



ABSciCON 2017

MESA, ARIZONA

1
00:00:00,220 --> 00:00:12,560

[Music]

2
00:00:17,730 --> 00:00:15,390

alright then so so what I'm going to

3
00:00:20,130 --> 00:00:17,740

talk about in this talk is actually what

4
00:00:21,690 --> 00:00:20,140

Proxima send B might be like today and

5
00:00:23,790 --> 00:00:21,700

how we would go about taking

6
00:00:26,190 --> 00:00:23,800

measurements to discriminate what it

7
00:00:28,109 --> 00:00:26,200

might be like and I also make the point

8
00:00:30,029 --> 00:00:28,119

that what it might be like today is very

9
00:00:32,220 --> 00:00:30,039

much a function of the evolution of this

10
00:00:33,450 --> 00:00:32,230

planet and so rodrigo talked a little

11
00:00:35,790 --> 00:00:33,460

bit about what might have happened to

12
00:00:38,400 --> 00:00:35,800

this planet for example early on I'm

13
00:00:42,660 --> 00:00:38,410

hearing microphone noises that you're

14

00:00:44,790 --> 00:00:42,670

okay alright so as Rodrigo went over

15

00:00:47,389 --> 00:00:44,800

there are several evolutionary end

16

00:00:50,310 --> 00:00:47,399

States possible for Proxima Centauri B

17

00:00:52,170 --> 00:00:50,320

we ran through you know simulations of

18

00:00:54,479 --> 00:00:52,180

different initial volatile inventories

19

00:00:56,250 --> 00:00:54,489

and hydrogen of entries to see whether

20

00:00:57,870 --> 00:00:56,260

or not we could get water to survive and

21

00:00:59,880 --> 00:00:57,880

Rodrigo talked about so the probability

22

00:01:01,440 --> 00:00:59,890

distribution of that so the upshot is

23

00:01:02,850 --> 00:01:01,450

that water may or may not survive

24

00:01:05,730 --> 00:01:02,860

depending of course on the initial

25

00:01:07,380 --> 00:01:05,740

volatile inventory and if Proximus NB

26

00:01:08,820 --> 00:01:07,390

formed in its current position i think

27

00:01:11,820 --> 00:01:08,830

you saw that he sort of had a peak near

28

00:01:13,950 --> 00:01:11,830

zero water so it may be more probable

29

00:01:16,080 --> 00:01:13,960

that it doesn't have any water left but

30

00:01:17,760 --> 00:01:16,090

if it migrated in or formed with a

31

00:01:19,320 --> 00:01:17,770

protective hydrogen envelope then

32

00:01:21,270 --> 00:01:19,330

perhaps it's managed to preserve the

33

00:01:22,440 --> 00:01:21,280

volatiles underneath so when we're

34

00:01:24,960 --> 00:01:22,450

thinking about modeling what we might

35

00:01:27,960 --> 00:01:24,970

see today we're looking at potentially

36

00:01:29,910 --> 00:01:27,970

very oxygen-rich atmosphere but this

37

00:01:31,380 --> 00:01:29,920

planet is also potentially five billion

38

00:01:32,969 --> 00:01:31,390

years old and so we would expect some

39

00:01:35,460 --> 00:01:32,979

significant evolution to have occurred

40

00:01:37,920 --> 00:01:35,470

and part of that may in fact be

41

00:01:40,469 --> 00:01:37,930

evolution towards a more co2 dominated

42

00:01:42,090 --> 00:01:40,479

state for the planet and of course we've

43

00:01:44,219 --> 00:01:42,100

seen that with an example of a planet

44

00:01:45,840 --> 00:01:44,229

that's undergoing runaway in our own

45

00:01:47,310 --> 00:01:45,850

solar system and I like to think of

46

00:01:49,410 --> 00:01:47,320

Venus as kind of the popcorn in solar

47

00:01:51,690 --> 00:01:49,420

system it's kind of the end state a

48

00:01:53,789 --> 00:01:51,700

terrestrial planet evolution it's lost

49

00:01:56,730 --> 00:01:53,799

at least a three meter deep ocean

50

00:01:59,490 --> 00:01:56,740

overall and is now evolved to be a far

51
00:02:01,679 --> 00:01:59,500
more co2 rich State primarily because by

52
00:02:04,350 --> 00:02:01,689
losing its ocean and having its plate

53
00:02:05,850 --> 00:02:04,360
tectonics shut down that basically

54
00:02:08,100 --> 00:02:05,860
removes two of the major sinks for

55
00:02:09,660 --> 00:02:08,110
carbon dioxide for this object as I

56
00:02:12,360 --> 00:02:09,670
would expect this potential evolution of

57
00:02:14,069 --> 00:02:12,370
oxygen-rich through the co2 rich as the

58
00:02:15,930 --> 00:02:14,079
oxygen is ultimately sequestered or

59
00:02:18,660 --> 00:02:15,940
oxidized as the surface and co2 is

60
00:02:20,879 --> 00:02:18,670
outgassed and then of course we also

61
00:02:22,740 --> 00:02:20,889
because we want Proximus NVT habitable

62
00:02:23,909 --> 00:02:22,750
to be habitable we looked at situations

63
00:02:25,630 --> 00:02:23,919

where it was much more earth-like

64

00:02:26,620 --> 00:02:25,640

with the rationale that

65

00:02:28,150 --> 00:02:26,630

have so they're being protected from

66

00:02:31,210 --> 00:02:28,160

votes I lost by a hydrogen envelope

67

00:02:35,170 --> 00:02:31,220

early on or it had migrated in and so

68

00:02:38,410 --> 00:02:35,180

the cases we considered were essentially

69

00:02:39,970 --> 00:02:38,420

an earth-like planet also an early early

70

00:02:41,380 --> 00:02:39,980

earth-like planets on our Qian like

71

00:02:44,350 --> 00:02:41,390

world as well

72

00:02:46,030 --> 00:02:44,360

and we looked at an abiotic Oh to world

73

00:02:48,340 --> 00:02:46,040

one in which the ocean had survived and

74

00:02:50,410 --> 00:02:48,350

one in which it had not we looked at a

75

00:02:52,330 --> 00:02:50,420

desiccated ExoMars type scenario where

76
00:02:54,280 --> 00:02:52,340
co2 in the atmosphere due to the lack of

77
00:02:57,850 --> 00:02:54,290
catalyst had broken down into a stable

78
00:02:59,260 --> 00:02:57,860
co2 o2 Co atmosphere we also looked at

79
00:03:01,060 --> 00:02:59,270
sort of more evolved States sort of

80
00:03:02,920 --> 00:03:01,070
catching it from o2 dominated the co2

81
00:03:04,840 --> 00:03:02,930
dominated we had where we had almost

82
00:03:06,850 --> 00:03:04,850
equal amounts of o2 and co2 in the

83
00:03:09,280 --> 00:03:06,860
atmosphere and finally we looked at an

84
00:03:11,979 --> 00:03:09,290
EXO Venus both EXO Venus light with only

85
00:03:14,500 --> 00:03:11,989
ten bars and a more sort of a classic 90

86
00:03:16,570 --> 00:03:14,510
bar version of Venus and so we modeled

87
00:03:19,090 --> 00:03:16,580
these with couples won the climate

88
00:03:21,430 --> 00:03:19,100

photochemical models at moths in in

89

00:03:22,660 --> 00:03:21,440

principle but we also used our new VPL

90

00:03:25,449 --> 00:03:22,670

climate model which is being developed

91

00:03:27,130 --> 00:03:25,459

by what started out with Dave crisp and

92

00:03:28,660 --> 00:03:27,140

Tye Robinson but agile Mankowski is now

93

00:03:30,610 --> 00:03:28,670

in charge of that and her to talk on

94

00:03:32,410 --> 00:03:30,620

trapars from him earlier this week but

95

00:03:33,670 --> 00:03:32,420

this model has a lot more of the physics

96

00:03:36,880 --> 00:03:33,680

in it and allows us to model

97

00:03:38,229 --> 00:03:36,890

environments that at monster's not so

98

00:03:42,610 --> 00:03:38,239

you can see here the surface

99

00:03:44,650 --> 00:03:42,620

temperatures that we have derived with

100

00:03:46,539 --> 00:03:44,660

these models those in red we consider

101
00:03:47,979 --> 00:03:46,549
not not habitable either because of the

102
00:03:49,420 --> 00:03:47,989
actual surface temperature or the fact

103
00:03:51,400 --> 00:03:49,430
that were modeling and desiccated planet

104
00:03:53,800 --> 00:03:51,410
those in green are potentially habitable

105
00:03:55,120 --> 00:03:53,810
no surprise the earth-like planets

106
00:03:56,590 --> 00:03:55,130
turned out being habitable because that

107
00:03:57,520 --> 00:03:56,600
is the definition they have all zone

108
00:03:59,259 --> 00:03:57,530
that a planet with an earth-like

109
00:04:01,090 --> 00:03:59,269
atmosphere will be habitable in that

110
00:04:03,910 --> 00:04:01,100
zone and Proxima Centuri sits in that

111
00:04:06,220 --> 00:04:03,920
zone interestingly the oxygen dominated

112
00:04:08,590 --> 00:04:06,230
atmosphere with an ocean also turned up

113
00:04:10,330 --> 00:04:08,600

a reasonable surface temperature however

114

00:04:11,530 --> 00:04:10,340

it is very oxygen-rich and so the

115

00:04:13,270 --> 00:04:11,540

question is whether or not life could

116

00:04:15,069 --> 00:04:13,280

actually evolve on that type of planet

117

00:04:18,029 --> 00:04:15,079

or certainly if it came out of the

118

00:04:20,650 --> 00:04:18,039

oceans it might get a nasty surprise so

119

00:04:22,029 --> 00:04:20,660

so we looked at these overall and these

120

00:04:23,469 --> 00:04:22,039

are our results and the upshot of this

121

00:04:25,480 --> 00:04:23,479

is this is all really the same planet

122

00:04:26,980 --> 00:04:25,490

this is Proximus ND but because of its

123

00:04:28,990 --> 00:04:26,990

atmospheric evolution you're looking at

124

00:04:31,029 --> 00:04:29,000

very different current atmospheric

125

00:04:32,590 --> 00:04:31,039

States and so consequently a whole slew

126

00:04:35,110 --> 00:04:32,600

of different potential surface

127

00:04:36,879 --> 00:04:35,120

temperatures and desiccation and

128

00:04:40,089 --> 00:04:36,889

volatile States

129

00:04:41,260 --> 00:04:40,099

so we because we're running a 1d model

130

00:04:43,330 --> 00:04:41,270

and we're looking at a planet that may

131

00:04:45,129 --> 00:04:43,340

or may not be synchronously rotating we

132

00:04:48,640 --> 00:04:45,139

also wanted to see how far off we might

133

00:04:51,550 --> 00:04:48,650

be by comparing to other 3d 3d GCMs with

134

00:04:54,219 --> 00:04:51,560

our 1d model and these are our results

135

00:04:56,080 --> 00:04:54,229

here from the 1d model these are 3d

136

00:04:57,760 --> 00:04:56,090

comparisons with the turbid Adele with

137

00:04:59,890 --> 00:04:57,770

their asynchronous state so that's Rita

138

00:05:01,659 --> 00:04:59,900

- spin orbit resonance and we actually

139

00:05:02,980 --> 00:05:01,669

get within five degrees of that so the

140

00:05:04,990 --> 00:05:02,990

1d model is is a pretty good

141

00:05:07,059 --> 00:05:05,000

approximation for this relatively

142

00:05:11,640 --> 00:05:07,069

rapidly spinning state sorry didn't mean

143

00:05:14,679 --> 00:05:11,650

to do that and well if we look at the

144

00:05:16,929 --> 00:05:14,689

synchronous rotator here we're off by

145

00:05:18,850 --> 00:05:16,939

about 18 degrees we're too warm in this

146

00:05:20,019 --> 00:05:18,860

particular case but that's not a huge

147

00:05:21,879 --> 00:05:20,029

amount when you're trying to determine

148

00:05:24,640 --> 00:05:21,889

whether the planet can in fact support

149

00:05:26,350 --> 00:05:24,650

liquid water on its surface so we get

150

00:05:27,820 --> 00:05:26,360

fairly close with these cases we also

151
00:05:29,860 --> 00:05:27,830
looked at whether we would have

152
00:05:31,330 --> 00:05:29,870
atmospheric collapse with the scenarios

153
00:05:32,950 --> 00:05:31,340
that we looked at and in the

154
00:05:34,390 --> 00:05:32,960
asynchronous case none of the scenarios

155
00:05:36,760 --> 00:05:34,400
we looked at our prone to atmospheric

156
00:05:38,469 --> 00:05:36,770
collapse but the desiccated oxygen which

157
00:05:42,129 --> 00:05:38,479
ones are kind of on the verge if the

158
00:05:43,300 --> 00:05:42,139
planet is synchronously rotating okay

159
00:05:44,890 --> 00:05:43,310
and I also want to point out that even

160
00:05:46,240 --> 00:05:44,900
though we did this for Proxima B there's

161
00:05:48,909 --> 00:05:46,250
a lot of excitement we sort of threw all

162
00:05:50,619 --> 00:05:48,919
of our tools at Proxima B it's certainly

163
00:05:51,850 --> 00:05:50,629

very relevant also for other planets

164

00:05:54,610 --> 00:05:51,860

that have been discovered so the

165

00:05:56,740 --> 00:05:54,620

Trappist for example chapters 1 e and f

166

00:05:59,769 --> 00:05:56,750

here a kind of in a similar position in

167

00:06:01,329 --> 00:05:59,779

their in their habitable zones and so

168

00:06:02,740 --> 00:06:01,339

the results that we've developed you

169

00:06:07,800 --> 00:06:02,750

could also apply to those worlds as well

170

00:06:10,570 --> 00:06:07,810

as long as as well as some LHS 11:40 b2

171

00:06:12,209 --> 00:06:10,580

okay so thinking about what we might be

172

00:06:15,850 --> 00:06:12,219

able to detect if we have these states

173

00:06:17,019 --> 00:06:15,860

then we are looking at potentially the

174

00:06:19,329 --> 00:06:17,029

first thing we might be able to do is

175

00:06:21,369 --> 00:06:19,339

with JWST looking at thermal phase

176

00:06:22,929 --> 00:06:21,379

curves and in this case we could

177

00:06:25,149 --> 00:06:22,939

actually try and go after an actual

178

00:06:26,950 --> 00:06:25,159

atmosphere compositional detection these

179

00:06:27,309 --> 00:06:26,960

are simulations done by jay cuesta

180

00:06:30,070 --> 00:06:27,319

gagger

181

00:06:31,929 --> 00:06:30,080

of the thermal phase curve in this case

182

00:06:33,459 --> 00:06:31,939

this is the ideal case if there's a very

183

00:06:34,839 --> 00:06:33,469

strong day/night temperature contrast

184

00:06:36,459 --> 00:06:34,849

and by that I mean that the night side

185

00:06:39,339 --> 00:06:36,469

is giving off no thermal or negligible

186

00:06:41,320 --> 00:06:39,349

thermal radiation down here with a 20

187

00:06:44,320 --> 00:06:41,330

Kelvin difference between day and night

188

00:06:45,579 --> 00:06:44,330

it's a little bit more challenging the

189

00:06:48,339 --> 00:06:45,589

true answer is probably somewhere

190

00:06:49,719 --> 00:06:48,349

between those but what you're looking at

191

00:06:51,309 --> 00:06:49,729

is if we have an ideal

192

00:06:53,170 --> 00:06:51,319

Kayson is a strong day/night temperature

193

00:06:55,629 --> 00:06:53,180

difference maybe 10 hours per band /

194

00:06:57,670 --> 00:06:55,639

prophase to get this using a mere

195

00:06:59,499 --> 00:06:57,680

instrument and this is at wavelength

196

00:07:01,059 --> 00:06:59,509

longer than 10 microns because Proximus

197

00:07:03,309 --> 00:07:01,069

NB actually saturates at wavelength

198

00:07:05,679 --> 00:07:03,319

shorter than that so we could we could

199

00:07:07,600 --> 00:07:05,689

potentially use this the JWST to try and

200

00:07:09,249 --> 00:07:07,610

go after and not only an atmosphere

201

00:07:13,110 --> 00:07:09,259

detection but also potentially a

202

00:07:21,279 --> 00:07:13,120

compositional detection as well sorry I

203

00:07:26,679 --> 00:07:21,289

got just gone back large a bit slow okay

204

00:07:28,480 --> 00:07:26,689

Toofer so we also simulated spectra it

205

00:07:30,369 --> 00:07:28,490

is a direct imaging spectra so this is

206

00:07:31,869 --> 00:07:30,379

in reflected light trying to look at how

207

00:07:34,360 --> 00:07:31,879

we would discriminate between an ocean

208

00:07:37,149 --> 00:07:34,370

lost planet with abundant o - versus an

209

00:07:38,829 --> 00:07:37,159

O - rich earth-like biosphere the big

210

00:07:40,239 --> 00:07:38,839

difference of course is the sheer number

211

00:07:42,730 --> 00:07:40,249

of bars of oxygen that were potentially

212

00:07:44,409 --> 00:07:42,740

looking at and in that case oxygen will

213

00:07:45,639 --> 00:07:44,419

collide in this higher density

214

00:07:47,679 --> 00:07:45,649

atmosphere and produced collision

215

00:07:49,149 --> 00:07:47,689

induced absorption and the O two O two

216

00:07:51,610 --> 00:07:49,159

collision induced absorption is very

217

00:07:53,170 --> 00:07:51,620

prominent in both the visible and the

218

00:07:55,300 --> 00:07:53,180

near-infrared and so that's something we

219

00:07:56,860 --> 00:07:55,310

could look for to try and discriminate

220

00:07:59,439 --> 00:07:56,870

something for a more sort of earth-like

221

00:08:02,350 --> 00:07:59,449

classic position with just oxygen here

222

00:08:03,909 --> 00:08:02,360

and you don't see the oto to dimer it is

223

00:08:08,290 --> 00:08:03,919

present in the Earth's atmosphere but it

224

00:08:11,739 --> 00:08:08,300

is very very very very weak we looked at

225

00:08:14,619 --> 00:08:11,749

other spectra I press the button but

226

00:08:20,829 --> 00:08:14,629

it's not advancing it that we could look

227

00:08:25,209 --> 00:08:20,839

at so I can get my slides up I will try

228

00:08:26,920 --> 00:08:25,219

again yeah okay so so the other thing

229

00:08:28,449 --> 00:08:26,930

and this is not a VPL related thing but

230

00:08:30,699 --> 00:08:28,459

I'm extremely excited about this and

231

00:08:32,680 --> 00:08:30,709

this is of the potential that we could

232

00:08:34,480 --> 00:08:32,690

upgrade instruments sphere and espresso

233

00:08:37,149 --> 00:08:34,490

and the VLT and actually be getting

234

00:08:39,639 --> 00:08:37,159

ground-based measurements of the oxygen

235

00:08:40,899 --> 00:08:39,649

a band from high resolution spectroscopy

236

00:08:42,219 --> 00:08:40,909

from the ground and this could be

237

00:08:43,329 --> 00:08:42,229

achieved within the next three to five

238

00:08:46,329 --> 00:08:43,339

years as well so that's another

239

00:08:48,639 --> 00:08:46,339

measurement we might want to look at

240

00:08:50,079 --> 00:08:48,649

we also learned some some fun things as

241

00:08:52,509 --> 00:08:50,089

far as photo chemistry and what we might

242

00:08:55,600 --> 00:08:52,519

see in the spectra as we were doing this

243

00:08:57,100 --> 00:08:55,610

these are spectra of the o₂ dominated

244

00:08:59,380 --> 00:08:57,110

world's one with an ocean one without

245

00:09:00,319 --> 00:08:59,390

the defecated world is an orange the

246

00:09:02,780 --> 00:09:00,329

ocean in purple

247

00:09:04,429 --> 00:09:02,790

all these are spaghetti plot for your

248

00:09:06,859 --> 00:09:04,439

photo chemist you love these but what I

249

00:09:09,199 --> 00:09:06,869

do want to point out here is that in the

250

00:09:10,879 --> 00:09:09,209

desiccated case ozone is able to persist

251
00:09:13,309 --> 00:09:10,889
all the way down to the surface whereas

252
00:09:14,419 --> 00:09:13,319
in the in the more water rich case it's

253
00:09:15,799 --> 00:09:14,429
actually scrubbed out of the lower

254
00:09:17,720 --> 00:09:15,809
atmosphere by the presence of water

255
00:09:19,220 --> 00:09:17,730
vapour down there and that does make a

256
00:09:21,410 --> 00:09:19,230
significant difference in the spectrum

257
00:09:22,729 --> 00:09:21,420
we actually see a very strong this has

258
00:09:24,139 --> 00:09:22,739
been transmission so this would be more

259
00:09:26,329 --> 00:09:24,149
likely for the Trappist planet since

260
00:09:27,799 --> 00:09:26,339
we're not sure approximate transits but

261
00:09:29,419 --> 00:09:27,809
in transmission you can actually see

262
00:09:31,489 --> 00:09:29,429
this very strong ship we banned in the

263
00:09:33,530 --> 00:09:31,499

ozone which is completely missing in

264

00:09:34,910 --> 00:09:33,540

fact in the desiccated case and so

265

00:09:36,259 --> 00:09:34,920

that's another interesting thing what

266

00:09:37,910 --> 00:09:36,269

they would look at for that's also a

267

00:09:42,289 --> 00:09:37,920

secondary indicator that we might in

268

00:09:44,809 --> 00:09:42,299

fact have an ocean on this world so in

269

00:09:46,340 --> 00:09:44,819

the next spectra yeah so we also model

270

00:09:47,900 --> 00:09:46,350

the course of self photo chemically

271

00:09:53,689 --> 00:09:47,910

self-consistent earth around this planet

272

00:09:56,629 --> 00:09:53,699

forced by Proxima Centuri bees spectrum

273

00:09:58,160 --> 00:09:56,639

and we then ran these through simulators

274

00:09:59,710 --> 00:09:58,170

that were developed by ty Robinson and

275

00:10:02,419 --> 00:09:59,720

Jake Lustig Jager disease as well

276

00:10:03,979 --> 00:10:02,429

looking at sort of what we might see

277

00:10:06,139 --> 00:10:03,989

we're in about ten hours of integration

278

00:10:08,150 --> 00:10:06,149

with have X here and Louvois R here the

279

00:10:09,259 --> 00:10:08,160

Lubar wavelength ranges is significantly

280

00:10:10,909 --> 00:10:09,269

longer because we're looking at a

281

00:10:13,400 --> 00:10:10,919

different in a working angle cutoff for

282

00:10:15,799 --> 00:10:13,410

1 lambda over D over here what you can

283

00:10:17,329 --> 00:10:15,809

see obviously from this is a very noisy

284

00:10:18,289 --> 00:10:17,339

spectrum and these shorter wavelengths

285

00:10:20,509 --> 00:10:18,299

and that's because we're looking at a

286

00:10:21,889 --> 00:10:20,519

light type m-dwarf where we are not

287

00:10:23,689 --> 00:10:21,899

getting a lot of flux and since we're

288

00:10:25,039 --> 00:10:23,699

observing in reflected light you just

289

00:10:26,569 --> 00:10:25,049

never really going to get a great signal

290

00:10:28,069 --> 00:10:26,579

there because it's not you know any any

291

00:10:30,379 --> 00:10:28,079

sunlight falling on the planet there

292

00:10:32,989 --> 00:10:30,389

that makes it harder to try and pick out

293

00:10:39,049 --> 00:10:32,999

things like Rayleigh scattering because

294

00:10:41,059 --> 00:10:39,059

of that so in the final example here and

295

00:10:43,970 --> 00:10:41,069

this is for Giada so she's sharing these

296

00:10:46,789 --> 00:10:43,980

are hey the hazy are kyun Cybex the

297

00:10:49,100 --> 00:10:46,799

planet shuttle of days and these haze of

298

00:10:50,840 --> 00:10:49,110

dominated worlds actually do have a very

299

00:10:51,650 --> 00:10:50,850

strong feature but again it's kind of in

300

00:10:52,999 --> 00:10:51,660

the zone where it's going to be

301
00:10:55,669 --> 00:10:53,009
difficult to observe because of the

302
00:10:58,400 --> 00:10:55,679
reflectivity and and the low blue

303
00:11:00,679 --> 00:10:58,410
component of the star but what's also

304
00:11:04,039 --> 00:11:00,689
very interesting here is the semi-major

305
00:11:05,780 --> 00:11:04,049
axis sorry the interworking angles that

306
00:11:07,159 --> 00:11:05,790
we can look at so this this red one here

307
00:11:08,509 --> 00:11:07,169
is one λ over D that's what we

308
00:11:10,129 --> 00:11:08,519
really like to achieve this is two

309
00:11:13,430 --> 00:11:10,139
 λ over D here and three λ over

310
00:11:14,420 --> 00:11:13,440
D so you can see that and again

311
00:11:16,010 --> 00:11:14,430
the scales are different for the

312
00:11:18,200 --> 00:11:16,020
different size telescopes in six point

313
00:11:20,750 --> 00:11:18,210

five meter and this is a 16 meter class

314

00:11:22,670 --> 00:11:20,760

telescope so it will be difficult to

315

00:11:25,550 --> 00:11:22,680

observe the haze if we can't get past

316

00:11:27,140 --> 00:11:25,560

about 2 lambda over D with Havoc's and

317

00:11:28,400 --> 00:11:27,150

hopefully we will with the star shade I

318

00:11:29,870 --> 00:11:28,410

would be looking in a very short

319

00:11:31,850 --> 00:11:29,880

wavelength range and would be stuck in

320

00:11:34,430 --> 00:11:31,860

the region whether the star is not very

321

00:11:35,630 --> 00:11:34,440

reflective and so again I star Shiva

322

00:11:36,710 --> 00:11:35,640

star so you can get us out to here that

323

00:11:39,050 --> 00:11:36,720

would be great so we can see that

324

00:11:40,760 --> 00:11:39,060

particular wavelength range for leVoir

325

00:11:42,140 --> 00:11:40,770

if we can achieve 2 lambda over D we

326

00:11:45,590 --> 00:11:42,150

have a fairly good wavelength range to

327

00:11:47,570 --> 00:11:45,600

it to look at as well so for these

328

00:11:49,070 --> 00:11:47,580

particular telescopes they will

329

00:11:50,210 --> 00:11:49,080

certainly get enough flux but it will be

330

00:11:51,650 --> 00:11:50,220

the any working angle that will

331

00:11:54,080 --> 00:11:51,660

challenge whether or not we can get

332

00:11:56,900 --> 00:11:54,090

these observations so I have pressed the

333

00:11:57,380 --> 00:11:56,910

button but I'm not seeing anything okay

334

00:12:00,410 --> 00:11:57,390

here we go

335

00:12:01,790 --> 00:12:00,420

so in conclusion we've modeled a bunch

336

00:12:03,920 --> 00:12:01,800

of atmospheres that are plausible for

337

00:12:07,040 --> 00:12:03,930

this object so they could be o2 rich

338

00:12:09,440 --> 00:12:07,050

initially becoming more co2 rich as the

339

00:12:10,970 --> 00:12:09,450

o2 is sequestered these environments

340

00:12:12,380 --> 00:12:10,980

could be habitable or not and it's just

341

00:12:13,880 --> 00:12:12,390

interesting to look at the fact that it

342

00:12:15,290 --> 00:12:13,890

is again the same planet but these very

343

00:12:17,690 --> 00:12:15,300

different environments give us different

344

00:12:19,850 --> 00:12:17,700

results thermal phase curves may be a

345

00:12:23,000 --> 00:12:19,860

good first thing to go after but we also

346

00:12:24,560 --> 00:12:23,010

have a bunch of a very rich suite of

347

00:12:25,640 --> 00:12:24,570

molecules available in the visible and

348

00:12:26,690 --> 00:12:25,650

near-infrared that could help us

349

00:12:28,640 --> 00:12:26,700

discriminate between these different

350

00:12:29,930 --> 00:12:28,650

types of environments and then finally

351

00:12:31,490 --> 00:12:29,940

that although this modeling with

352

00:12:33,140 --> 00:12:31,500

Stanford proximity it certainly could

353

00:12:34,820 --> 00:12:33,150

also apply to these other new planets

354

00:12:38,230 --> 00:12:34,830

that we are discovering so I will end

355

00:12:42,319 --> 00:12:40,220

[Music]

356

00:12:56,160 --> 00:12:42,329

I say very much Vicki we have time for

357

00:13:01,449 --> 00:12:59,500

hi Richard rivers of Colorado I was

358

00:13:03,069 --> 00:13:01,459

actually wondering about starshade if

359

00:13:04,840 --> 00:13:03,079

you have any update regarding the

360

00:13:06,430 --> 00:13:04,850

progress because I was I was under the

361

00:13:08,310 --> 00:13:06,440

impression that this point as mothballed

362

00:13:10,660 --> 00:13:08,320

are basically in kind of a purgatory I

363

00:13:11,949 --> 00:13:10,670

don't believe that is a case shown if

364

00:13:14,259 --> 00:13:11,959

you would like to answer that question

365

00:13:16,360 --> 00:13:14,269

I know Maggie's coming here to but Sean

366

00:13:18,850 --> 00:13:16,370

Sean would definitely be okay there you

367

00:13:22,329 --> 00:13:18,860

go Maggie you Anton its baseline to be

368

00:13:23,920 --> 00:13:22,339

the W first would be starshade ready but

369

00:13:25,240 --> 00:13:23,930

it's not officially included as part of

370

00:13:26,920 --> 00:13:25,250

the mission as of yet and we'll be

371

00:13:29,019 --> 00:13:26,930

relying on the de kado survey to be

372

00:13:31,689 --> 00:13:29,029

really smart about that and say yeah we

373

00:13:34,600 --> 00:13:31,699

should slide on yeah so that's that's

374

00:13:36,129 --> 00:13:34,610

the again the the test is w first this

375

00:13:41,710 --> 00:13:36,139

was for Havoc's with the starshade which

376

00:13:45,090 --> 00:13:41,720

is another mission altogether right yeah

377

00:13:49,990 --> 00:13:48,550

Alex pixel University Arizona oh so you

378

00:13:51,189 --> 00:13:50,000

mentioned how these results could be

379

00:13:54,310 --> 00:13:51,199

generally clickable to a fair example

380

00:13:56,500 --> 00:13:54,320

LHS 1140 because same type of stars same

381

00:13:59,740 --> 00:13:56,510

general installation what about effects

382

00:14:00,519 --> 00:13:59,750

of density you mean the density the

383

00:14:01,569 --> 00:14:00,529

planet itself

384

00:14:04,120 --> 00:14:01,579

yeah cuz there's like three times as

385

00:14:05,980 --> 00:14:04,130

much surface gravity right so so yeah so

386

00:14:07,120 --> 00:14:05,990

I mean that that will change the scale

387

00:14:08,680 --> 00:14:07,130

height of the atmosphere and therefore

388

00:14:11,170 --> 00:14:08,690

the response to the incoming radiation

389

00:14:12,910 --> 00:14:11,180

so yeah I guess what I'm saying here is

390

00:14:14,769 --> 00:14:12,920

just that the disc my idea that we will

391

00:14:16,329 --> 00:14:14,779

have evolved secondary outgassed

392

00:14:17,620 --> 00:14:16,339

atmospheres and some of the phenomena

393

00:14:19,240 --> 00:14:17,630

that we're looking for is generalized

394

00:14:21,250 --> 00:14:19,250

but you're right those those individual

395

00:14:22,569 --> 00:14:21,260

cases we absolutely go after a model for

396

00:14:27,519 --> 00:14:22,579

the specifics of the planet thank you

397

00:14:29,410 --> 00:14:27,529

sure hi great talk to Zaleski ASU so you

398

00:14:30,850 --> 00:14:29,420

mentioned very briefly the possibility

399

00:14:32,800 --> 00:14:30,860

of going after this with current

400

00:14:34,480 --> 00:14:32,810

ground-based direct imaging with a few

401
00:14:35,800 --> 00:14:34,490
upgrades in three to five years could

402
00:14:37,629 --> 00:14:35,810
you touch on that may be a bit more and

403
00:14:39,759 --> 00:14:37,639
explain how you got the three five-year

404
00:14:43,150 --> 00:14:39,769
timeline so okay so this is a paper by

405
00:14:46,889 --> 00:14:43,160
Louis Adel which is came out in 2016 and

406
00:14:50,230 --> 00:14:46,899
it's proposed upgrades to the sphere at

407
00:14:51,699 --> 00:14:50,240
i/o system on the VLT and also the

408
00:14:54,340 --> 00:14:51,709
espresso high resolution spectrograph

409
00:14:55,780 --> 00:14:54,350
and the time estimates were based on the

410
00:14:58,629 --> 00:14:55,790
number of hours they needed to detect

411
00:15:01,449 --> 00:14:58,639
the the band if I can get back there

412
00:15:04,509 --> 00:15:01,459
probably not so they need about 60 hours

413
00:15:06,370 --> 00:15:04,519

total but but they also will only be

414

00:15:07,040 --> 00:15:06,380

able to get that sporadically sort of at

415

00:15:08,840 --> 00:15:07,050

maximum you

416

00:15:10,280 --> 00:15:08,850

Gatien and so that has to separate the

417

00:15:12,139 --> 00:15:10,290

time at which they can integrate their

418

00:15:13,639 --> 00:15:12,149

signal over and so they will be waiting

419

00:15:15,259 --> 00:15:13,649

for a sort of orbital and it's only an

420

00:15:17,030 --> 00:15:15,269

11 day orbit but still it's going to is

421

00:15:18,199 --> 00:15:17,040

going to extend their time out so part

422

00:15:19,370 --> 00:15:18,209

of that time is the upgrade to the

423

00:15:20,780 --> 00:15:19,380

instruments and the other part is the

424

00:15:24,019 --> 00:15:20,790

time taken to integrate to get the

425

00:15:25,060 --> 00:15:24,029

oxygen thank you this thing picking

