AbGradCon 2018

1
00:00:00,260 --> 00:00:10,879
[Music]

2
00:00:15,060 --> 00:00:13,200
that all of my talk is the bracelet and

3
00:00:16,650 --> 00:00:15,070
search for techno signatures and I hope

4
00:00:20,279 --> 00:00:16,660
by the end of my talk that will make

5
00:00:23,580 --> 00:00:20,289
sense I'm gonna start with this question

6
00:00:25,109 --> 00:00:23,590
what is steady so I want to ask this

7
00:00:28,499 --> 00:00:25,119
question to all of you if you can raise

8
00:00:34,860 --> 00:00:28,509
your hands it before today you have

9
00:00:37,410 --> 00:00:34,870
heard the term steady Wow okay good so

10
00:00:39,960 --> 00:00:37,420
hopefully you all know then why it means

11
00:00:41,070 --> 00:00:39,970
in any case for those of you that don't

12
00:00:43,140 --> 00:00:41,080
know

13
00:00:45,840 --> 00:00:43,150

Siri is it storage for terrestrial

14
00:00:50,190 --> 00:00:45,850
intelligence and it's a field of

15
00:00:51,930 --> 00:00:50,200
research which basically is between you

16
00:00:54,210 --> 00:00:51,940
have here so biology and communication

17
00:00:57,480 --> 00:00:54,220
technology and study live somewhere

18
00:00:59,610 --> 00:00:57,490
there through trying there have been

19
00:01:00,930 --> 00:00:59,620
many different institutions where they

20
00:01:02,880 --> 00:01:00,940
have done sorry

21
00:01:05,340 --> 00:01:02,890
one way or another I think at this

22
00:01:06,780 --> 00:01:05,350
moment the two main ones are probably

23
00:01:08,880 --> 00:01:06,790
have heard about the SETI Institute and

24
00:01:14,070 --> 00:01:08,890
I'm part of this one the Berkeley

25
00:01:16,080 --> 00:01:14,080
Research Center in Berkeley so I'm gonna

26
00:01:18,630 --> 00:01:16,090
tell you more about my work talking bad

27
00:01:22,770 --> 00:01:18,640
but I going to actually start my talk

28
00:01:26,010 --> 00:01:22,780
now with an introduction in perspective

29
00:01:28,230 --> 00:01:26,020
of astrobiology and how there are

30
00:01:31,620 --> 00:01:28,240
several ways that we want to find life

31
00:01:33,480 --> 00:01:31,630
outside our planet and I think basically

32
00:01:36,480 --> 00:01:33,490
there are three different ways and we

33
00:01:39,860 --> 00:01:36,490
have her talks about this today so

34
00:01:43,860 --> 00:01:39,870
basically we have in field sampling

35
00:01:46,380 --> 00:01:43,870
exoplanet atmospheres and setting for

36
00:01:49,020 --> 00:01:46,390
instead of sampling I think like the

37
00:01:52,080 --> 00:01:49,030
cool thing about this one is that you

38
00:01:55,580 --> 00:01:52,090

basically doing a direct detection of

39
00:01:58,940 --> 00:01:55,590
life either you go to Mars or well or

40
00:02:01,920 --> 00:01:58,950
some of the moons of our solar system

41
00:02:03,899 --> 00:02:01,930
you will be able to find some kind of

42
00:02:07,500 --> 00:02:03,909
life you're looking for fossils as with

43
00:02:10,009 --> 00:02:07,510
her maybe that's more difficult in

44
00:02:13,890 --> 00:02:10,019
contrast this other two methods are

45
00:02:16,979 --> 00:02:13,900
remote sensing you're finding signatures

46
00:02:17,700 --> 00:02:16,989
that like one way or another creates and

47
00:02:22,530 --> 00:02:17,710
you can

48
00:02:24,810 --> 00:02:22,540
interpret those as life may I guess made

49
00:02:26,720 --> 00:02:24,820
by life so the first one is when you

50
00:02:29,820 --> 00:02:26,730
looking at the atmospheres of exoplanets

51
00:02:31,950 --> 00:02:29,830
as we heard from Andrew earlier we have

52
00:02:33,330 --> 00:02:31,960
what is called bio signatures so you're

53
00:02:35,220 --> 00:02:33,340
looking at the atmospheres and by

54
00:02:37,440 --> 00:02:35,230
looking at their composition you can

55
00:02:39,780 --> 00:02:37,450
realize if there are some elements there

56
00:02:42,600 --> 00:02:39,790
that the only way that you can have them

57
00:02:46,590 --> 00:02:42,610
is because some biological process is

58
00:02:48,180 --> 00:02:46,600
creating them in the case of sorry we

59
00:02:51,500 --> 00:02:48,190
have words called signal signatures and

60
00:02:53,790 --> 00:02:51,510
I'll explain more about that later

61
00:02:55,980 --> 00:02:53,800
one extra comparison that I want to make

62
00:02:59,640 --> 00:02:55,990
about all of this is that we might think

63
00:03:02,160 --> 00:02:59,650

that in general looking for microbial

64
00:03:06,210 --> 00:03:02,170
life or simpler forms of life might be

65
00:03:08,640 --> 00:03:06,220
easier or it's easier to create so it

66
00:03:10,590 --> 00:03:08,650
might be actually easier to find but

67
00:03:11,190 --> 00:03:10,600
actually I think there is a reason why

68
00:03:13,920 --> 00:03:11,200
thing

69
00:03:18,180 --> 00:03:13,930
SETI is an in equal footing with all the

70
00:03:20,400 --> 00:03:18,190
other options and that's the range so if

71
00:03:22,020 --> 00:03:20,410
we have in situ sampling at least from

72
00:03:24,450 --> 00:03:22,030
the next couple of decades I think that

73
00:03:28,070 --> 00:03:24,460
we are pretty much bound to a solar

74
00:03:30,300 --> 00:03:28,080
system and roll even less than ten

75
00:03:35,070 --> 00:03:30,310
planets or moons so we can search for

76
00:03:37,590 --> 00:03:35,080
life for the case of so planet

77
00:03:39,930 --> 00:03:37,600
atmospheres with the coming of vws T I

78
00:03:43,260 --> 00:03:39,940
think we're still banned for near white

79
00:03:45,420 --> 00:03:43,270
stars and that might be I don't know the

80
00:03:52,880 --> 00:03:45,430
numbers exactly but somewhere around say

81
00:03:55,950 --> 00:03:52,890
that's 104 the case of chedi we first

82
00:03:58,470 --> 00:03:55,960
limit ourselves to the same level of

83
00:04:02,010 --> 00:03:58,480
technology that we have we could already

84
00:04:04,710 --> 00:04:02,020
look for millions of stars and if we

85
00:04:07,050 --> 00:04:04,720
allow ourselves for advancements in

86
00:04:08,490 --> 00:04:07,060
technology just extrapolating from our

87
00:04:13,710 --> 00:04:08,500
own technology not going to something

88
00:04:16,979 --> 00:04:13,720

crazy we could easily get this number

89
00:04:19,560 --> 00:04:16,989
much higher so even though you know

90
00:04:22,830 --> 00:04:19,570
finding intelligent life somewhere else

91
00:04:24,420 --> 00:04:22,840
maybe in a way harder I mean the

92
00:04:27,120 --> 00:04:24,430
probabilities of creating intelligent

93
00:04:30,170 --> 00:04:27,130
life might be much smaller than just

94
00:04:31,690 --> 00:04:30,180
life just by having larger numbers that

95
00:04:36,490 --> 00:04:31,700
my company

96
00:04:39,370 --> 00:04:36,500
that something that all of them share is

97
00:04:42,760 --> 00:04:39,380
that we don't have any other examples of

98
00:04:46,780 --> 00:04:42,770
life we don't really know what how

99
00:04:48,580 --> 00:04:46,790
common is life elsewhere so we can say

100
00:04:51,190 --> 00:04:48,590
that by the lack of constraints I

101
00:04:53,350 --> 00:04:51,200
basically likely that we live in the

102
00:04:55,540 --> 00:04:53,360
only biosphere in the galaxy or are

103
00:04:58,780 --> 00:04:55,550
thousands of them the same thing you can

104
00:05:01,510 --> 00:04:58,790
say for civilizations but I think a

105
00:05:03,460 --> 00:05:01,520
scout second set and this is very much

106
00:05:05,320 --> 00:05:03,470
of the core of an Israeli experiment is

107
00:05:06,640 --> 00:05:05,330
that the only significant test for the

108
00:05:09,790 --> 00:05:06,650
sisters of extraterrestrial intelligence

109
00:05:11,530 --> 00:05:09,800
is an experimental one so what we're

110
00:05:13,750 --> 00:05:11,540
trying to do is make an experiment and

111
00:05:18,160 --> 00:05:13,760
try to figure out if there is something

112
00:05:19,240 --> 00:05:18,170
out there okay so so far I've been

113
00:05:21,100 --> 00:05:19,250

telling you about the search for

114
00:05:27,060 --> 00:05:21,110
extraterrestrial intelligence but

115
00:05:32,080 --> 00:05:29,710
we're actually doing is the search for

116
00:05:33,850 --> 00:05:32,090
terrestrial technology and we use

117
00:05:38,140 --> 00:05:33,860
technology as a proxy for intelligence

118
00:05:41,470 --> 00:05:38,150
so here on our own planet we probably

119
00:05:44,850 --> 00:05:41,480
have several examples what somebody

120
00:05:49,330 --> 00:05:44,860
could call intelligence but in order to

121
00:05:50,980 --> 00:05:49,340
communicate or in order to fear out if

122
00:05:53,140 --> 00:05:50,990
there is life at very large distances

123
00:05:56,590 --> 00:05:53,150
that is intelligent in the only way

124
00:05:59,100 --> 00:05:56,600
would be you know an example here were

125
00:06:01,890 --> 00:05:59,110
looking for intelligence that can create

126
00:06:04,000 --> 00:06:01,900
very large buildings for instance and

127
00:06:07,150 --> 00:06:04,010
the type of technology that we're

128
00:06:09,220 --> 00:06:07,160
actually interested on is examples that

129
00:06:11,620 --> 00:06:09,230
we have in our own technology is a

130
00:06:13,840 --> 00:06:11,630
communication technology so finding a

131
00:06:16,270 --> 00:06:13,850
way to send a message across very large

132
00:06:18,730 --> 00:06:16,280
differences so these are some examples

133
00:06:21,790 --> 00:06:18,740
of that so for instance we have very

134
00:06:26,050 --> 00:06:21,800
high power TV or radio stations that can

135
00:06:28,690 --> 00:06:26,060
basically go around our planet they can

136
00:06:30,850 --> 00:06:28,700
actually those signals can go for many

137
00:06:34,840 --> 00:06:30,860
light-years from us

138
00:06:38,620 --> 00:06:34,850

they'll the strongest transmitter that

139
00:06:41,110 --> 00:06:38,630
we have in our planet is on the our

140
00:06:43,120 --> 00:06:41,120
stable planet physical guy right there

141
00:06:45,610 --> 00:06:43,130
error anything they are receive all

142
00:06:49,210 --> 00:06:45,620
telescope you might have

143
00:06:52,120 --> 00:06:49,220
known before this is a 300 meter dish in

144
00:06:54,670 --> 00:06:52,130
importer Rico and it's a strong that you

145
00:06:57,400 --> 00:06:54,680
can actually use it to map the surface

146
00:06:59,950 --> 00:06:57,410
of asteroids nearby asteroids in our own

147
00:07:02,409 --> 00:06:59,960
solar system it's pretty cool we also

148
00:07:03,939 --> 00:07:02,419
have examples not only from radio but

149
00:07:07,780 --> 00:07:03,949
also from optical where you can have

150
00:07:10,810 --> 00:07:07,790
basically a laser very powerful lasers

151
00:07:14,170 --> 00:07:10,820
that in principle I do China to a

152
00:07:17,680 --> 00:07:14,180
different star who like outshine at

153
00:07:21,060 --> 00:07:17,690
those regions our own Sun by thousands

154
00:07:23,740 --> 00:07:21,070
of times okay

155
00:07:27,100 --> 00:07:23,750
so you can see that so far when I'm

156
00:07:29,620 --> 00:07:27,110
telling you is electromagnetic waves and

157
00:07:32,560 --> 00:07:29,630
there are reasons why electromagnetic

158
00:07:37,090 --> 00:07:32,570
waves we think it's a way to go

159
00:07:39,040 --> 00:07:37,100
it's a is the venue for communication

160
00:07:40,719 --> 00:07:39,050
and you know sometimes we have questions

161
00:07:42,420 --> 00:07:40,729
from people saying okay why

162
00:07:46,120 --> 00:07:42,430
what is they're using I don't know

163
00:07:48,040 --> 00:07:46,130

documents or neutrinos or gravitational

164
00:07:50,710 --> 00:07:48,050
waves or something else but there are

165
00:07:53,980 --> 00:07:50,720
actually reasons why electromagnetic

166
00:07:55,120 --> 00:07:53,990
waves is a very appealing metal and I

167
00:07:56,800 --> 00:07:55,130
just gonna see some of them and I'll

168
00:07:58,750 --> 00:07:56,810
tell you about that so the first one

169
00:08:01,150 --> 00:07:58,760
here is that they're easy to generate

170
00:08:05,200 --> 00:08:01,160
and to receive I'm very cheap to make

171
00:08:07,629 --> 00:08:05,210
and that's obvious right so all our

172
00:08:10,240 --> 00:08:07,639
technology is based on this so the Wi-Fi

173
00:08:11,890 --> 00:08:10,250
in this room radio stations and many

174
00:08:15,520 --> 00:08:11,900
other things are all based on this

175
00:08:17,830 --> 00:08:15,530
control technology they travel the fast

176
00:08:19,960 --> 00:08:17,840
speed possible and that's the speed of

177
00:08:21,610 --> 00:08:19,970
light so we know from physics that there

178
00:08:23,890 --> 00:08:21,620
is not in the control faster than that

179
00:08:25,540 --> 00:08:23,900
so you can imagine whatever high

180
00:08:27,730 --> 00:08:25,550
technology that you can create the

181
00:08:34,089 --> 00:08:27,740
fastest rocket out there still it will

182
00:08:35,769 --> 00:08:34,099
be slower than this way there is also

183
00:08:38,380 --> 00:08:35,779
another thing about electromagnetic

184
00:08:42,390 --> 00:08:38,390
waves that help us on this and that's

185
00:08:47,170 --> 00:08:42,400
that you can easily distinguish

186
00:08:50,290 --> 00:08:47,180
artificial made signals from natural

187
00:08:52,990 --> 00:08:50,300
nature basic notes and one example of

188
00:08:56,020 --> 00:08:53,000

that is a Voyager and we like this

189
00:08:58,759 --> 00:08:56,030
spacecraft and thanks for for telling us

190
00:09:00,079 --> 00:08:58,769
about it earlier so

191
00:09:04,040 --> 00:09:00,089
has been travelling for several decades

192
00:09:05,720 --> 00:09:04,050
not throwing through our solar system

193
00:09:06,379 --> 00:09:05,730
and it's just now outside of the solar

194
00:09:09,350 --> 00:09:06,389
system

195
00:09:13,309 --> 00:09:09,360
and it has a transmitter of 40 watts

196
00:09:15,889 --> 00:09:13,319
which is what your typical fridge light

197
00:09:18,109 --> 00:09:15,899
bulb has and we're able to detect that

198
00:09:21,910 --> 00:09:18,119
very easily so that's a very clear

199
00:09:24,979 --> 00:09:21,920
example to me that how with a very

200
00:09:27,470 --> 00:09:24,989
amount of energy you can send a message

201
00:09:29,859 --> 00:09:27,480
across very large distances so this is

202
00:09:31,789 --> 00:09:29,869
an example of actual signal from Voyager

203
00:09:34,489 --> 00:09:31,799
this is kind of the data that will look

204
00:09:37,910 --> 00:09:34,499
every day so you have here frequency and

205
00:09:41,179 --> 00:09:37,920
time so earlier on from Randall we're

206
00:09:43,009 --> 00:09:41,189
looking at spectrum radio spectrum so in

207
00:09:45,590 --> 00:09:43,019
this case what we call this is an ami

208
00:09:46,879 --> 00:09:45,600
spectrum so every time step you can in

209
00:09:49,039 --> 00:09:46,889
mind you have an spectrum and it's

210
00:09:54,949 --> 00:09:49,049
evolving in time in this case we have

211
00:09:57,079 --> 00:09:54,959
this very narrow band signal I'm coming

212
00:09:59,509 --> 00:09:57,089
back to my topic here about having an

213
00:10:03,289 --> 00:09:59,519

artificial signal is that if you see

214
00:10:05,960 --> 00:10:03,299
here of the numbers this only 50 Hertz

215
00:10:08,929 --> 00:10:05,970
wide here and there is nothing in nature

216
00:10:12,289 --> 00:10:08,939
that can create a signal that narrow the

217
00:10:15,139 --> 00:10:12,299
narrow is signals that you can create

218
00:10:17,509 --> 00:10:15,149
masers and so on are thousands of times

219
00:10:19,189 --> 00:10:17,519
wider than that so you find a signal

220
00:10:21,769 --> 00:10:19,199
that is this narrow coming from

221
00:10:24,910 --> 00:10:21,779
somewhere else the radar in view okay

222
00:10:30,679 --> 00:10:28,669
all right so they can do the same you

223
00:10:32,179 --> 00:10:30,689
can put all your energy or transmitter

224
00:10:34,429 --> 00:10:32,189
instead of putting all in air with one

225
00:10:36,319 --> 00:10:34,439
single frequency you can do the same but

226
00:10:38,809 --> 00:10:36,329
in time so you can put all your energy

227
00:10:40,910 --> 00:10:38,819
in a very amount of time and create some

228
00:10:43,249 --> 00:10:40,920
kind of pulse so that's something that

229
00:10:47,419 --> 00:10:43,259
for instant optical SETI experiments

230
00:10:48,739 --> 00:10:47,429
house trying to find so that's that's

231
00:10:50,929 --> 00:10:48,749
basically another way so there is

232
00:10:53,569 --> 00:10:50,939
examples in nature that can create this

233
00:10:55,729 --> 00:10:53,579
so for instance pulsars I don't know you

234
00:10:57,470 --> 00:10:55,739
have heard about that or FRBS fast radio

235
00:10:59,329 --> 00:10:57,480
bursts they're actually some theories

236
00:11:02,239 --> 00:10:59,339
that people think that I don't believe

237
00:11:04,819 --> 00:11:02,249
that but there's very famous scientists

238
00:11:06,829 --> 00:11:04,829

that they they have have papers out

239
00:11:11,780 --> 00:11:06,839
there that they can explain if RV's by

240
00:11:12,560 --> 00:11:11,790
some artificial means okay there is one

241
00:11:15,680 --> 00:11:12,570
more

242
00:11:17,420 --> 00:11:15,690
my electromagnetic waves is very

243
00:11:22,040 --> 00:11:17,430
interesting to some signals and that

244
00:11:24,320 --> 00:11:22,050
that they are able to traverse our

245
00:11:27,650 --> 00:11:24,330
galaxy with no much problem so they our

246
00:11:29,590 --> 00:11:27,660
galaxy is full of gas and dust and god

247
00:11:33,260 --> 00:11:29,600
block signals and you know for instance

248
00:11:35,390 --> 00:11:33,270
optical light is blocked by that for the

249
00:11:38,660 --> 00:11:35,400
case of radio in particular there is no

250
00:11:39,920 --> 00:11:38,670
problem right so here in this room we

251
00:11:44,060 --> 00:11:39,930
know that we can get signals from

252
00:11:45,410 --> 00:11:44,070
outside it's kind of the same way so

253
00:11:47,270 --> 00:11:45,420
then what we can say it's like we don't

254
00:11:49,940 --> 00:11:47,280
really need to invoke any unknown

255
00:11:52,790 --> 00:11:49,950
physics to when we're talking about

256
00:11:53,300 --> 00:11:52,800
finding signals artificial made from

257
00:11:55,850 --> 00:11:53,310
somewhere else

258
00:11:59,630 --> 00:11:55,860
I think electromagnetic waves if it's

259
00:12:01,790 --> 00:11:59,640
already proven that flux since the 60s

260
00:12:04,940 --> 00:12:01,800
from from these people front rate and so

261
00:12:09,130 --> 00:12:04,950
on we know that this is the way to go

262
00:12:10,970 --> 00:12:09,140
okay so what about wishes particularly

263
00:12:14,330 --> 00:12:10,980

parts of the electromagnetic spectrum

264
00:12:17,600 --> 00:12:14,340
are most interesting so here in this

265
00:12:21,260 --> 00:12:17,610
plot we have wavelength or frequencies

266
00:12:24,110 --> 00:12:21,270
same thing we have a very large

267
00:12:26,470 --> 00:12:24,120
wavelength we have radio on the move in

268
00:12:31,310 --> 00:12:26,480
this direction we have microwaves

269
00:12:35,000 --> 00:12:31,320
infrared optical and UV and an x-ray

270
00:12:37,460 --> 00:12:35,010
right so what is plotted showing us here

271
00:12:40,250 --> 00:12:37,470
is they have most very capacity so

272
00:12:43,100 --> 00:12:40,260
basically if you put an instrument on

273
00:12:46,100 --> 00:12:43,110
the surface our planet only in some

274
00:12:48,800 --> 00:12:46,110
regions you're actually able to see the

275
00:12:50,660 --> 00:12:48,810
universe right because they almost fear

276
00:12:53,300 --> 00:12:50,670
blocks all of these regions right there

277
00:12:55,490 --> 00:12:53,310
so that kind of limits are you doing any

278
00:12:59,690 --> 00:12:55,500
kind of ground-based experiment

279
00:13:02,300 --> 00:12:59,700
virtually optical infrared and radio but

280
00:13:04,190 --> 00:13:02,310
there is no specifics on which

281
00:13:07,130 --> 00:13:04,200
particular frequency which particular

282
00:13:09,410 --> 00:13:07,140
optical wavelength you want to look you

283
00:13:12,200 --> 00:13:09,420
actually want to look all of that so

284
00:13:17,120 --> 00:13:12,210
that that requires a lot of time and a

285
00:13:19,720 --> 00:13:17,130
lot of money so luckily years ago the

286
00:13:22,450 --> 00:13:19,730
breakthrough listen program started by

287
00:13:26,060 --> 00:13:22,460
the yuri milner

288
00:13:31,130 --> 00:13:26,070

which is a silicon valley beginner and

289
00:13:33,830 --> 00:13:31,140
to help us here and so this is basically

290
00:13:36,950 --> 00:13:33,840
is winning the lottery and we were able

291
00:13:38,450 --> 00:13:36,960
now to have access to Barry basically

292
00:13:40,910 --> 00:13:38,460
the largest radio telescopes in the

293
00:13:42,860 --> 00:13:40,920
world tell you more about the Green Bank

294
00:13:46,780 --> 00:13:42,870
telescope later also we're doing some

295
00:13:51,020 --> 00:13:46,790
optical observations so this is really

296
00:13:53,270 --> 00:13:51,030
the largest scale SETI program in the

297
00:13:54,290 --> 00:13:53,280
history of humanity so we're very

298
00:13:56,090 --> 00:13:54,300
excited about that

299
00:13:57,760 --> 00:13:56,100
and it's already ongoing weren't already

300
00:14:02,530 --> 00:13:57,770
into way for ten or twenty more years

301
00:14:05,420 --> 00:14:02,540
start this we're already looking for it

302
00:14:07,750 --> 00:14:05,430
there are many programs within break to

303
00:14:10,880 --> 00:14:07,760
listen and I just want to give you a

304
00:14:12,530 --> 00:14:10,890
perspective on that what are we having

305
00:14:14,090 --> 00:14:12,540
all these different programs and for

306
00:14:20,330 --> 00:14:14,100
that I just want to show you this slide

307
00:14:22,160 --> 00:14:20,340
right here okay okay I'm all that so I

308
00:14:23,540 --> 00:14:22,170
want showing here is the power

309
00:14:24,860 --> 00:14:23,550
distribution of transmitters in the

310
00:14:27,350 --> 00:14:24,870
universe so you can imagine that you

311
00:14:29,660 --> 00:14:27,360
have power here a number of transmitters

312
00:14:33,230 --> 00:14:29,670
so you can imagine then that you have

313
00:14:34,640 --> 00:14:33,240

some distribution that a low power you

314
00:14:36,740 --> 00:14:34,650
have a lot of transmitters and a half

315
00:14:38,510 --> 00:14:36,750
hour you don't have that many but we

316
00:14:40,700 --> 00:14:38,520
don't know what distribution really

317
00:14:41,780 --> 00:14:40,710
exists so it might be that you don't

318
00:14:45,830 --> 00:14:41,790
really have that many powerful

319
00:14:48,200 --> 00:14:45,840
transmitters or it could be more flat so

320
00:14:49,730 --> 00:14:48,210
for that we had different projects that

321
00:14:55,070 --> 00:14:49,740
were looking at so nearby stars for

322
00:14:56,300 --> 00:14:55,080
instance we're looking at only policy so

323
00:14:58,670 --> 00:14:56,310
you're looking for nearby stars that

324
00:14:59,810 --> 00:14:58,680
means that they the power of the

325
00:15:03,320 --> 00:14:59,820
transmitter that you're trying to

326
00:15:05,270 --> 00:15:03,330
receive is not strong you can also look

327
00:15:07,130 --> 00:15:05,280
at galaxies and in this case we're

328
00:15:10,730 --> 00:15:07,140
providing this region here for more

329
00:15:13,280 --> 00:15:10,740
powerful transmitters can appoint a

330
00:15:14,660 --> 00:15:13,290
little bit on time here but basically

331
00:15:17,960 --> 00:15:14,670
you can also do something in between

332
00:15:20,240 --> 00:15:17,970
were you looking at the our own Milky

333
00:15:21,980 --> 00:15:20,250
Way and the plane of the Milky Way

334
00:15:25,580 --> 00:15:21,990
so we're basically covering all of these

335
00:15:28,220 --> 00:15:25,590
different projects cannot just to to end

336
00:15:32,600 --> 00:15:28,230
some of the first results that we have

337
00:15:36,200 --> 00:15:32,610
from the bright recent project was

338
00:15:38,690 --> 00:15:36,210

published last year where we look at 700

339
00:15:39,890 --> 00:15:38,700
stars one Vickers and I know when I go

340
00:15:41,870 --> 00:15:39,900
into details now but I just want to

341
00:15:43,340 --> 00:15:41,880
say that sometimes people ask well you

342
00:15:44,240 --> 00:15:43,350
know sherry sir should have been going

343
00:15:46,100 --> 00:15:44,250
on for decades

344
00:15:48,200 --> 00:15:46,110
you haven't find anything but this is

345
00:15:50,780 --> 00:15:48,210
the the largest study experiment ever

346
00:15:53,150 --> 00:15:50,790
done and you can see this not that large

347
00:15:55,250 --> 00:15:53,160
I mean it's only 700 stars I'm only a

348
00:15:57,140 --> 00:15:55,260
small range of frequencies so there is a

349
00:15:59,270 --> 00:15:57,150
lot of parameter space you to look for

350
00:16:00,590 --> 00:15:59,280
and that we're very sorry the next few

351
00:16:03,290 --> 00:16:00,600
years we're really gonna increase these

352
00:16:05,510 --> 00:16:03,300
numbers quite a lot there is a lot of

353
00:16:07,640 --> 00:16:05,520
stuff that I'm not talking about today I

354
00:16:10,060 --> 00:16:07,650
just want to mention that also you are

355
00:16:12,410 --> 00:16:10,070
doing machine learning we have some

356
00:16:15,080 --> 00:16:12,420
collaborations there or other Rey

357
00:16:17,150 --> 00:16:15,090
astronomy as well and if you know any

358
00:16:22,010 --> 00:16:17,160
undergrads that when I come work with us

359
00:16:23,960 --> 00:16:22,020
we actually started our REU program a

360
00:16:27,560 --> 00:16:23,970
couple years ago and the new students

361
00:16:29,900 --> 00:16:27,570
are arriving today well yesterday I just

362
00:16:31,970 --> 00:16:29,910
want to finish with this here we should

363
00:16:34,010 --> 00:16:31,980

really be very exploration off for me

364
00:16:37,520 --> 00:16:34,020
from a Stephen Hawking that passed away

365
00:16:39,230 --> 00:16:37,530
this year he's gonna read it to you to

366
00:16:41,540 --> 00:16:39,240
understand the universe you must know

367
00:16:44,300 --> 00:16:41,550
about atoms about forces that bind them

368
00:16:47,090 --> 00:16:44,310
the countries with space and time the

369
00:16:50,330 --> 00:16:47,100
verge of deaths of stars the dance of

370
00:16:53,600 --> 00:16:50,340
galaxies the secrets of black holes but

371
00:16:55,910 --> 00:16:53,610
that is not enough these ideas cannot

372
00:16:57,500 --> 00:16:55,920
explain everything they can explain the

373
00:17:00,200 --> 00:16:57,510
lights of stars who know the lies that

374
00:17:01,850 --> 00:17:00,210
child from Planet Earth to understand

375
00:17:12,680 --> 00:17:01,860
these lights you must know about life

376
00:17:19,090 --> 00:17:12,690
about minds thanks thank you very much

377
00:17:25,520 --> 00:17:22,760
so all these new surveys and everything

378
00:17:28,910 --> 00:17:25,530
with the lottery money are looking

379
00:17:30,260 --> 00:17:28,920
really cool but all of these things that

380
00:17:33,650 --> 00:17:30,270
you're talking about like lasers and

381
00:17:36,440 --> 00:17:33,660
radio over any sort of distance those

382
00:17:39,460 --> 00:17:36,450
require both a directional transmitter

383
00:17:41,750 --> 00:17:39,470
and a directional receiver am i right

384
00:17:43,580 --> 00:17:41,760
not necessarily okay

385
00:17:45,980 --> 00:17:43,590
because it seems like when you have to

386
00:17:48,620 --> 00:17:45,990
have a directional transmitter and a

387
00:17:51,710 --> 00:17:48,630
directional receiver that are completely

388
00:17:53,600 --> 00:17:51,720

uncoordinated trying to point at the

389
00:17:55,820 --> 00:17:53,610
same place at the same time you

390
00:17:57,860 --> 00:17:55,830
you wind up having your limiting factor

391
00:18:00,020 --> 00:17:57,870
sort of be patients rather than

392
00:18:02,870 --> 00:18:00,030
necessarily the ability of your

393
00:18:05,900 --> 00:18:02,880
equipment to do something and that

394
00:18:08,150 --> 00:18:05,910
factor into how these sort of surveys

395
00:18:10,520 --> 00:18:08,160
are proceeding right I cannot give a

396
00:18:13,760 --> 00:18:10,530
general answer so there is a lot of

397
00:18:15,350 --> 00:18:13,770
parameter space to cover right so if you

398
00:18:17,900 --> 00:18:15,360
get a signal coming from the other side

399
00:18:20,480 --> 00:18:17,910
of our galaxy takes thousands of years

400
00:18:24,020 --> 00:18:20,490
to get here so this temporality issue

401
00:18:25,909 --> 00:18:24,030
it's there we also I mean there is a lot

402
00:18:27,350 --> 00:18:25,919
of space and frequencies to cover and we

403
00:18:29,090 --> 00:18:27,360
don't really know what is the preferred

404
00:18:31,190 --> 00:18:29,100
option so what you want to do with any

405
00:18:32,930 --> 00:18:31,200
experiment or what we're trying with our

406
00:18:34,909 --> 00:18:32,940
advancing technologies to increase

407
00:18:39,440 --> 00:18:34,919
really this parameter as much as we can

408
00:18:50,450 --> 00:18:39,450
so more time or frequency more space in

409
00:18:52,970 --> 00:18:50,460
the sky well so I appreciate enhance and

410
00:18:55,789 --> 00:18:52,980
about the seating I feel challenged

411
00:18:58,730 --> 00:18:55,799
about city is probably you need to make

412
00:19:01,850 --> 00:18:58,740
the instrument like very much cheaper

413
00:19:05,060 --> 00:19:01,860

than now so you somehow can coverage

414
00:19:08,990 --> 00:19:05,070
basically the host guy and you know for

415
00:19:12,350 --> 00:19:09,000
whom many many longer time that is what

416
00:19:14,060 --> 00:19:12,360
my thinking the other thing I don't it's

417
00:19:16,820 --> 00:19:14,070
just my thinking I'm not doing anything

418
00:19:20,030 --> 00:19:16,830
with setting it's probably that I saw

419
00:19:23,000 --> 00:19:20,040
let some people I want to putting like

420
00:19:25,340 --> 00:19:23,010
an observatory or less for some house to

421
00:19:28,100 --> 00:19:25,350
the moon where you don't be limited with

422
00:19:30,169 --> 00:19:28,110
the weight where so maybe it could be

423
00:19:36,530 --> 00:19:30,179
you know combining with other astronomy

424
00:19:38,210 --> 00:19:36,540
projects to say this just might be yeah

425
00:19:41,150 --> 00:19:38,220
I didn't cover much of already astronomy

426
00:19:44,750 --> 00:19:41,160
but so there is a lot of advancements on

427
00:19:46,730 --> 00:19:44,760
what we call wide feel radius tournament

428
00:19:49,010 --> 00:19:46,740
so basically you have these kinds of a

429
00:19:52,669 --> 00:19:49,020
race of telescopes and it can cover very

430
00:19:54,140 --> 00:19:52,679
wide areas of the sky so and this is a

431
00:19:57,049 --> 00:19:54,150
technology that is advancing we're

432
00:19:58,820 --> 00:19:57,059
rapidly in the last years there is for

433
00:20:00,080 --> 00:19:58,830
instance a ska this one of the newest

434
00:20:02,570 --> 00:20:00,090
cell radio telescopes that we're really

435
00:20:05,779 --> 00:20:02,580
looking forward to to to work with in

436
00:20:08,450 --> 00:20:05,789
the case of the moon yeah

437
00:20:10,789 --> 00:20:08,460
of us not just in the cellar community

438
00:20:12,469 --> 00:20:10,799

but also in the real strano me community

439
00:20:17,570 --> 00:20:12,479
in general were very interested on that

440
00:20:19,999 --> 00:20:17,580
of course it's expensive so I have a

441
00:20:21,649 --> 00:20:20,009
question as well you put up some figures

442
00:20:24,639 --> 00:20:21,659
there that look very optimistic

443
00:20:26,479 --> 00:20:24,649
regarding technology at least at the

444
00:20:29,659 --> 00:20:26,489
civilization level that we're at

445
00:20:32,599 --> 00:20:29,669
technology level these 1 to 10 to 12

446
00:20:34,159 --> 00:20:32,609
really big number what I'm wondering is

447
00:20:36,109 --> 00:20:34,169
what's your take in terms of the silence

448
00:20:37,549 --> 00:20:36,119
and then the second portion of that you

449
00:20:43,369 --> 00:20:37,559
have any opinion regarding Cadi star

450
00:20:45,469 --> 00:20:43,379
thanks right let's see so I'm sure if I

451
00:20:51,649 --> 00:20:45,479
can really go back but so basically the

452
00:20:54,019 --> 00:20:51,659
numbers that I was showing is so

453
00:21:01,580 --> 00:20:54,029
basically the numbers that I was showing

454
00:21:03,680 --> 00:21:01,590
are knots ok well it's basically the

455
00:21:05,539 --> 00:21:03,690
number of stars that you can search

456
00:21:09,289 --> 00:21:05,549
right so I'm not saying that they're

457
00:21:11,330 --> 00:21:09,299
like a million bees out there I'm saying

458
00:21:14,479 --> 00:21:11,340
that you can search whatever on current

459
00:21:17,269 --> 00:21:14,489
telescopes we can search say a million

460
00:21:22,969 --> 00:21:17,279
stars and see if any of those has any

461
00:21:24,200 --> 00:21:22,979
signal coming we sure about the the rest

462
00:21:26,690 --> 00:21:24,210
of your question there but about Tavi

463
00:21:29,599 --> 00:21:26,700

star can tell you that there has been a

464
00:21:32,210 --> 00:21:29,609
lot of evolution at the last year there

465
00:21:35,570 --> 00:21:32,220
I really have any specifics to say right

466
00:21:37,310 --> 00:21:35,580
now but it seems that I think most of

467
00:21:40,969 --> 00:21:37,320
the community is moving out towards a

468
00:21:54,669 --> 00:21:40,979
more natural cause than a artificial

469
00:21:59,419 --> 00:21:56,600
yo so you

470
00:22:01,940 --> 00:21:59,429
I remember from last year actually you

471
00:22:07,159 --> 00:22:01,950
mentioned that you're looking for very

472
00:22:11,240 --> 00:22:07,169
very narrow lines right so I know a

473
00:22:14,930 --> 00:22:11,250
hydrogen line is pretty sharp now it can

474
00:22:19,400 --> 00:22:14,940
be make anything finer than that

475
00:22:24,110 --> 00:22:19,410
sure so when you have a hydrogen line in

476
00:22:27,049 --> 00:22:24,120
in space you you actually have it that

477
00:22:28,970 --> 00:22:27,059
will be say thousands of Hertz wide and

478
00:22:31,850 --> 00:22:28,980
we know these measures have the same or

479
00:22:33,880 --> 00:22:31,860
even wider so that signals that were

480
00:22:37,240 --> 00:22:33,890
looking for a say a thousand times