1458
00:55:08,309 --> 00:55:06,400
technical students research strategies

1459
00:55:11,190 --> 00:55:08,319
um uh at

1460
00:55:13,910 --> 00:55:11,200
this point in time when uh when the

1461
00:55:16,630 --> 00:55:13,920
field is heavily constrained uh by by

1462
00:55:18,390 --> 00:55:16,640
funding and another kind of obstacles so

1463
00:55:19,670 --> 00:55:18,400

you uh you may have already seen the

1464
00:55:21,030 --> 00:55:19,680
axis but

1465
00:55:22,710 --> 00:55:21,040
refer to them

1466
00:55:24,390 --> 00:55:22,720
here on the left

1467
00:55:26,870 --> 00:55:24,400
the first figure of merit is observing

1468
00:55:28,789 --> 00:55:26,880
capability so

1469
00:55:31,510 --> 00:55:28,799
third strategies that can be done right

1470
00:55:33,990 --> 00:55:31,520
now are considered of higher merit

1471
00:55:35,829 --> 00:55:34,000
the second one is costs including all

1472
00:55:38,309 --> 00:55:35,839
kinds of capital that is needed to

1473
00:55:40,630 --> 00:55:38,319
conduct a search so uh any techno

1474
00:55:43,430 --> 00:55:40,640
signature searches that can be done

1475
00:55:45,430 --> 00:55:43,440
cheaply are considered of higher merit

1476
00:55:48,470 --> 00:55:45,440
the third one is uh the ancillary

1477
00:55:50,870 --> 00:55:48,480
benefits so if spurs has many ancillary

1478
00:55:52,069 --> 00:55:50,880
benefits then it is considered of higher

1479
00:55:55,190 --> 00:55:52,079
merit

1480
00:55:57,589 --> 00:55:55,200
similarly a search that is looking for a

1481
00:55:59,589 --> 00:55:57,599
techno signature that is detectable

1482
00:56:01,349 --> 00:55:59,599
is also considered of higher merit and

1483
00:56:03,670 --> 00:56:01,359
also search that is looking for a

1484
00:56:06,470 --> 00:56:03,680
long-lived techno signature again is

1485
00:56:07,829 --> 00:56:06,480
considered hybrid as well as searches

1486
00:56:09,670 --> 00:56:07,839
that are looking for

1487
00:56:11,670 --> 00:56:09,680
uh technology techno signatures that

1488
00:56:13,190 --> 00:56:11,680

have a high signal to noise ratio with

1489
00:56:16,150 --> 00:56:13,200
respect to the backgrounds they are

1490
00:56:17,430 --> 00:56:16,160
unambiguous and they do not require a

1491
00:56:19,990 --> 00:56:17,440
lot of uh

1492
00:56:21,349 --> 00:56:20,000
let's say imaginative extrapolation

1493
00:56:22,870 --> 00:56:21,359
extrapolation from the current

1494
00:56:26,230 --> 00:56:22,880
technology that humans are capable of

1495
00:56:28,630 --> 00:56:26,240
doing uh right now and also another

1496
00:56:30,710 --> 00:56:28,640
figure of merit is the inevitability of

1497
00:56:32,069 --> 00:56:30,720
a techno signature so this this means

1498
00:56:33,670 --> 00:56:32,079
that if uh

1499
00:56:35,109 --> 00:56:33,680
if we don't need many assumptions

1500
00:56:38,069 --> 00:56:35,119
regarding the psychology or the

1501
00:56:39,750 --> 00:56:38,079
sociology of of the entities behind

1502
00:56:41,670 --> 00:56:39,760
generating this technology

1503
00:56:43,910 --> 00:56:41,680
then we can consider research be of

1504
00:56:46,150 --> 00:56:43,920
higher merit as well as searches that

1505
00:56:47,990 --> 00:56:46,160
can provide a lot of information

1506
00:56:51,109 --> 00:56:48,000
uh we do we have a

1507
00:56:52,549 --> 00:56:51,119
chance to review the acts again uh

1508
00:56:55,510 --> 00:56:52,559
in a few minutes

1509
00:56:57,829 --> 00:56:55,520
so for today i'm going to um to present

1510
00:57:01,589 --> 00:56:57,839
the case for using the delphi method uh

1511
00:57:03,349 --> 00:57:01,599
therefore a method from uh orsite uh as

1512
00:57:05,829 --> 00:57:03,359
a way to prioritize the consequence of

1513
00:57:08,470 --> 00:57:05,839

searches using the nine axes of merit

1514
00:57:11,750 --> 00:57:08,480
and we will also demonstrate practically

1515
00:57:14,069 --> 00:57:11,760
in real time how this could be done

1516
00:57:16,549 --> 00:57:14,079
so the delphi method was originally

1517
00:57:19,670 --> 00:57:16,559
developed by rand

1518
00:57:21,910 --> 00:57:19,680
think tank in the early 1960s as a tool

1519
00:57:25,430 --> 00:57:21,920
for foresight and force forecasting

1520
00:57:27,430 --> 00:57:25,440
issues um this this method is is used

1521
00:57:29,270 --> 00:57:27,440
for in judgemental forecasting and it's

1522
00:57:31,430 --> 00:57:29,280
mental foresight where there is a deep

1523
00:57:33,670 --> 00:57:31,440
uncertainty and it was specifically

1524
00:57:36,870 --> 00:57:33,680
designed to remove any conference room

1525
00:57:39,910 --> 00:57:36,880
impediments uh to to give uh to give an

1526
00:57:43,190 --> 00:57:39,920
opportunity uh for a group to reach uh

1527
00:57:45,670 --> 00:57:43,200
consensus without uh without the all the

1528
00:57:47,910 --> 00:57:45,680
negative features of groups

1529
00:57:50,069 --> 00:57:47,920
with limited time or any sort of

1530
00:57:51,990 --> 00:57:50,079
domineering opinions that may undermine

1531
00:57:55,109 --> 00:57:52,000
the effectiveness of the discussion so

1532
00:57:57,030 --> 00:57:55,119
the delphi method uh is based on on the

1533
00:57:59,990 --> 00:57:57,040
following principles first the first one

1534
00:58:01,829 --> 00:58:00,000
is anonymity the second one is iteration

1535
00:58:04,069 --> 00:58:01,839
the third one is controlled feedback of

1536
00:58:05,670 --> 00:58:04,079
responses to all the group members and

1537
00:58:07,190 --> 00:58:05,680
the fourth one is the statistical

1538
00:58:08,640 --> 00:58:07,200

aggregation of the individual's

1539
00:58:09,670 --> 00:58:08,650
responses

1540
00:58:10,470 --> 00:58:09,680
[Music]

1541
00:58:13,510 --> 00:58:10,480
and

1542
00:58:14,870 --> 00:58:13,520
to do that um the

1543
00:58:16,390 --> 00:58:14,880
the designer of the delphi method

1544
00:58:19,430 --> 00:58:16,400
usually

1545
00:58:21,349 --> 00:58:19,440
tries to to locate a group of experts

1546
00:58:23,190 --> 00:58:21,359
that are uh asked to respond a

1547
00:58:24,230 --> 00:58:23,200
non-muslim sequence of questions for a

1548
00:58:27,270 --> 00:58:24,240
specific

1549
00:58:30,309 --> 00:58:27,280
thing then the the the

1550
00:58:32,150 --> 00:58:30,319
opinions are aggregated and they are fed

1551
00:58:34,230 --> 00:58:32,160
back to respondents with a statistic in

1552
00:58:35,910 --> 00:58:34,240
the form of a statistical summary and

1553
00:58:38,549 --> 00:58:35,920
also responsible given the opportunity

1554
00:58:41,190 --> 00:58:38,559
to to discuss their reasons for

1555
00:58:44,069 --> 00:58:41,200
uh for stating uh what they have stated

1556
00:58:45,750 --> 00:58:44,079
what answering the the items

1557
00:58:47,750 --> 00:58:45,760
and um

1558
00:58:50,069 --> 00:58:47,760
when they are when

1559
00:58:52,950 --> 00:58:50,079
when participants are presented uh with

1560
00:58:54,870 --> 00:58:52,960
uh with the aggregate responses of the

1561
00:58:56,789 --> 00:58:54,880
group they also given the opportunity to

1562
00:58:59,270 --> 00:58:56,799
submit a revised response

1563
00:59:01,190 --> 00:58:59,280

after considering uh what has been

1564
00:59:03,109 --> 00:59:01,200
submitted by the group or we submit

1565
00:59:04,870 --> 00:59:03,119
their first response and this is the

1566
00:59:06,870 --> 00:59:04,880
iteration part of the delphi process

1567
00:59:09,349 --> 00:59:06,880
that can give the opportunity to the

1568
00:59:12,069 --> 00:59:09,359
group to reach consensus of course

1569
00:59:13,990 --> 00:59:12,079
consensus is not a mandatory condition

1570
00:59:16,549 --> 00:59:14,000
but there are some best practices out

1571
00:59:18,309 --> 00:59:16,559
there that can uh can lead to a good

1572
00:59:19,349 --> 00:59:18,319
design of a delphi method that would

1573
00:59:21,910 --> 00:59:19,359
potentially

1574
00:59:24,549 --> 00:59:21,920
consensus so today we're going to uh to

1575
00:59:26,549 --> 00:59:24,559
try the real-time uh variant of the

1576
00:59:27,990 --> 00:59:26,559
delphi method which is as what i said

1577
00:59:31,270 --> 00:59:28,000
before with the only

1578
00:59:32,950 --> 00:59:31,280
uh change that the rounds are that are

1579
00:59:36,309 --> 00:59:32,960
occurring

1580
00:59:37,829 --> 00:59:36,319
one after the other in in rapid

1581
00:59:40,549 --> 00:59:37,839
iteration

1582
00:59:44,390 --> 00:59:40,559
and we will

1583
00:59:45,589 --> 00:59:44,400
use a transformation of the nine axis of

1584
00:59:47,349 --> 00:59:45,599
merit

1585
00:59:49,910 --> 00:59:47,359
based on the concept of semantic

1586
00:59:52,549 --> 00:59:49,920
differentials that has already been used

1587
00:59:55,270 --> 00:59:52,559
in the literature of the dolphin studies

1588
00:59:57,030 --> 00:59:55,280

and in in this in this conceptualization

1589
01:00:00,710 --> 00:59:57,040
of the actions of merit

1590
01:00:03,510 --> 01:00:00,720
a standard scaling technique is used uh

1591
01:00:06,150 --> 01:00:03,520
to to create a um

1592
01:00:08,630 --> 01:00:06,160
a reference a greater scale with with

1593
01:00:11,910 --> 01:00:08,640
seven reference points uh between two

1594
01:00:14,630 --> 01:00:11,920
bipolar contrasting adjectives for or uh

1595
01:00:17,109 --> 01:00:14,640
or a cluster of adjectives in our case

1596
01:00:18,390 --> 01:00:17,119
with a neutral midpoint uh so you will

1597
01:00:21,589 --> 01:00:18,400
see uh

1598
01:00:22,470 --> 01:00:21,599
nine items with with such scales in uh

1599
01:00:26,870 --> 01:00:22,480
in

1600
01:00:28,630 --> 01:00:26,880
and

1601
01:00:31,109 --> 01:00:28,640
uh let's start

1602
01:00:33,270 --> 01:00:31,119
immediately with the

1603
01:00:36,069 --> 01:00:33,280
illustration if you have your

1604
01:00:38,150 --> 01:00:36,079
smartphone or a laptop you can uh you

1605
01:00:40,829 --> 01:00:38,160
can scan the qr code

1606
01:00:43,270 --> 01:00:40,839
with your smartphone to get to

1607
01:00:46,950 --> 01:00:43,280
the the form

1608
01:00:49,270 --> 01:00:46,960
and if not you can type in the url here

1609
01:00:49,280 --> 01:00:51,829
and i

1610
01:00:55,109 --> 01:00:53,109
for a little while so that you can

1611
01:00:58,069 --> 01:00:55,119
access the survey and then i can show

1612
01:01:00,390 --> 01:00:58,079
you uh how the demonstration

1613
01:01:02,069 --> 01:01:00,400

can occur although there are detailed

1614
01:01:05,270 --> 01:01:02,079
instructions in there and i think that

1615
01:01:07,190 --> 01:01:05,280
we have a lot of time

1616
01:01:08,230 --> 01:01:07,200
to complete it so

1617
01:01:12,549 --> 01:01:08,240
if you

1618
01:01:14,549 --> 01:01:12,559
scan the qr code or type in the url

1619
01:01:15,829 --> 01:01:14,559
the shortened one or the long one

1620
01:01:19,750 --> 01:01:15,839
you will

1621
01:01:21,190 --> 01:01:19,760
be presented with a main screen uh

1622
01:01:22,950 --> 01:01:21,200
perhaps i can

1623
01:01:25,349 --> 01:01:22,960
i can see

1624
01:01:28,390 --> 01:01:25,359
what i'm sharing so you what it will

1625
01:01:29,990 --> 01:01:28,400
look like it will look like

1626
01:01:36,150 --> 01:01:30,000
it will look like

1627
01:01:41,349 --> 01:01:39,030
you have to uh you have to click on the

1628
01:01:43,589 --> 01:01:41,359
start survey button then you will be

1629
01:01:46,230 --> 01:01:43,599
presented with uh with the instructions

1630
01:01:48,390 --> 01:01:46,240
where we are asking you to contemplate

1631
01:01:50,150 --> 01:01:48,400
on a specific techno signature research

1632
01:01:52,069 --> 01:01:50,160
strategy which is the search for waste

1633
01:01:53,990 --> 01:01:52,079
hit from megastructures

1634
01:01:55,910 --> 01:01:54,000
so this exercise is focused is

1635
01:01:57,750 --> 01:01:55,920
exclusively on searching for the waste

1636
01:02:00,549 --> 01:01:57,760
heat emitted by

1637
01:02:02,950 --> 01:02:00,559
megastructures that can be observed in

1638
01:02:04,870 --> 01:02:02,960

infrared wavelengths

1639
01:02:07,589 --> 01:02:04,880
and

1640
01:02:10,630 --> 01:02:07,599
you will see here uh the transformation

1641
01:02:14,150 --> 01:02:10,640
of the nine axis figures of merit in the

1642
01:02:17,109 --> 01:02:14,160
form of the semantic differential scale

1643
01:02:20,470 --> 01:02:17,119
if you are not sure what the axis means

1644
01:02:22,470 --> 01:02:20,480
you can click on the small

1645
01:02:26,150 --> 01:02:22,480
question mark here you will find a small

1646
01:02:29,990 --> 01:02:28,950
below and the first time you click

1647
01:02:33,750 --> 01:02:30,000
on

1648
01:02:36,150 --> 01:02:33,760
presented with a

1649
01:02:38,549 --> 01:02:36,160
window where you can submit your email

1650
01:02:41,349 --> 01:02:38,559
to get a link

1651
01:02:42,870 --> 01:02:41,359
to review the results of the group

1652
01:02:45,589 --> 01:02:42,880
afterwards

1653
01:02:46,710 --> 01:02:45,599
so if you didn't manage to do that then

1654
01:02:49,109 --> 01:02:46,720
there is

1655
01:02:50,630 --> 01:02:49,119
if you miss that window then

1656
01:02:51,990 --> 01:02:50,640
when you reach then

1657
01:02:53,190 --> 01:02:52,000
the final

1658
01:02:55,910 --> 01:02:53,200
axis

1659
01:02:57,029 --> 01:02:55,920
uh just click on the return to start

1660
01:02:58,390 --> 01:02:57,039
page

1661
01:03:01,589 --> 01:02:58,400
uh

1662
01:03:03,910 --> 01:03:01,599
button right below the save button

1663
01:03:06,150 --> 01:03:03,920

don't just don't click submit i mean

1664
01:03:08,870 --> 01:03:06,160
if you didn't manage to give your email

1665
01:03:11,109 --> 01:03:08,880
to the platform don't click submit

1666
01:03:14,789 --> 01:03:11,119
click on return to the main page the

1667
01:03:19,589 --> 01:03:17,349
when you uh when you reach the start

1668
01:03:21,990 --> 01:03:19,599
page uh after

1669
01:03:24,150 --> 01:03:22,000
providing your judgments uh you will be

1670
01:03:25,750 --> 01:03:24,160
presented with uh the aggregated

1671
01:03:26,789 --> 01:03:25,760
responses of the group

1672
01:03:29,670 --> 01:03:26,799
and

1673
01:03:32,150 --> 01:03:29,680
if you want um you will be given the

1674
01:03:34,549 --> 01:03:32,160
opportunity to revisit your judgment and

1675
01:03:35,750 --> 01:03:34,559
there is an uh

1676
01:03:37,829 --> 01:03:35,760
there is a

1677
01:03:39,029 --> 01:03:37,839
button that says edit answer you can

1678
01:03:40,630 --> 01:03:39,039
click that

1679
01:03:43,109 --> 01:03:40,640
and then you can

1680
01:03:44,870 --> 01:03:43,119
submit a second judgment perhaps taking

1681
01:03:59,670 --> 01:03:44,880
into consideration

1682
01:04:02,549 --> 01:04:01,349
so let's see if we have some results

1683
01:04:04,309 --> 01:04:02,559
here

1684
01:04:06,390 --> 01:04:04,319
we have some results

1685
01:04:08,630 --> 01:04:06,400
right

1686
01:04:10,390 --> 01:04:08,640
i'm sure how much time we have perhaps

1687
01:04:19,349 --> 01:04:10,400
we can

1688
01:04:19,359 --> 01:04:23,029

all right

1689
01:04:25,990 --> 01:04:24,950
so in order to see if consensus has been

1690
01:04:28,309 --> 01:04:26,000
raised you have to do some

1691
01:04:29,990 --> 01:04:28,319
post-processing but we can already

1692
01:04:34,870 --> 01:04:30,000
can already see that

1693
01:04:43,990 --> 01:04:36,950
yeah

1694
01:04:49,190 --> 01:04:46,309
the medium has changed

1695
01:04:51,990 --> 01:04:49,200
yeah so as far as we leave the

1696
01:04:53,510 --> 01:04:52,000
survey open you can come again

1697
01:04:55,910 --> 01:04:53,520
by clicking the

1698
01:04:57,109 --> 01:04:55,920
link and then iterate on your on your

1699
01:04:59,510 --> 01:04:57,119
responses

1700
01:05:02,309 --> 01:04:59,520
and provide a revised judgment if you

1701
01:05:04,870 --> 01:05:02,319
want uh so

1702
01:05:08,390 --> 01:05:04,880
that would uh would give someone the

1703
01:05:10,630 --> 01:05:08,400
opportunity to uh to gain uh

1704
01:05:12,870 --> 01:05:10,640
feedback on the group's aggregate

1705
01:05:14,470 --> 01:05:12,880
results and afterwards

1706
01:05:18,150 --> 01:05:14,480
one can uh

1707
01:05:21,510 --> 01:05:18,160
process uh the outputs and if the uh the

1708
01:05:23,029 --> 01:05:21,520
partial deviation of the of the values

1709
01:05:24,870 --> 01:05:23,039
of the

1710
01:05:28,950 --> 01:05:24,880
the items collected by the by the

1711
01:05:30,710 --> 01:05:28,960
experts is uh lower than 60 percent then

1712
01:05:32,710 --> 01:05:30,720
to the literature that is considered

1713
01:05:34,950 --> 01:05:32,720

consensus for an item

1714
01:05:36,950 --> 01:05:34,960
uh but we will have to do that uh

1715
01:05:38,470 --> 01:05:36,960
afterwards

1716
01:05:41,589 --> 01:05:38,480
so

1717
01:05:44,230 --> 01:05:41,599
yeah the next steps um if i have a

1718
01:05:47,270 --> 01:05:44,240
minute the next step would be to collect

1719
01:05:49,430 --> 01:05:47,280
the uh first you have to deploy this

1720
01:05:51,349 --> 01:05:49,440
massively or like the judgments of the

1721
01:05:53,990 --> 01:05:51,359
experts from an expert community and

1722
01:05:56,950 --> 01:05:54,000
then uh these these axis are not

1723
01:05:59,109 --> 01:05:56,960
weighted so we have to uh to weight the

1724
01:06:01,190 --> 01:05:59,119
axes themselves so we have to run a

1725
01:06:03,190 --> 01:06:01,200
similar process to find the relative

1726
01:06:04,710 --> 01:06:03,200
importance of each of the nine figures

1727
01:06:07,190 --> 01:06:04,720
of merit and nine axes have made

1728
01:06:08,870 --> 01:06:07,200
themselves in order to to find the

1729
01:06:11,910 --> 01:06:08,880
weights how much each axis should

1730
01:06:13,829 --> 01:06:11,920
contribute to the overall uh value let's

1731
01:06:15,670 --> 01:06:13,839
say of merit of a specific technician as

1732
01:06:17,270 --> 01:06:15,680
research and if we manage to do that

1733
01:06:19,430 --> 01:06:17,280
then combining the different method with

1734
01:06:21,510 --> 01:06:19,440
another appropriate multiple criteria

1735
01:06:24,069 --> 01:06:21,520
decision making method might enable the

1736
01:06:27,670 --> 01:06:24,079
community to collectively conduct

1737
01:06:29,829 --> 01:06:27,680
exercises of relative prioritization

1738
01:06:31,029 --> 01:06:29,839

among potential searches for techno

1739
01:06:34,549 --> 01:06:31,039
signatures

1740
01:06:36,470 --> 01:06:34,559
without excluding uh candidates but if

1741
01:06:37,349 --> 01:06:36,480
you run this um

1742
01:06:40,069 --> 01:06:37,359
very

1743
01:06:43,589 --> 01:06:40,079
frequently then candidates might be able

1744
01:06:46,710 --> 01:06:43,599
to uh to move up the rounds and i would

1745
01:06:47,829 --> 01:06:46,720
propose that this this should occur

1746
01:06:54,549 --> 01:06:47,839
in a

1747
01:06:56,789 --> 01:06:54,559
the list did not remain fixed

1748
01:06:58,549 --> 01:06:56,799
that's all i would be happy to

1749
01:07:01,109 --> 01:06:58,559
answer any questions

1750
01:07:04,630 --> 01:07:01,119
i hope you managed to

1751
01:07:09,510 --> 01:07:04,640
revisit any of your responses and i hope

1752
01:07:15,109 --> 01:07:11,829
yes it works very well

1753
01:07:18,549 --> 01:07:15,119
congratulations for setting this up

1754
01:07:21,270 --> 01:07:18,559
i have a question about this

1755
01:07:23,270 --> 01:07:21,280
real-time delphi is it possible to

1756
01:07:26,470 --> 01:07:23,280
to write a

1757
01:07:30,470 --> 01:07:28,390
to comment on on the

1758
01:07:32,789 --> 01:07:30,480
different replies yeah

1759
01:07:36,309 --> 01:07:32,799
right now in the in the platform as it

1760
01:07:37,990 --> 01:07:36,319
is uh we cannot uh we have not given the

1761
01:07:39,190 --> 01:07:38,000
opportunity participants to comment but

1762
01:07:42,789 --> 01:07:39,200
yes

1763
01:07:45,190 --> 01:07:42,799

you can uh you can have uh

1764
01:07:48,870 --> 01:07:45,200
participate provide rationales

1765
01:07:50,870 --> 01:07:48,880
as to why they uh voted on uh like why

1766
01:07:53,349 --> 01:07:50,880
they have a select specific point on the

1767
01:07:56,390 --> 01:07:53,359
scale and there is also the option for

1768
01:07:59,029 --> 01:07:56,400
others to comment on these rationales

1769
01:08:01,430 --> 01:07:59,039
so even if there is not consensus if in

1770
01:08:03,109 --> 01:08:01,440
the post-processing uh it seems that

1771
01:08:05,349 --> 01:08:03,119
some items have

1772
01:08:07,750 --> 01:08:05,359
like there is dissent on some items

1773
01:08:08,789 --> 01:08:07,760
perhaps the the discussion in the

1774
01:08:11,750 --> 01:08:08,799
commands

1775
01:08:15,750 --> 01:08:11,760
could provide insights on why there is a

1776
01:08:18,149 --> 01:08:15,760
disagreement but i have um i have not uh

1777
01:08:19,269 --> 01:08:18,159
included that in this demo presentation

1778
01:08:21,269 --> 01:08:19,279
just to

1779
01:08:22,870 --> 01:08:21,279
to make sure that it works in real time

1780
01:08:24,470 --> 01:08:22,880
it's the first time it happens in a

1781
01:08:30,070 --> 01:08:24,480
conference

1782
01:08:30,080 --> 01:08:32,789
thank you very much

1783
01:08:32,799 --> 01:08:37,189
thank you thank you so much

1784
01:08:40,870 --> 01:08:39,269
so now we have time for our discussion

1785
01:08:42,149 --> 01:08:40,880
we have a little bit more than 20

1786
01:08:44,950 --> 01:08:42,159
minutes

1787
01:08:46,709 --> 01:08:44,960
um so you can ask questions

1788
01:08:49,110 --> 01:08:46,719

about any of the talks you saw this

1789
01:08:55,349 --> 01:08:51,269
and i don't know who has a microphone

1790
01:08:58,149 --> 01:08:56,550
we do have

1791
01:08:59,829 --> 01:08:58,159
questions

1792
01:09:03,829 --> 01:08:59,839
online as well

1793
01:09:08,149 --> 01:09:06,390
hi there thanks for all the talks um

1794
01:09:09,749 --> 01:09:08,159
actually my first question is see ravi

1795
01:09:10,789 --> 01:09:09,759
and probably i'll say to adam a little

1796
01:09:12,709 --> 01:09:10,799
bit

1797
01:09:14,870 --> 01:09:12,719
um for the stuff that you showed related

1798
01:09:16,870 --> 01:09:14,880
to like nitrogen dioxide being

1799
01:09:18,709 --> 01:09:16,880
a possible techno signature

1800
01:09:20,470 --> 01:09:18,719
i guess i see kind of like a paradox

1801
01:09:22,309 --> 01:09:20,480
between this idea that

1802
01:09:24,070 --> 01:09:22,319
as humans on earth

1803
01:09:26,229 --> 01:09:24,080
if we want to kind of persist over long

1804
01:09:28,309 --> 01:09:26,239
periods we need to stop using pollutants

1805
01:09:30,470 --> 01:09:28,319
but then also using the things of the as

1806
01:09:32,470 --> 01:09:30,480
a possible type of signature i wouldn't

1807
01:09:34,870 --> 01:09:32,480
expect them to be kind of

1808
01:09:36,149 --> 01:09:34,880
long-lasting on planets um because it

1809
01:09:37,990 --> 01:09:36,159
seemed like you need to survive for a

1810
01:09:39,430 --> 01:09:38,000
long time you need to get rid of them

1811
01:09:41,749 --> 01:09:39,440
uh so how do you kind of like think

1812
01:09:44,390 --> 01:09:41,759
about the kind of probabilities of these

1813
01:09:48,709 --> 01:09:45,669

well it's just

1814
01:09:51,030 --> 01:09:48,719
the so the the work that i presented is

1815
01:09:53,030 --> 01:09:51,040
that if you have something on the planet

1816
01:09:54,950 --> 01:09:53,040
that resembles

1817
01:09:56,709 --> 01:09:54,960
the kind of pollution or the technology

1818
01:09:59,510 --> 01:09:56,719
that we industrialize technology that we

1819
01:10:01,189 --> 01:09:59,520
have would we be able to detect it

1820
01:10:03,270 --> 01:10:01,199
doesn't necessarily mean that they would

1821
01:10:05,270 --> 01:10:03,280
exist there and they may not be

1822
01:10:07,430 --> 01:10:05,280
long-lived actually like you said for a

1823
01:10:08,550 --> 01:10:07,440
civilization that you survived for a

1824
01:10:10,390 --> 01:10:08,560
long time

1825
01:10:12,229 --> 01:10:10,400
uh polluting your administration and

1826
01:10:13,510 --> 01:10:12,239
then trying to sustain you may not be

1827
01:10:15,350 --> 01:10:13,520
impossible

1828
01:10:20,870 --> 01:10:15,360
um

1829
01:10:24,310 --> 01:10:22,550
i mentioned adam because it seemed like

1830
01:10:26,630 --> 01:10:24,320
also your work you know you've thought

1831
01:10:27,430 --> 01:10:26,640
about kind of time scales of

1832
01:10:29,669 --> 01:10:27,440
you know

1833
01:10:30,630 --> 01:10:29,679
human

1834
01:10:32,229 --> 01:10:30,640
uh

1835
01:10:34,229 --> 01:10:32,239
you know signatures and that that kind

1836
01:10:36,390 --> 01:10:34,239
of thing so i think maybe you've thought

1837
01:10:38,870 --> 01:10:36,400
about this too a little bit

1838
01:10:40,310 --> 01:10:38,880

yeah um we have i think you know

1839
01:10:42,630 --> 01:10:40,320
after thinking about this for a while i

1840
01:10:44,390 --> 01:10:42,640
don't think it's true that long-lived

1841
01:10:45,990 --> 01:10:44,400
civilizations disappear into their

1842
01:10:47,990 --> 01:10:46,000
planet i mean certainly

1843
01:10:50,310 --> 01:10:48,000
um in order to be a sustainable

1844
01:10:52,390 --> 01:10:50,320
technosphere you need to

1845
01:10:54,390 --> 01:10:52,400
integrate yourself into the biosphere

1846
01:10:56,630 --> 01:10:54,400
right so we just recently did a paper uh

1847
01:10:58,870 --> 01:10:56,640
david grinspoon and sarah walker and i

1848
01:10:59,990 --> 01:10:58,880
on planetary intelligence the idea that

1849
01:11:01,750 --> 01:11:00,000
you know what does it take for a

1850
01:11:03,350 --> 01:11:01,760
biosphere to become long-term what would

1851
01:11:05,110 --> 01:11:03,360
it take for a technosphere to become

1852
01:11:07,350 --> 01:11:05,120
long-term but it doesn't mean that you

1853
01:11:08,630 --> 01:11:07,360
disappear because integrating into the

1854
01:11:09,590 --> 01:11:08,640
biosphere

1855
01:11:12,550 --> 01:11:09,600
for a

1856
01:11:14,470 --> 01:11:12,560
you know energy using a civilization

1857
01:11:17,189 --> 01:11:14,480
that's using a lot of energy would

1858
01:11:18,790 --> 01:11:17,199
probably mean um that you're still

1859
01:11:20,790 --> 01:11:18,800
visible in some ways like you're you're

1860
01:11:22,950 --> 01:11:20,800
making the biosphere vibrant you're

1861
01:11:25,030 --> 01:11:22,960
increasing biodiversity or

1862
01:11:26,950 --> 01:11:25,040
you're certainly reducing dangerous

1863
01:11:28,790 --> 01:11:26,960

chemicals but that doesn't necessarily

1864
01:11:31,110 --> 01:11:28,800
mean that you're you're not producing

1865
01:11:33,030 --> 01:11:31,120
any techno signatures in fact if we're

1866
01:11:35,910 --> 01:11:33,040
thinking about dissipation

1867
01:11:38,149 --> 01:11:35,920
as a mechanism uh or as a techno

1868
01:11:40,470 --> 01:11:38,159
signature then dissipation may i would

1869
01:11:43,030 --> 01:11:40,480
expect it actually to grow um and that

1870
01:11:44,470 --> 01:11:43,040
may be apparent in the chemical networks

1871
01:11:46,790 --> 01:11:44,480
in the energy

1872
01:11:49,669 --> 01:11:46,800
energy networks um so you know

1873
01:11:51,830 --> 01:11:49,679
long-lived high-tech civilizations i

1874
01:11:53,510 --> 01:11:51,840
think don't sort of you know disappear

1875
01:11:58,630 --> 01:11:53,520
into their biosphere so that's why i'm

1876
01:12:02,870 --> 01:12:01,030
i just wondered

1877
01:12:04,310 --> 01:12:02,880
i can read the online question whenever

1878
01:12:06,149 --> 01:12:04,320
yeah go ahead read all my questions if

1879
01:12:08,390 --> 01:12:06,159
you're wondering

1880
01:12:11,750 --> 01:12:08,400
sure so this is from

1881
01:12:14,149 --> 01:12:11,760
dr mark elliott's wouldn't sf6 via

1882
01:12:15,830 --> 01:12:14,159
smoking gun technic signature since it

1883
01:12:17,669 --> 01:12:15,840
is only produced synthetically by

1884
01:12:23,030 --> 01:12:17,679
industrial processing

1885
01:12:26,550 --> 01:12:24,790
i can comment on that that's a great

1886
01:12:28,870 --> 01:12:26,560
question and eddie schweiterman who's

1887
01:12:30,790 --> 01:12:28,880
here is his uh leading effort to study

1888
01:12:34,390 --> 01:12:30,800

that sf6 and other

1889
01:12:42,709 --> 01:12:34,400
artificial greenhouse gasses um

1890
01:12:46,709 --> 01:12:44,229
yeah so you know we're working on it

1891
01:12:48,550 --> 01:12:46,719
it's certainly at the 6b if there was i

1892
01:12:51,510 --> 01:12:48,560
think one part per million is extremely

1893
01:12:53,350 --> 01:12:51,520
detectable and infrared um so

1894
01:12:54,870 --> 01:12:53,360
uh it's not great for humans but yeah if

1895
01:12:56,310 --> 01:12:54,880
you were terraforming the planet or

1896
01:12:58,790 --> 01:12:56,320
something like that with

1897
01:12:59,750 --> 01:12:58,800
ethics cfcs any kind of these industrial

1898
01:13:00,790 --> 01:12:59,760
gases

1899
01:13:01,830 --> 01:13:00,800
um

1900
01:13:04,229 --> 01:13:01,840
yeah you know the question would you

1901
01:13:05,669 --> 01:13:04,239
want pollution on your planet uh maybe

1902
01:13:07,430 --> 01:13:05,679
it would be good for us but like maybe

1903
01:13:09,510 --> 01:13:07,440
we want to do that on mars to make mars

1904
01:13:11,910 --> 01:13:09,520
warm um so so you really think about

1905
01:13:14,310 --> 01:13:11,920
that and certainly that would be

1906
01:13:15,990 --> 01:13:14,320
a pretty unambiguous uh detective

1907
01:13:17,669 --> 01:13:16,000
signature molecule

1908
01:13:19,350 --> 01:13:17,679
compared to others

1909
01:13:21,350 --> 01:13:19,360
hi um

1910
01:13:23,990 --> 01:13:21,360
so several of the talks today talked

1911
01:13:25,990 --> 01:13:24,000
about the emissions of fossil fuels

1912
01:13:27,910 --> 01:13:26,000
however given that fossil fuels are

1913
01:13:29,750 --> 01:13:27,920

present on earth only because

1914
01:13:31,830 --> 01:13:29,760
recalcitrant carbon compounds like

1915
01:13:34,229 --> 01:13:31,840
lignin involved millions of years ahead

1916
01:13:36,310 --> 01:13:34,239
of time before

1917
01:13:37,590 --> 01:13:36,320
fungus that had enzymes capable of

1918
01:13:39,189 --> 01:13:37,600
breaking them down

1919
01:13:44,550 --> 01:13:39,199
can we assume that's always going to be

1920
01:13:49,430 --> 01:13:46,870
i think biomass you know maybe not

1921
01:13:50,709 --> 01:13:49,440
burning fossil fuels but combustion

1922
01:13:53,030 --> 01:13:50,719
is something that that's going to be

1923
01:13:54,550 --> 01:13:53,040
common because uh you know when you

1924
01:13:56,950 --> 01:13:54,560
think about what energy sources are

1925
01:13:59,750 --> 01:13:56,960
available to a young civilization and

1926
01:14:01,669 --> 01:13:59,760
you know burning you know biomass by its

1927
01:14:03,430 --> 01:14:01,679
very nature is probably going to have a

1928
01:14:05,750 --> 01:14:03,440
lot of energy content in it and you've

1929
01:14:07,830 --> 01:14:05,760
got lightning around and so i think i

1930
01:14:09,590 --> 01:14:07,840
think by i think combustion may be the

1931
01:14:11,270 --> 01:14:09,600
first thing that you stumble on i mean

1932
01:14:12,790 --> 01:14:11,280
there's i'm happy to talk about other

1933
01:14:14,470 --> 01:14:12,800
ways it can happen but when you think

1934
01:14:17,110 --> 01:14:14,480
about what's readily available to a

1935
01:14:21,430 --> 01:14:17,120
young civilization burning something

1936
01:14:23,830 --> 01:14:21,440
becomes uh seems seems obvious i also

1937
01:14:27,110 --> 01:14:23,840
want to add something that

1938
01:14:28,630 --> 01:14:27,120

even if civilization develops into being

1939
01:14:29,990 --> 01:14:28,640
cleaner

1940
01:14:32,470 --> 01:14:30,000
just because of the second law of

1941
01:14:34,870 --> 01:14:32,480
thermodynamics we need to anticipate

1942
01:14:37,430 --> 01:14:34,880
waste and entropy so it's something

1943
01:14:39,910 --> 01:14:37,440
universal like pollution

1944
01:14:42,709 --> 01:14:39,920
has to happen for any

1945
01:14:45,030 --> 01:14:42,719
any active living thing

1946
01:14:47,750 --> 01:14:45,040
but the question is yes what kind of

1947
01:14:48,550 --> 01:14:47,760
pollution and how can we detect it right

1948
01:14:51,030 --> 01:14:48,560
so

1949
01:14:52,149 --> 01:14:51,040
i want to point out that not as it's not

1950
01:14:54,709 --> 01:14:52,159
a single

1951
01:14:57,750 --> 01:14:54,719
uh signature is not a technological

1952
01:15:01,590 --> 01:14:57,760
signature you need multiple ones so

1953
01:15:03,750 --> 01:15:01,600
if you use if you find uh no2 on a

1954
01:15:06,149 --> 01:15:03,760
planet you may not know that it's coming

1955
01:15:08,149 --> 01:15:06,159
from biology or wildfires or something

1956
01:15:09,350 --> 01:15:08,159
happening or from technology something

1957
01:15:11,590 --> 01:15:09,360
else needs to

1958
01:15:13,510 --> 01:15:11,600
be happening on the planet to

1959
01:15:15,590 --> 01:15:13,520
have a confirmation on for example i

1960
01:15:18,149 --> 01:15:15,600
wanted to ask actually to steve or

1961
01:15:20,790 --> 01:15:18,159
someone that is radio technology also

1962
01:15:24,070 --> 01:15:22,149
because if an industrialized

1963
01:15:27,510 --> 01:15:24,080

civilization can have this kind of a

1964
01:15:30,870 --> 01:15:27,520
phase radio wasn't there before so

1965
01:15:34,149 --> 01:15:30,880
how long we can expect it to pass

1966
01:15:36,149 --> 01:15:34,159
yeah i guess yeah we we don't know

1967
01:15:38,070 --> 01:15:36,159
um we've had radio technology for 100

1968
01:15:40,630 --> 01:15:38,080
years here on earth is it going to be

1969
01:15:42,709 --> 01:15:40,640
superseded by something else um

1970
01:15:45,430 --> 01:15:42,719
there's certainly been

1971
01:15:48,229 --> 01:15:45,440
uh you know a lot of change in the way

1972
01:15:51,510 --> 01:15:48,239
that we communicate as humans over the

1973
01:15:54,390 --> 01:15:51,520
lifetime of humans as a species

1974
01:15:55,510 --> 01:15:54,400
radio is also a very efficient way of

1975
01:15:57,350 --> 01:15:55,520
communicating you know the

1976
01:15:58,550 --> 01:15:57,360
electromagnetic spectrum generally is an

1977
01:16:00,630 --> 01:15:58,560
efficient way of communicating with

1978
01:16:02,550 --> 01:16:00,640
interstellar distances so

1979
01:16:04,149 --> 01:16:02,560
uh you know we can sort of hypothesize

1980
01:16:06,550 --> 01:16:04,159
within the limits of the physics that we

1981
01:16:08,709 --> 01:16:06,560
know now that other ways that you might

1982
01:16:11,110 --> 01:16:08,719
communicate over longest gravitational

1983
01:16:12,630 --> 01:16:11,120
waves or something or you know

1984
01:16:14,149 --> 01:16:12,640
neutrinos or

1985
01:16:14,950 --> 01:16:14,159
yeah um

1986
01:16:15,910 --> 01:16:14,960
so

1987
01:16:17,750 --> 01:16:15,920
uh

1988
01:16:18,870 --> 01:16:17,760

yeah it's kind of hard to say to how

1989
01:16:20,709 --> 01:16:18,880
long it will be until something better

1990
01:16:22,229 --> 01:16:20,719
comes along but what we've got is

1991
01:16:36,550 --> 01:16:22,239
pretty good in a very efficient shape i

1992
01:16:39,110 --> 01:16:37,750
um interesting there's all these

1993
01:16:42,149 --> 01:16:39,120
questions about the lifetimes of the

1994
01:16:43,910 --> 01:16:42,159
signals and um ravi's talked on this

1995
01:16:47,590 --> 01:16:43,920
before he alerted that right before

1996
01:16:48,550 --> 01:16:47,600
adams had me wondering for adam um or

1997
01:16:49,830 --> 01:16:48,560
anyone

1998
01:16:51,830 --> 01:16:49,840
if you

1999
01:16:53,750 --> 01:16:51,840
you were thinking about or talking about

2000
01:16:55,510 --> 01:16:53,760
modeling um the pathways that a

2001
01:16:57,270 --> 01:16:55,520
civilization might take and it's changes

2002
01:16:58,709 --> 01:16:57,280
in say greenhouse gas emissions and

2003
01:17:01,030 --> 01:16:58,719
temperature over time

2004
01:17:02,950 --> 01:17:01,040
if you look backwards at our own

2005
01:17:04,870 --> 01:17:02,960
civilization here on earth

2006
01:17:07,110 --> 01:17:04,880
um i'm thinking about both the no2 but

2007
01:17:08,950 --> 01:17:07,120
also like the cfcs do

2008
01:17:10,470 --> 01:17:08,960
if you plot plot of the trajectory of

2009
01:17:12,390 --> 01:17:10,480
those gases

2010
01:17:15,110 --> 01:17:12,400
do they fit any of your

2011
01:17:16,950 --> 01:17:15,120
models and

2012
01:17:18,790 --> 01:17:16,960
i'm thinking also like if they did would

2013
01:17:20,790 --> 01:17:18,800

that be both predictive of our future or

2014
01:17:23,189 --> 01:17:20,800
could we look for patterns where

2015
01:17:24,310 --> 01:17:23,199
you know civilizations use a a temper

2016
01:17:26,149 --> 01:17:24,320
you have you have to have a long base

2017
01:17:28,310 --> 01:17:26,159
line of observations to to catch this

2018
01:17:31,750 --> 01:17:28,320
but could that also be like a leading

2019
01:17:32,950 --> 01:17:31,760
indicator of a of a civilization that

2020
01:17:37,430 --> 01:17:32,960
goes to one of your end state

2021
01:17:41,750 --> 01:17:39,030
uh let me just answer that quickly and

2022
01:17:42,790 --> 01:17:41,760
then um others can chime in yeah i think

2023
01:17:44,390 --> 01:17:42,800
it's a really interesting idea and it

2024
01:17:46,550 --> 01:17:44,400
goes exactly to ravi's point that a

2025
01:17:53,830 --> 01:17:46,560
single molecule is not a techno

2026
01:17:53,840 --> 01:18:05,430
there is

2027
01:18:05,440 --> 01:18:15,510
all right thank you

2028
01:18:15,520 --> 01:18:18,950
who is the question going to

2029
01:18:22,709 --> 01:18:21,350
there is another question coming up

2030
01:18:25,110 --> 01:18:22,719
okay

2031
01:18:26,470 --> 01:18:25,120
hi everyone

2032
01:18:27,990 --> 01:18:26,480
thank you very much for this very very

2033
01:18:30,070 --> 01:18:28,000
interesting session

2034
01:18:32,709 --> 01:18:30,080
um i have a question for everyone or

2035
01:18:35,910 --> 01:18:32,719
maybe more specifically for ravi

2036
01:18:38,950 --> 01:18:35,920
so let's say that we detect um some no2

2037
01:18:40,870 --> 01:18:38,960
cfc funny kind of problems sf6

2038
01:18:42,149 --> 01:18:40,880

on an exoplanet atmosphere but that

2039
01:18:44,149 --> 01:18:42,159
occupant is

2040
01:18:46,950 --> 01:18:44,159
very outside the habitable zone either

2041
01:18:52,790 --> 01:18:46,960
way too hot or way too low or will you

2042
01:18:52,800 --> 01:18:57,030
by jumping the jaw

2043
01:19:02,470 --> 01:18:59,189
if we find

2044
01:19:03,990 --> 01:19:02,480
uh any of these multiple signals on an

2045
01:19:05,510 --> 01:19:04,000
exoplanet

2046
01:19:11,669 --> 01:19:05,520
that

2047
01:19:13,350 --> 01:19:11,679
does not look habitable and we find cfcs

2048
01:19:14,390 --> 01:19:13,360
and no2 and

2049
01:19:16,229 --> 01:19:14,400
some other

2050
01:19:18,310 --> 01:19:16,239
you know technological

2051
01:19:20,470 --> 01:19:18,320
potentially technological

2052
01:19:23,990 --> 01:19:20,480
gas or signal

2053
01:19:29,030 --> 01:19:28,149
how will we interpret that uh carefully

2054
01:19:30,870 --> 01:19:29,040
so

2055
01:19:34,149 --> 01:19:30,880
um because

2056
01:19:37,110 --> 01:19:34,159
we should first uh remove any

2057
01:19:40,709 --> 01:19:37,120
potential bio you know

2058
01:19:41,669 --> 01:19:40,719
geological or biological uh sources that

2059
01:19:42,870 --> 01:19:41,679
we could

2060
01:19:45,990 --> 01:19:42,880
um

2061
01:19:49,110 --> 01:19:46,000
uh you know come up with and once we

2062
01:19:50,870 --> 01:19:49,120
eliminate those any other sources and we

2063
01:19:52,310 --> 01:19:50,880

cannot think of anything we would

2064
01:19:53,990 --> 01:19:52,320
carefully

2065
01:19:56,390 --> 01:19:54,000
say that you know we cannot explain it

2066
01:19:59,030 --> 01:19:56,400
we will not say that's arising from

2067
01:20:01,590 --> 01:19:59,040
technology that we cannot explain and

2068
01:20:02,390 --> 01:20:01,600
say we cannot explain it based on what

2069
01:20:05,510 --> 01:20:02,400
we

2070
01:20:07,669 --> 01:20:05,520
know about the physics of you know the

2071
01:20:08,709 --> 01:20:07,679
planet or you know geological activities

2072
01:20:12,550 --> 01:20:08,719
and that's

2073
01:20:14,550 --> 01:20:12,560
as far as i would go in announcing the

2074
01:20:16,229 --> 01:20:14,560
any potential discovery

2075
01:20:19,510 --> 01:20:16,239
because there could be processes that we

2076
01:20:21,430 --> 01:20:19,520
will never be able to think of

2077
01:20:24,070 --> 01:20:21,440
that could result in these false

2078
01:20:26,149 --> 01:20:24,080
positives just like chance or con paul's

2079
01:20:28,149 --> 01:20:26,159
was reason right now well one thing i

2080
01:20:29,750 --> 01:20:28,159
can add to that too is we didn't talk

2081
01:20:32,629 --> 01:20:29,760
about in the session uh the idea of

2082
01:20:35,830 --> 01:20:32,639
graveyard civilizations so no2 might not

2083
01:20:37,750 --> 01:20:35,840
fit this but if you saw cfcs and uh

2084
01:20:39,270 --> 01:20:37,760
anything that had a long lifetime i mean

2085
01:20:41,750 --> 01:20:39,280
maybe there was a planet that was

2086
01:20:44,870 --> 01:20:41,760
terraformed and then it died out and

2087
01:20:47,110 --> 01:20:44,880
you're observing sort of the longer

2088
01:20:49,030 --> 01:20:47,120

lasting atmospheric constituents you

2089
01:20:50,310 --> 01:20:49,040
know in a too hot or too cool planets so

2090
01:20:51,990 --> 01:20:50,320
that could be one scenario and we

2091
01:20:53,830 --> 01:20:52,000
couldn't obviously conclude that just

2092
01:20:58,629 --> 01:20:53,840
from the observations but that would be

2093
01:21:01,669 --> 01:21:00,870
i think in this context one

2094
01:21:04,229 --> 01:21:01,679
other

2095
01:21:07,110 --> 01:21:04,239
advantage of the terraformed planets

2096
01:21:09,350 --> 01:21:07,120
versus the ones where it's just based

2097
01:21:12,149 --> 01:21:09,360
is that we probably from the observing

2098
01:21:13,750 --> 01:21:12,159
strategy point of view we

2099
01:21:15,270 --> 01:21:13,760
have a better strategy to observe them

2100
01:21:16,790 --> 01:21:15,280
and we probably look at planets and then

2101
01:21:18,310 --> 01:21:16,800
we figure out there's something at the

2102
01:21:20,470 --> 01:21:18,320
edge of the aboriginal zone that is much

2103
01:21:22,709 --> 01:21:20,480
warmer or much colder than it's supposed

2104
01:21:25,510 --> 01:21:22,719
to be before we even get spectra of them

2105
01:21:27,830 --> 01:21:25,520
right so so like if we do let's say a

2106
01:21:29,510 --> 01:21:27,840
mid-infrared spectrum of a planet and we

2107
01:21:31,590 --> 01:21:29,520
see it's hotter than it's supposed to be

2108
01:21:34,790 --> 01:21:31,600
then we can say okay maybe we analyze

2109
01:21:36,550 --> 01:21:34,800
that deeper to find that sf6 so this

2110
01:21:38,550 --> 01:21:36,560
this terraforming thing gives you a

2111
01:21:40,470 --> 01:21:38,560
first step to to

2112
01:21:44,790 --> 01:21:40,480
to kind of like uh go down which

2113
01:21:47,830 --> 01:21:46,070

maybe it's a failed attempt at

2114
01:21:49,910 --> 01:21:47,840
terraforming too terraforming might be

2115
01:21:53,110 --> 01:21:49,920
really hard

2116
01:21:55,830 --> 01:21:53,120
yes i i would like us to to add uh

2117
01:21:58,390 --> 01:21:55,840
to what you said robbie about not one

2118
01:22:01,669 --> 01:21:58,400
single gas would be any kind of proof

2119
01:22:04,070 --> 01:22:01,679
and i think also not multiple gas would

2120
01:22:07,189 --> 01:22:04,080
would be a convincing proof

2121
01:22:10,470 --> 01:22:07,199
so in a way i liked the approach of adam

2122
01:22:13,350 --> 01:22:10,480
to look at the dynamics to look at how

2123
01:22:15,270 --> 01:22:13,360
these gases evolve in time and i mean

2124
01:22:17,669 --> 01:22:15,280
that's what science is about it's about

2125
01:22:20,310 --> 01:22:17,679
making predictions so if you say well

2126
01:22:22,870 --> 01:22:20,320
these guys's gazes are due to

2127
01:22:24,950 --> 01:22:22,880
technological activity and therefore if

2128
01:22:27,030 --> 01:22:24,960
we look at it next year next two years

2129
01:22:29,430 --> 01:22:27,040
it should increase in this way in this

2130
01:22:32,310 --> 01:22:29,440
proportion and then if this is validated

2131
01:22:34,470 --> 01:22:32,320
then i think a case could become much

2132
01:22:37,510 --> 01:22:34,480
stronger

2133
01:22:40,149 --> 01:22:37,520
hi so my questions for varisha i was

2134
01:22:42,310 --> 01:22:40,159
wondering um when like what the timeline

2135
01:22:45,510 --> 01:22:42,320
is for that database being publicly

2136
01:22:47,110 --> 01:22:45,520
accessible and then also if you envision

2137
01:22:49,430 --> 01:22:47,120
nasa maybe using

2138
01:22:52,629 --> 01:22:49,440

something like the delphi method that um

2139
01:22:54,310 --> 01:22:52,639
george shared for like community

2140
01:22:56,070 --> 01:22:54,320
discussions on

2141
01:22:58,950 --> 01:22:56,080
i don't know deciding which directions

2142
01:23:01,510 --> 01:22:58,960
to focus on thanks

2143
01:23:03,270 --> 01:23:01,520
yeah so i think to ask your first

2144
01:23:06,870 --> 01:23:03,280
question the timeline we're looking at

2145
01:23:09,350 --> 01:23:06,880
is like in the coming maybe like four to

2146
01:23:10,870 --> 01:23:09,360
five months is when we assume the entire

2147
01:23:12,550 --> 01:23:10,880
database will be

2148
01:23:15,990 --> 01:23:12,560
complete to the best of our knowledge

2149
01:23:17,590 --> 01:23:16,000
and be uh published uh so

2150
01:23:19,350 --> 01:23:17,600
and for the next question yes we were

2151
01:23:21,910 --> 01:23:19,360
just talking about it in the chat right

2152
01:23:23,430 --> 01:23:21,920
now and george and i will tag up

2153
01:23:26,390 --> 01:23:23,440
later and

2154
01:23:26,400 --> 01:23:32,149
thanks

2155
01:23:32,159 --> 01:23:37,990
i also have a question for you um

2156
01:23:41,910 --> 01:23:38,709
so

2157
01:23:44,470 --> 01:23:41,920
george presented the axis of mary to to

2158
01:23:46,229 --> 01:23:44,480
evaluate each techno signature

2159
01:23:47,590 --> 01:23:46,239
and you're in your approach you have

2160
01:23:50,629 --> 01:23:47,600
assessors

2161
01:23:53,669 --> 01:23:50,639
that are specific with each techno

2162
01:23:55,350 --> 01:23:53,679
signature search so

2163
01:23:58,390 --> 01:23:55,360

so what do you think about the pros and

2164
01:24:00,790 --> 01:23:58,400
cons of having ssl specific to a techno

2165
01:24:03,350 --> 01:24:00,800
signature strategy and search versus

2166
01:24:04,390 --> 01:24:03,360
having axes of marines that could

2167
01:24:05,830 --> 01:24:04,400
potentially

2168
01:24:08,070 --> 01:24:05,840
apply to any

2169
01:24:10,390 --> 01:24:08,080
techno signature

2170
01:24:12,709 --> 01:24:10,400
yeah so the essences that have been

2171
01:24:15,350 --> 01:24:12,719
created actually include the access of

2172
01:24:17,669 --> 01:24:15,360
merit as well and like in addition to

2173
01:24:18,470 --> 01:24:17,679
that there are some fields that

2174
01:24:23,510 --> 01:24:18,480
uh

2175
01:24:26,310 --> 01:24:23,520
like for for the broad community of

2176
01:24:27,910 --> 01:24:26,320
users like keeping that in mind like if

2177
01:24:29,510 --> 01:24:27,920
there is a new researcher in the field

2178
01:24:31,750 --> 01:24:29,520
they would be interested in

2179
01:24:34,870 --> 01:24:31,760
identifying where the opportunities are

2180
01:24:38,790 --> 01:24:34,880
so like so that was the basis for how

2181
01:24:41,990 --> 01:24:38,800
the sss was created so it's specific to

2182
01:24:43,430 --> 01:24:42,000
the user as opposed to being specific to

2183
01:24:45,430 --> 01:24:43,440
the

2184
01:24:58,229 --> 01:24:45,440
techno signature approach

2185
01:25:02,470 --> 01:25:00,550
hi um my name is aaron kanji i'm a phd

2186
01:25:04,390 --> 01:25:02,480
candidate at c boulder and this question

2187
01:25:06,310 --> 01:25:04,400
is for george um

2188
01:25:08,550 --> 01:25:06,320

very interesting demonstration of the

2189
01:25:10,470 --> 01:25:08,560
delphi method which i did not know about

2190
01:25:14,070 --> 01:25:10,480
um thank you for that and i'm just

2191
01:25:15,510 --> 01:25:14,080
wondering if when this technique is used

2192
01:25:17,110 --> 01:25:15,520
across different disciplines and

2193
01:25:19,270 --> 01:25:17,120
different topics

2194
01:25:21,830 --> 01:25:19,280
if folks who use it have noticed any

2195
01:25:23,430 --> 01:25:21,840
sort of trends toward

2196
01:25:26,229 --> 01:25:23,440
like reaching a sort of middle of the

2197
01:25:28,550 --> 01:25:26,239
road or more conservative consensus i i

2198
01:25:30,709 --> 01:25:28,560
could kind of imagine that folks who

2199
01:25:33,990 --> 01:25:30,719
wanted to express like a high-risk high

2200
01:25:36,229 --> 01:25:34,000
reward opinion might sort of stick out

2201
01:25:40,390 --> 01:25:36,239
and eventually sort of um you know come

2202
01:25:42,550 --> 01:25:40,400
back to the middle that makes sense

2203
01:25:43,510 --> 01:25:42,560
yes uh so thank you

2204
01:25:46,870 --> 01:25:43,520
uh

2205
01:25:49,350 --> 01:25:46,880
thank you for for your interest um yes

2206
01:25:50,470 --> 01:25:49,360
developed specifically for for testing

2207
01:25:53,510 --> 01:25:50,480
or for

2208
01:25:56,470 --> 01:25:53,520
uh for decision making so it has been

2209
01:25:58,870 --> 01:25:56,480
widely used in the health sciences where

2210
01:26:02,229 --> 01:25:58,880
expert opinion is highly valued

2211
01:26:03,750 --> 01:26:02,239
um so you may find a

2212
01:26:06,470 --> 01:26:03,760
very like a

2213
01:26:08,709 --> 01:26:06,480

lot of examples in the in the literature

2214
01:26:13,669 --> 01:26:08,719
uh using the delphi method and various

2215
01:26:17,590 --> 01:26:15,750
versions of the delphi method

2216
01:26:20,870 --> 01:26:17,600
to help

2217
01:26:22,629 --> 01:26:20,880
nurses or or clinicians or any other

2218
01:26:25,270 --> 01:26:22,639
health professionals

2219
01:26:26,870 --> 01:26:25,280
reads some sort of standards let's say

2220
01:26:28,390 --> 01:26:26,880
of practice

2221
01:26:30,870 --> 01:26:28,400
by

2222
01:26:32,310 --> 01:26:30,880
discussing in a structured format so as

2223
01:26:34,470 --> 01:26:32,320
you said

2224
01:26:37,030 --> 01:26:34,480
indeed

2225
01:26:39,590 --> 01:26:37,040
the delphi method might

2226
01:26:40,470 --> 01:26:39,600
like if if you want rich consensus it

2227
01:26:42,149 --> 01:26:40,480
might

2228
01:26:54,070 --> 01:26:42,159
um

2229
01:26:56,870 --> 01:26:54,080
mandate it so it is possible for

2230
01:26:58,470 --> 01:26:56,880
uh for high risk uh let's say high

2231
01:27:01,669 --> 01:26:58,480
reward

2232
01:27:04,790 --> 01:27:01,679
opinions to to emerge uh in such certain

2233
01:27:06,950 --> 01:27:04,800
survey and that's why usually uh you you

2234
01:27:08,390 --> 01:27:06,960
need multiple rounds uh we just

2235
01:27:10,310 --> 01:27:08,400
demonstrated this in real time because

2236
01:27:13,430 --> 01:27:10,320
there is a real time for end of the

2237
01:27:16,229 --> 01:27:13,440
method but you you will need to do this

2238
01:27:19,910 --> 01:27:16,239

over months uh it's a lengthy procedure

2239
01:27:22,070 --> 01:27:19,920
where you have also the the option of

2240
01:27:24,390 --> 01:27:22,080
you can give the experts the option to

2241
01:27:27,189 --> 01:27:24,400
uh to explain the rationales in free

2242
01:27:29,510 --> 01:27:27,199
form and then you have the people

2243
01:27:31,110 --> 01:27:29,520
managing the survey aggregating and

2244
01:27:33,510 --> 01:27:31,120
collating the results and presenting the

2245
01:27:35,830 --> 01:27:33,520
information to the others and if

2246
01:27:38,310 --> 01:27:35,840
if the others can be convinced

2247
01:27:41,350 --> 01:27:38,320
um perhaps of the merits of a high-risk

2248
01:27:42,390 --> 01:27:41,360
high reward approach then

2249
01:27:45,590 --> 01:27:42,400
the

2250
01:27:48,629 --> 01:27:45,600
median might be shifted so it's it's uh

2251
01:27:50,950 --> 01:27:48,639
let's say it's a structured uh dialogue

2252
01:27:53,189 --> 01:27:50,960
uh it's it's not more it's not so much

2253
01:27:53,910 --> 01:27:53,199
of a survey than a structured dialogue

2254
01:27:57,350 --> 01:27:53,920
that

2255
01:28:00,470 --> 01:27:57,360
uh also gives the opportunity to uh to

2256
01:28:03,189 --> 01:28:00,480
the respondents to reach uh disagreement

2257
01:28:05,030 --> 01:28:03,199
that they agree they disagree so if

2258
01:28:07,189 --> 01:28:05,040
there are metrics that you can use to

2259
01:28:09,590 --> 01:28:07,199
show that there is strong disagreement

2260
01:28:11,750 --> 01:28:09,600
over some topic then you can dive

2261
01:28:14,229 --> 01:28:11,760
deep and see why there is disagreement

2262
01:28:16,550 --> 01:28:14,239
why there are there might be assumptions

2263
01:28:18,790 --> 01:28:16,560

um built in the

2264
01:28:20,310 --> 01:28:18,800
systems that cognitive systems that they

2265
01:28:22,950 --> 01:28:20,320
respond to deploy when they are

2266
01:28:25,110 --> 01:28:22,960
responding to the the items and there

2267
01:28:26,310 --> 01:28:25,120
are other methods that you can use to

2268
01:28:27,990 --> 01:28:26,320
try to

2269
01:28:29,510 --> 01:28:28,000
reach to the root of that or you can

2270
01:28:31,030 --> 01:28:29,520
resolve it

2271
01:28:32,390 --> 01:28:31,040
there are other methods like the normal

2272
01:28:34,310 --> 01:28:32,400
group technique that you can deploy

2273
01:28:36,310 --> 01:28:34,320
right immediately afterwards

2274
01:28:38,470 --> 01:28:36,320
so there are

2275
01:28:39,990 --> 01:28:38,480
yes there are some there are some

2276
01:28:42,229 --> 01:28:40,000
let's say

2277
01:28:44,629 --> 01:28:42,239
setbacks but but you can also find ways

2278
01:28:46,790 --> 01:28:44,639
to mitigate uh midgate these and

2279
01:28:49,590 --> 01:28:46,800
in the full scale version of a multiple

2280
01:28:50,790 --> 01:28:49,600
round let's say the process even harris

2281
01:28:52,229 --> 01:28:50,800
high reward

2282
01:28:54,950 --> 01:28:52,239
opinions

2283
01:28:56,470 --> 01:28:54,960
would be represented and they would be

2284
01:28:58,709 --> 01:28:56,480
given the opportunity to explain the

2285
01:29:00,229 --> 01:28:58,719
rationales and perhaps convince let's

2286
01:29:02,470 --> 01:29:00,239
say rhetorically

2287
01:29:04,950 --> 01:29:02,480
the other experts that there is merit in

2288
01:29:07,110 --> 01:29:04,960

their approach so it's all that's mental

2289
01:29:08,550 --> 01:29:07,120
it's not qualitative

2290
01:29:10,550 --> 01:29:08,560
it's semi

2291
01:29:13,350 --> 01:29:10,560
but it uses best

2292
01:29:15,590 --> 01:29:13,360
available knowledge let's say that is

2293
01:29:17,669 --> 01:29:15,600
the expert's head so it's an expert

2294
01:29:20,390 --> 01:29:17,679
judgment method that is the best that

2295
01:29:23,430 --> 01:29:20,400
you can have when you don't have enough

2296
01:29:26,790 --> 01:29:23,440
uh data to do statistical forecasting or

2297
01:29:28,790 --> 01:29:26,800
or try to feed statistical data to any

2298
01:29:29,990 --> 01:29:28,800
other decision making

2299
01:29:38,550 --> 01:29:30,000
techniques

2300
01:29:46,470 --> 01:29:40,790
are there any online questions that we

2301
01:29:50,310 --> 01:29:48,709
well what i can just make a comment that

2302
01:29:52,310 --> 01:29:50,320
uh you know various talk made me think

2303
01:29:53,189 --> 01:29:52,320
about is i think it's interesting that

2304
01:29:54,550 --> 01:29:53,199
you can

2305
01:29:56,070 --> 01:29:54,560
fit all the

2306
01:29:57,270 --> 01:29:56,080
well so techno signatures depends on

2307
01:29:59,430 --> 01:29:57,280
motivation i think one of the things

2308
01:30:01,270 --> 01:29:59,440
that came out of this this analysis at

2309
01:30:03,430 --> 01:30:01,280
least um if you're going to search for

2310
01:30:05,350 --> 01:30:03,440
something many of these depend on you

2311
01:30:07,030 --> 01:30:05,360
know the motivation of the hypothetical

2312
01:30:08,790 --> 01:30:07,040
aliens that are doing this is this a

2313
01:30:10,229 --> 01:30:08,800

distinction between just a question to

2314
01:30:11,590 --> 01:30:10,239
pose it's a distinction between bio

2315
01:30:13,510 --> 01:30:11,600
signatures and technical signatures are

2316
01:30:15,430 --> 01:30:13,520
there bio signatures that depend on

2317
01:30:17,189 --> 01:30:15,440
motivation or are there not and then

2318
01:30:18,470 --> 01:30:17,199
that's really one of the distinctions so

2319
01:30:19,510 --> 01:30:18,480
i don't have an answer just kind of

2320
01:30:20,870 --> 01:30:19,520
throwing it out there at the end of the

2321
01:30:23,110 --> 01:30:20,880
discussion maybe that's something to

2322
01:30:24,629 --> 01:30:23,120
think about and what is motivation you

2323
01:30:26,310 --> 01:30:24,639
know they can

2324
01:30:28,790 --> 01:30:26,320
is that is that tied to intelligence or

2325
01:30:30,709 --> 01:30:28,800
cognition or does it not matter is

2326
01:30:33,110 --> 01:30:30,719
what kind of choices does biology make

2327
01:30:36,709 --> 01:30:33,120
that could look like motivation so

2328
01:30:39,430 --> 01:30:38,310
if anyone have any comments feel free to

2329
01:30:41,750 --> 01:30:39,440
share yes

2330
01:30:43,270 --> 01:30:41,760
no i think i i think that's the crucial

2331
01:30:44,310 --> 01:30:43,280
difference between the two searches

2332
01:30:46,790 --> 01:30:44,320
indeed

2333
01:30:48,950 --> 01:30:46,800
and and also that's a difficulty for

2334
01:30:51,750 --> 01:30:48,960
diagnosing signatures is to to imagine

2335
01:30:53,110 --> 01:30:51,760
what could be these motivations

2336
01:30:55,270 --> 01:30:53,120
but there are

2337
01:30:57,910 --> 01:30:55,280
more or less conservative

2338
01:30:59,830 --> 01:30:57,920

ways to to approach this question

2339
01:31:01,430 --> 01:30:59,840
but yes that's an additional difficulty

2340
01:31:03,910 --> 01:31:01,440
i would say

2341
01:31:06,070 --> 01:31:03,920
i was thinking of the kind of what is it

2342
01:31:08,070 --> 01:31:06,080
like a nature verse nurture

2343
01:31:09,590 --> 01:31:08,080
so you're talking about motivation i'm

2344
01:31:11,189 --> 01:31:09,600
assuming

2345
01:31:13,030 --> 01:31:11,199
i feel like it's based on kind of what

2346
01:31:15,189 --> 01:31:13,040
you're given whatever the civilization

2347
01:31:18,310 --> 01:31:15,199
sort of started with to a certain extent

2348
01:31:19,430 --> 01:31:18,320
like whatever that planet

2349
01:31:21,350 --> 01:31:19,440
setup is

2350
01:31:22,709 --> 01:31:21,360
if it's not like earth

2351
01:31:24,629 --> 01:31:22,719
i mean it could be something terrestrial

2352
01:31:26,790 --> 01:31:24,639
but you know completely different kind

2353
01:31:28,629 --> 01:31:26,800
of chemical

2354
01:31:30,550 --> 01:31:28,639
bases or whatever

2355
01:31:31,750 --> 01:31:30,560
so that's what i think motivation i kind

2356
01:31:36,870 --> 01:31:31,760
of think that way it's like what are you

2357
01:31:38,629 --> 01:31:37,669
uh

2358
01:31:40,629 --> 01:31:38,639
so

2359
01:31:41,830 --> 01:31:40,639
this is a shameless promotion

2360
01:31:51,350 --> 01:31:41,840
i

2361
01:31:53,669 --> 01:31:51,360
or two talks

2362
01:31:55,910 --> 01:31:53,679
and if you want to be added to that

2363
01:31:57,510 --> 01:31:55,920

email list to receive these seminars

2364
01:31:58,550 --> 01:31:57,520
they are recorded and posted on the

2365
01:32:00,790 --> 01:31:58,560
website

2366
01:32:02,709 --> 01:32:00,800
just contact me after this session and i

2367
01:32:04,470 --> 01:32:02,719
can add you to the list

2368
01:32:06,390 --> 01:32:04,480
or if you want to give a talk at that

2369
01:32:08,709 --> 01:32:06,400
seminar series you're most welcome or if

2370
01:32:10,229 --> 01:32:08,719
you know someone equally who's working

2371
01:32:13,270 --> 01:32:10,239
in that and want to recommend even that

2372
01:32:15,270 --> 01:32:13,280
would be great too so

2373
01:32:17,430 --> 01:32:15,280
thank you very much i think we can close

2374
01:32:19,270 --> 01:32:17,440
the session for today thank you to all

2375
01:32:20,810 --> 01:32:19,280
the participants and the audience and

2376
01:32:26,709 --> 01:32:20,820
everyone on zoom