
AbSciCon
2017
MESA, ARIZONA

1
00:00:12,250 --> 00:00:06,150
you

2
00:00:16,780 --> 00:00:14,190
[Music]

3
00:00:21,370 --> 00:00:16,790
yes Oh Thank You Ravi for that excellent

4
00:00:25,179 --> 00:00:21,380
introduction so when we when we think

5
00:00:27,730 --> 00:00:25,189
about think about detecting bio

6
00:00:29,410 --> 00:00:27,740
signatures we often think about okay so

7
00:00:30,609 --> 00:00:29,420
we we're going to disc average that

8
00:00:32,950 --> 00:00:30,619
planet where we're going to get a disk

9
00:00:34,860 --> 00:00:32,960
average spectrum we're going to put that

10
00:00:36,850 --> 00:00:34,870
spectrum that spectrum is going to get

11
00:00:39,430 --> 00:00:36,860
analyzed by our telescopes and we're

12
00:00:40,990 --> 00:00:39,440
going to recover that spectrum it'll

13
00:00:42,310 --> 00:00:41,000

have evidence of absorbing molecules

14
00:00:43,630 --> 00:00:42,320
perhaps that have a Rayleigh scattering

15
00:00:46,360 --> 00:00:43,640
tale which will tell us something about

16
00:00:47,620 --> 00:00:46,370
atmospheric math and those absorption

17
00:00:50,979 --> 00:00:47,630
features will fingerprint certain

18
00:00:52,810 --> 00:00:50,989
molecules and we'll use the evidence of

19
00:00:55,630 --> 00:00:52,820
those molecules to infer things like the

20
00:00:57,549 --> 00:00:55,640
presence of life oxygen maiden for

21
00:00:59,979 --> 00:00:57,559
oxygen takoto synthesis or surface

22
00:01:02,500 --> 00:00:59,989
features from the vegetation vegetation

23
00:01:03,610 --> 00:01:02,510
like earth or perhaps other types of

24
00:01:06,160 --> 00:01:03,620
pigments we heard about in the previous

25
00:01:07,870 --> 00:01:06,170
session I think we often tend to think

26
00:01:10,810 --> 00:01:07,880
of the spectra as sort of out there and

27
00:01:11,650 --> 00:01:10,820
static and you know the features are

28
00:01:12,730 --> 00:01:11,660
there and maybe we'll have the

29
00:01:15,700 --> 00:01:12,740
signal-to-noise to get them or maybe

30
00:01:16,899 --> 00:01:15,710
maybe they don't but one complication to

31
00:01:18,550 --> 00:01:16,909
think about is the influence of

32
00:01:20,050 --> 00:01:18,560
time-dependent properties of the

33
00:01:22,810 --> 00:01:20,060
planetary spectrum so as you're

34
00:01:23,950 --> 00:01:22,820
integrating that disk average spectrum

35
00:01:25,330 --> 00:01:23,960
it's going to take a long time the

36
00:01:27,250 --> 00:01:25,340
planets going to be rotating it's going

37
00:01:29,499 --> 00:01:27,260
to be going through phases and there are

38
00:01:31,960 --> 00:01:29,509

a lot of properties that are going to be

39
00:01:34,870 --> 00:01:31,970
dependent on they're going to change

40
00:01:37,570 --> 00:01:34,880
with time including surface fractions of

41
00:01:40,539 --> 00:01:37,580
different surface types so surface

42
00:01:42,130 --> 00:01:40,549
heterogeneity like land and ocean cloud

43
00:01:43,899 --> 00:01:42,140
heterogeneity we talked we talked about

44
00:01:46,210 --> 00:01:43,909
how important clouds were and the

45
00:01:47,469 --> 00:01:46,220
stochastic city of cloud cover there are

46
00:01:49,330 --> 00:01:47,479
other effects like phase reddening

47
00:01:51,340 --> 00:01:49,340
forward and back scattering from clouds

48
00:01:52,840 --> 00:01:51,350
your effective path links to the

49
00:01:54,190 --> 00:01:52,850
atmosphere will change if you're looking

50
00:01:56,410 --> 00:01:54,200
at Crescent phase or if you're looking

51
00:01:57,999 --> 00:01:56,420
at quadrature gibbous phase and those

52
00:02:01,090 --> 00:01:58,009
all affect you know your your

53
00:02:02,859 --> 00:02:01,100
signal-to-noise that you can recover so

54
00:02:05,039 --> 00:02:02,869
this image to the right this rotating

55
00:02:07,179 --> 00:02:05,049
earth is actually part of our model

56
00:02:08,949 --> 00:02:07,189
that's used to generate the spectral

57
00:02:11,590 --> 00:02:08,959
Earth database every pixel is a spectrum

58
00:02:15,220 --> 00:02:11,600
and so the the blue the blue pixels look

59
00:02:18,160 --> 00:02:15,230
like ocean and then the you know white

60
00:02:20,589 --> 00:02:18,170
pixels look like clouds and the sort of

61
00:02:21,940 --> 00:02:20,599
brown pixels are land surfaces and all

62
00:02:23,650 --> 00:02:21,950
those pixels are integrated together

63
00:02:25,160 --> 00:02:23,660

into our disk average spectrum and we

64
00:02:27,440 --> 00:02:25,170
can do this at several different

65
00:02:28,699 --> 00:02:27,450
Lucian's and so on the right is the

66
00:02:31,070 --> 00:02:28,709
highest resolution that's number seven

67
00:02:32,510 --> 00:02:31,080
and then and then number one is the

68
00:02:33,620 --> 00:02:32,520
lowest resolution we're adding something

69
00:02:35,510 --> 00:02:33,630
all these up to get our disc averaged

70
00:02:37,490 --> 00:02:35,520
spectrum and the more pixels we use the

71
00:02:40,040 --> 00:02:37,500
more the higher fidelity we can actually

72
00:02:41,540 --> 00:02:40,050
represent the spectrum of the earth and

73
00:02:44,470 --> 00:02:41,550
we can do this for two different phases

74
00:02:47,059 --> 00:02:44,480
so for example here it's gibbous

75
00:02:49,610 --> 00:02:47,069
quadrature and Crescent phases this kind

76
00:02:51,020 --> 00:02:49,620
of spans that amount of phases that the

77
00:02:53,030 --> 00:02:51,030
range of phases will actually be able to

78
00:02:54,380 --> 00:02:53,040
deserve with direct imaging telescopes

79
00:02:55,400 --> 00:02:54,390
because of interworking angle

80
00:02:58,009 --> 00:02:55,410
constraints and angular separation

81
00:02:59,809 --> 00:02:58,019
between the planet and the star on the

82
00:03:01,009 --> 00:02:59,819
right you can see here clearly and

83
00:03:02,420 --> 00:03:01,019
thankfully it shows up on this projector

84
00:03:04,550 --> 00:03:02,430
you can see this glint spot it's very

85
00:03:08,330 --> 00:03:04,560
beautiful but this is really in the

86
00:03:09,800 --> 00:03:08,340
model the model is doing glint so what

87
00:03:12,979 --> 00:03:09,810
does this look like spectrally so here's

88
00:03:15,050 --> 00:03:12,989

a one hour cadence earth rotating

89
00:03:17,330 --> 00:03:15,060
through 24 hour period and I've noted

90
00:03:20,570 --> 00:03:17,340
the major absorbing features from water

91
00:03:22,160 --> 00:03:20,580
from oxygen from ozone and Rayleigh

92
00:03:24,199 --> 00:03:22,170
scattering and the you see a lot of

93
00:03:26,449 --> 00:03:24,209
lines there that's those are solar lines

94
00:03:27,890 --> 00:03:26,459
that are reflected back and the initial

95
00:03:29,300 --> 00:03:27,900
spectrum is a very high resolution that

96
00:03:31,099 --> 00:03:29,310
we can degrade it to progressively lower

97
00:03:33,610 --> 00:03:31,109
resolutions now look what happens to the

98
00:03:38,479 --> 00:03:33,620
spectrum when I go to Crescent phase

99
00:03:40,640 --> 00:03:38,489
okay okay so you can see on the on the

100
00:03:42,590 --> 00:03:40,650
Left axis the spectrum is a lot dimmer

101
00:03:44,240 --> 00:03:42,600
but it's also a different color it's a

102
00:03:47,810 --> 00:03:44,250
lot redder the Rayleigh scattering tail

103
00:03:49,430 --> 00:03:47,820
went away relatively the the

104
00:03:51,289 --> 00:03:49,440
near-infrared is a lot brighter and the

105
00:03:52,610 --> 00:03:51,299
variability is a lot bigger too because

106
00:03:54,949 --> 00:03:52,620
you have a smaller fraction of the earth

107
00:03:57,229 --> 00:03:54,959
that fraction is covered by ocean or

108
00:04:00,890 --> 00:03:57,239
land or clouds that has a bigger

109
00:04:02,690 --> 00:04:00,900
temporal impact okay and so we can do

110
00:04:05,330 --> 00:04:02,700
this with varying viewing geometries too

111
00:04:07,490 --> 00:04:05,340
so here's a mid latitude pixel and you

112
00:04:10,420 --> 00:04:07,500
can see Africa and North America then

113
00:04:13,130 --> 00:04:10,430

come into view equatorial at a

114
00:04:14,809 --> 00:04:13,140
quadrature and then pull on this is a

115
00:04:17,270 --> 00:04:14,819
the South Pole and you can see

116
00:04:19,759 --> 00:04:17,280
Antarctica kind of peeking out and then

117
00:04:22,039 --> 00:04:19,769
South America and Australia coming in

118
00:04:27,439 --> 00:04:22,049
and so each pixel here again as a

119
00:04:30,619 --> 00:04:29,089
and so how do we doing that well we're

120
00:04:32,629 --> 00:04:30,629
doing the full radiative transfer for

121
00:04:34,070 --> 00:04:32,639
each for each individual pixel that

122
00:04:37,339 --> 00:04:34,080
includes absorption that includes

123
00:04:38,869 --> 00:04:37,349
rayleigh scattering and we do that for

124
00:04:42,230 --> 00:04:38,879
each time it's kind of surface type each

125
00:04:43,580 --> 00:04:42,240
kind of cloud type and we use blind

126
00:04:44,899 --> 00:04:43,590
intensities from high trend including

127
00:04:47,510 --> 00:04:44,909
the gases that are listed here water

128
00:04:49,610 --> 00:04:47,520
carbon dioxide oxygen ozone methane

129
00:04:52,999 --> 00:04:49,620
carbon monoxide and nitrous oxide so

130
00:04:54,800 --> 00:04:53,009
biosignature gases included and then we

131
00:04:57,950 --> 00:04:54,810
use data products from a suite of NASA

132
00:04:59,119 --> 00:04:57,960
of NASA's Earth observing satellites so

133
00:05:01,670 --> 00:04:59,129
those data products are publicly

134
00:05:03,230 --> 00:05:01,680
available and they allow us to get

135
00:05:04,430 --> 00:05:03,240
things like the mixing ratios of

136
00:05:06,770 --> 00:05:04,440
different gases as a function of

137
00:05:09,559 --> 00:05:06,780
latitude and longitude and so this plot

138
00:05:12,050 --> 00:05:09,569

represents for one pixel over the range

139
00:05:15,200 --> 00:05:12,060
of data of dates that we've modeled so

140
00:05:17,360 --> 00:05:15,210
this extends a month as seen from from

141
00:05:19,700 --> 00:05:17,370
from the moon so earth is recapitulating

142
00:05:21,800 --> 00:05:19,710
all the phases that you would see as an

143
00:05:24,290 --> 00:05:21,810
exoplanet with a with an edge on

144
00:05:27,110 --> 00:05:24,300
inclination so this is one pixel this is

145
00:05:29,119 --> 00:05:27,120
a range of how these gases vary with

146
00:05:32,149 --> 00:05:29,129
time over one month and then on the

147
00:05:34,999 --> 00:05:32,159
right here's all of the pixels of the

148
00:05:37,029 --> 00:05:35,009
earth and all the times so what's the

149
00:05:39,290 --> 00:05:37,039
full range of the gas at each altitude

150
00:05:41,240 --> 00:05:39,300
and so this is all being self

151
00:05:43,399 --> 00:05:41,250
consistently this is the real earth real

152
00:05:47,089 --> 00:05:43,409
real retrievals being inputted into the

153
00:05:49,279 --> 00:05:47,099
model and then we can also get the

154
00:05:51,350 --> 00:05:49,289
surface coverages so that the ice extent

155
00:05:53,600 --> 00:05:51,360
is a NASA data product so we can get

156
00:05:55,700 --> 00:05:53,610
that and the surface cloud the cloud

157
00:05:57,379 --> 00:05:55,710
coverage extents and positions we can

158
00:05:58,850 --> 00:05:57,389
get that so when you saw those movies

159
00:06:00,769 --> 00:05:58,860
with the clouds in there those are the

160
00:06:02,240 --> 00:06:00,779
real cloud positions for the date and

161
00:06:05,180 --> 00:06:02,250
time we modeled in the real clouds

162
00:06:06,860 --> 00:06:05,190
thicknesses so the left is the clear sky

163
00:06:09,230 --> 00:06:06,870

fraction of the different surface types

164
00:06:10,850 --> 00:06:09,240
we've modeled and then the right is the

165
00:06:12,649 --> 00:06:10,860
different cloud types and then this is

166
00:06:15,559 --> 00:06:12,659
the observing window we've modeled and

167
00:06:16,790 --> 00:06:15,569
how you know you oscillate the fraction

168
00:06:19,990 --> 00:06:16,800
of each surface type you're viewing

169
00:06:22,219 --> 00:06:20,000
because you have one viewing angle and

170
00:06:24,230 --> 00:06:22,229
you kid this is ground truth so and

171
00:06:26,149 --> 00:06:24,240
we're later testing these we can go back

172
00:06:28,939 --> 00:06:26,159
and see what do we put into the model

173
00:06:30,409 --> 00:06:28,949
and so this this is a snapshot for

174
00:06:33,769 --> 00:06:30,419
snapshot spectra at four different

175
00:06:36,620 --> 00:06:33,779
phases at Crescent gibbous quadrature

176
00:06:38,749 --> 00:06:36,630
and Crescent phases and I've noted up in

177
00:06:39,940 --> 00:06:38,759
the full face panel major absorbing

178
00:06:42,460 --> 00:06:39,950
features from different

179
00:06:45,220 --> 00:06:42,470
asses you can see real quick here that

180
00:06:47,410 --> 00:06:45,230
as you as you go to Crescent phase of

181
00:06:48,820 --> 00:06:47,420
course you get a lot less reflected

182
00:06:50,680 --> 00:06:48,830
light and that's expected your

183
00:06:52,270 --> 00:06:50,690
mid-infrared of course is more stable

184
00:06:54,250 --> 00:06:52,280
because the night side of the earth is

185
00:06:56,530 --> 00:06:54,260
still warm it's still emitting it's

186
00:06:57,880 --> 00:06:56,540
still emitting light and so the spectra

187
00:07:00,370 --> 00:06:57,890
of data products we have extend all

188
00:07:04,600 --> 00:07:00,380

these wavelengths and out from point 1

189
00:07:06,670 --> 00:07:04,610
to 200 microns so one thing that's been

190
00:07:12,100 --> 00:07:06,680
mentioned is using broadband photometry

191
00:07:13,810 --> 00:07:12,110
to try to more encapsulate real quickly

192
00:07:15,370 --> 00:07:13,820
what what the planet might look like the

193
00:07:18,220 --> 00:07:15,380
kind of gauge is habitability before you

194
00:07:21,790 --> 00:07:18,230
spend the observing time on spectra and

195
00:07:24,310 --> 00:07:21,800
so we did that too we did a you - b b -

196
00:07:26,440 --> 00:07:24,320
b v- R&R my sight magnitudes here's how

197
00:07:28,780 --> 00:07:26,450
they change with phase I'm so close to

198
00:07:29,950 --> 00:07:28,790
full phase and from quadrature to full

199
00:07:33,340 --> 00:07:29,960
phase you can actually get the

200
00:07:36,100 --> 00:07:33,350
modulation from the surface at Crescent

201
00:07:37,240 --> 00:07:36,110
phases you get a lot of phrase resonant

202
00:07:40,720 --> 00:07:37,250
reddening because you've scattered out

203
00:07:42,370 --> 00:07:40,730
the blue light and here's a great color

204
00:07:44,950 --> 00:07:42,380
color plot that's put together by Jake

205
00:07:46,660 --> 00:07:44,960
Lustig Jaeger and it shows the range of

206
00:07:48,670 --> 00:07:46,670
colors just for the earth the earth goes

207
00:07:50,260 --> 00:07:48,680
through as it goes through its phases so

208
00:07:53,590 --> 00:07:50,270
if we're thinking about surface bio

209
00:07:54,610 --> 00:07:53,600
signatures and how they change with or

210
00:07:56,350 --> 00:07:54,620
how they might how they might be

211
00:07:57,400 --> 00:07:56,360
different how we might identify them we

212
00:07:59,980 --> 00:07:57,410
also have to consider that there's an

213
00:08:01,690 --> 00:07:59,990

ABS here above that planet and that's

214
00:08:03,580 --> 00:08:01,700
going to induce color changes as a

215
00:08:05,920 --> 00:08:03,590
function of phase and so there's going

216
00:08:07,240 --> 00:08:05,930
to be a spread in colors depending on

217
00:08:09,610 --> 00:08:07,250
when you look at the planet so you have

218
00:08:10,900 --> 00:08:09,620
to consider that but those that spread

219
00:08:12,220 --> 00:08:10,910
and colors actually telling you there's

220
00:08:13,630 --> 00:08:12,230
an atmosphere and giving you properties

221
00:08:17,230 --> 00:08:13,640
about that atmosphere so we can use that

222
00:08:18,670 --> 00:08:17,240
and learn from that and so so I want to

223
00:08:20,560 --> 00:08:18,680
talk about other applications of this

224
00:08:24,180 --> 00:08:20,570
database so one thing we did was take a

225
00:08:27,250 --> 00:08:24,190
loo board model so loo bar is a large UV

226
00:08:29,440 --> 00:08:27,260
ultraviolet optical infrared telescope

227
00:08:31,600 --> 00:08:29,450
concept and so we use the chronograph

228
00:08:33,510 --> 00:08:31,610
noise model from Tyler Robinson and we

229
00:08:36,070 --> 00:08:33,520
simulated ok what would what would a

230
00:08:38,290 --> 00:08:36,080
Lubo are see at these different phases

231
00:08:40,690 --> 00:08:38,300
using as input our spectral Earth

232
00:08:44,470 --> 00:08:40,700
database and so here you can see you've

233
00:08:47,380 --> 00:08:44,480
got a great rail a tail o - Abe and

234
00:08:51,610 --> 00:08:47,390
ozone Bant Hartley Huggins out UV band a

235
00:08:53,110 --> 00:08:51,620
chap we ozone band and let's look at

236
00:08:53,590 --> 00:08:53,120
them as they change their phases so if

237
00:08:55,420 --> 00:08:53,600
you look

238
00:08:58,030 --> 00:08:55,430

and I give is faith our error bars have

239
00:09:00,430 --> 00:08:58,040
shrunk a little bit oh I should say that

240
00:09:02,379 --> 00:09:00,440
the parameters we use we assumed for

241
00:09:05,620 --> 00:09:02,389
this where respect to resolving power of

242
00:09:07,629 --> 00:09:05,630
eighty a mere diameter of 12 meters and

243
00:09:10,780 --> 00:09:07,639
distance of five parsecs and this is for

244
00:09:11,920 --> 00:09:10,790
a hundred our integration so so one

245
00:09:13,569 --> 00:09:11,930
hundred our integration gives you these

246
00:09:17,100 --> 00:09:13,579
error bars with the twelve meter

247
00:09:19,509 --> 00:09:17,110
telescope now if we go to crescent phase

248
00:09:20,980 --> 00:09:19,519
you can see a big difference we've

249
00:09:23,110 --> 00:09:20,990
completely removed the Rayleigh

250
00:09:24,400 --> 00:09:23,120
scattering tail so that's gone the earth

251
00:09:24,819 --> 00:09:24,410
is now a different color than it was

252
00:09:26,949 --> 00:09:24,829
before

253
00:09:28,689 --> 00:09:26,959
but another cool thing that happens is

254
00:09:30,430 --> 00:09:28,699
that the chap we ozone band now gets

255
00:09:32,230 --> 00:09:30,440
deeper because your path length to the

256
00:09:34,389 --> 00:09:32,240
atmosphere is bigger and so you get more

257
00:09:36,460 --> 00:09:34,399
ozone absorption now that that you

258
00:09:39,069 --> 00:09:36,470
shaped that you shape an earth spectrum

259
00:09:42,850 --> 00:09:39,079
is actually really diagnostic of Earth's

260
00:09:45,309 --> 00:09:42,860
spectrum and and separates it from the

261
00:09:46,809 --> 00:09:45,319
other terrestrial planets and from

262
00:09:47,980 --> 00:09:46,819
potential abiotic plants we could

263
00:09:50,650 --> 00:09:47,990

imagine just like bare rock with a

264
00:09:52,300 --> 00:09:50,660
nitrogen surface would be blue and it

265
00:09:53,590 --> 00:09:52,310
wouldn't have methane absorption that

266
00:09:56,019 --> 00:09:53,600
would separate it out from Neptune and

267
00:09:57,790 --> 00:09:56,029
Uranus but it wouldn't have that you

268
00:09:58,960 --> 00:09:57,800
shape and there it is again and so the

269
00:10:01,179 --> 00:09:58,970
idea here is that you could get

270
00:10:02,800 --> 00:10:01,189
broadband photometry to look for that

271
00:10:05,139 --> 00:10:02,810
you shape before you invested in the

272
00:10:06,519 --> 00:10:05,149
spectrum surface mapping is something

273
00:10:08,920 --> 00:10:06,529
that's been talked about I want to

274
00:10:10,389 --> 00:10:08,930
advertise a poster by Jacob Lustig

275
00:10:12,970 --> 00:10:10,399
Jaeger who's going to give a talk in

276
00:10:14,379 --> 00:10:12,980
this room 215 on Wednesday using the

277
00:10:16,389 --> 00:10:14,389
spectral earth database I've mentioned

278
00:10:18,069 --> 00:10:16,399
two tests retrieval models and see how

279
00:10:21,460 --> 00:10:18,079
well we can actually pull out ocean

280
00:10:24,550 --> 00:10:21,470
fraction a vegetation fraction and land

281
00:10:27,970 --> 00:10:24,560
fraction so please come see that one

282
00:10:30,309 --> 00:10:27,980
other thing that's kind of cool is that

283
00:10:32,920 --> 00:10:30,319
this model has also been used to model

284
00:10:34,780 --> 00:10:32,930
the earth shine effect on permanently

285
00:10:36,249 --> 00:10:34,790
shadowed craters on the moon so it's

286
00:10:38,019 --> 00:10:36,259
permanently shadowed from the Sun but

287
00:10:39,670 --> 00:10:38,029
not from the earth and so our models

288
00:10:41,019 --> 00:10:39,680

been use of that little bit beyond bio

289
00:10:43,150 --> 00:10:41,029
signatures but it shows the kind of

290
00:10:45,879 --> 00:10:43,160
flexibility of what this database can be

291
00:10:47,800 --> 00:10:45,889
used for and so finally I would kind of

292
00:10:48,699 --> 00:10:47,810
want to ask people in this room who

293
00:10:49,780 --> 00:10:48,709
might be working on instrument

294
00:10:51,370 --> 00:10:49,790
simulators who may be working on

295
00:10:52,749 --> 00:10:51,380
different kinds of bio signatures what

296
00:10:55,179 --> 00:10:52,759
can the spec to earth database do for

297
00:10:57,689 --> 00:10:55,189
you we can do arbitrary phase viewing

298
00:10:59,860 --> 00:10:57,699
angles haze and viewing angles we can do

299
00:11:02,019 --> 00:10:59,870
different observing cadence so an hour

300
00:11:03,250 --> 00:11:02,029
50 minutes we can work with that and we

301
00:11:05,530 --> 00:11:03,260
can switch from one surface to another

302
00:11:07,329 --> 00:11:05,540
so we can switch out our vegetation for

303
00:11:09,850 --> 00:11:07,339
anoxygenic photo choice for exam

304
00:11:11,230 --> 00:11:09,860
and look at the affect on the spectrum

305
00:11:13,600 --> 00:11:11,240
and how we're cover with retrieval

306
00:11:16,449 --> 00:11:13,610
models that bio signature would be and

307
00:11:22,590 --> 00:11:16,459
so and so with that I'll thank you all

308
00:11:25,030 --> 00:11:22,600
and take questions Thank You Eddie so

309
00:11:27,540 --> 00:11:25,040
that was really great job not because of

310
00:11:30,989 --> 00:11:27,550
your session chair but it's really good

311
00:11:35,559 --> 00:11:30,999
all right we are open for questions

312
00:11:38,230 --> 00:11:35,569
creating great talk so a lot of the

313
00:11:40,210 --> 00:11:38,240

planets that we're most interested at

314
00:11:42,420 --> 00:11:40,220
the moment regarding recent discoveries

315
00:11:44,679 --> 00:11:42,430
are planets around em dwarves where the

316
00:11:47,230 --> 00:11:44,689
the integration time will be a

317
00:11:50,259 --> 00:11:47,240
non-negligible amount of the orbital

318
00:11:52,619 --> 00:11:50,269
period yes so in that case I guess you

319
00:11:55,179 --> 00:11:52,629
have a convolution of many of these

320
00:11:57,249 --> 00:11:55,189
specific phases you've been shown is

321
00:12:01,059 --> 00:11:57,259
that going to be a problem for backing

322
00:12:03,280 --> 00:12:01,069
out individual spectra or corresponding

323
00:12:05,350 --> 00:12:03,290
to a specific phase in those case yeah

324
00:12:08,230 --> 00:12:05,360
so that's a great question and to answer

325
00:12:09,790 --> 00:12:08,240
that two things one is the the angular

326
00:12:11,650 --> 00:12:09,800
separation of the plant stars very bad

327
00:12:13,480 --> 00:12:11,660
for M stars you know how those own is

328
00:12:15,069 --> 00:12:13,490
close by so we'll only be able to

329
00:12:16,540 --> 00:12:15,079
directly image to close by once but we

330
00:12:18,970 --> 00:12:16,550
still might be able to do a few and to

331
00:12:21,549 --> 00:12:18,980
answer your question is absolutely you

332
00:12:23,799 --> 00:12:21,559
would have to consider the fact that the

333
00:12:25,540 --> 00:12:23,809
planets changing in phase depending on

334
00:12:27,730 --> 00:12:25,550
your inclination you might be lucky if

335
00:12:29,619 --> 00:12:27,740
it's based on it's always quadrature and

336
00:12:31,389 --> 00:12:29,629
you have to consider that you have to

337
00:12:34,600 --> 00:12:31,399
consider its rotation and so to back it

338
00:12:36,490 --> 00:12:34,610

out to back out to back out those

339
00:12:40,389 --> 00:12:36,500
quantities you would you would you would

340
00:12:41,710 --> 00:12:40,399
need more observations and in terms of

341
00:12:43,449 --> 00:12:41,720
the specifics that are treatable I would

342
00:12:48,429 --> 00:12:43,459
encourage you to come and to Jake's talk

343
00:12:50,169 --> 00:12:48,439
on Wednesday but I would say that in

344
00:12:52,319 --> 00:12:50,179
terms of rotation I don't think that

345
00:12:54,910 --> 00:12:52,329
it's going to be any worse for rotation

346
00:12:56,379 --> 00:12:54,920
because you're still going to have to

347
00:12:59,769 --> 00:12:56,389
look at the planet for the same amount

348
00:13:03,189 --> 00:12:59,779
of time whether it's whether it's an M

349
00:13:06,879 --> 00:13:03,199
star G Star for for disentangling those

350
00:13:08,739 --> 00:13:06,889
phase effects maybe maybe maybe that's

351
00:13:10,720 --> 00:13:08,749
maybe that's worse but what you can do

352
00:13:12,669 --> 00:13:10,730
is you can bin so you can say well I

353
00:13:14,980 --> 00:13:12,679
looked I looked at it for this amount of

354
00:13:16,480 --> 00:13:14,990
time in this phase and if you if you if

355
00:13:18,040 --> 00:13:16,490
you've observed over several orbital

356
00:13:19,629 --> 00:13:18,050
periods you can rebuild your data

357
00:13:20,919 --> 00:13:19,639
assuming depending on how you do the

358
00:13:21,340 --> 00:13:20,929
integration and you can do the same

359
00:13:23,710 --> 00:13:21,350
thing

360
00:13:25,680 --> 00:13:23,720
you do with a Earth's orbiting a g-star

361
00:13:29,080 --> 00:13:25,690
great thanks

362
00:13:31,660 --> 00:13:29,090
Sean good hey Sean hey Eddie

363
00:13:34,210 --> 00:13:31,670

great talk that wasn't a crescent face

364
00:13:36,790 --> 00:13:34,220
was particularly cool so the question I

365
00:13:39,490 --> 00:13:36,800
have is thinking on the other end from

366
00:13:41,140 --> 00:13:39,500
the color spectrum one thing that the

367
00:13:43,720 --> 00:13:41,150
leVoir stdt has been telling us is that

368
00:13:45,280 --> 00:13:43,730
we need to think of a way to fingerprint

369
00:13:46,960 --> 00:13:45,290
these different planets because we're

370
00:13:49,120 --> 00:13:46,970
going to observe them for let's say 100

371
00:13:50,680 --> 00:13:49,130
hours go away to other science or maybe

372
00:13:52,660 --> 00:13:50,690
other exoplanet targets and then come

373
00:13:54,580 --> 00:13:52,670
back and they'll all have moved in their

374
00:13:57,280 --> 00:13:54,590
orbits yeah and one thing we're worried

375
00:13:58,870 --> 00:13:57,290
about is is this phase dependence right

376
00:14:00,640 --> 00:13:58,880
blocking us from knowing which planets

377
00:14:02,550 --> 00:14:00,650
are the ones we saw before yeah yeah

378
00:14:06,730 --> 00:14:02,560
it's just popped outside the iwi right

379
00:14:08,230 --> 00:14:06,740
it is there it is can can you guys look

380
00:14:10,990 --> 00:14:08,240
at something like you know the SPECT

381
00:14:12,460 --> 00:14:11,000
resolution we have to get at to find the

382
00:14:13,810 --> 00:14:12,470
fingerprint you know to find the things

383
00:14:16,500 --> 00:14:13,820
that aren't dependent on phase or maybe

384
00:14:18,430 --> 00:14:16,510
I don't know yeah well I mean I mean it

385
00:14:20,800 --> 00:14:18,440
depends if you're if you're investing a

386
00:14:23,320 --> 00:14:20,810
lot of time with the planet and you get

387
00:14:25,600 --> 00:14:23,330
the rotation rate and you can match

388
00:14:27,760 --> 00:14:25,610

rotation rates yeah but again that takes

389
00:14:29,140 --> 00:14:27,770
a long time and depends on how you do

390
00:14:30,700 --> 00:14:29,150
your integrations I think I think we've

391
00:14:31,900 --> 00:14:30,710
talked about 100 hour integration really

392
00:14:33,670 --> 00:14:31,910
what you're talking about is like a

393
00:14:35,710 --> 00:14:33,680
hundred one hour integrations or

394
00:14:37,930 --> 00:14:35,720
something like that yeah you know a

395
00:14:39,790 --> 00:14:37,940
thousand ten minute integrations or I

396
00:14:41,620 --> 00:14:39,800
did that wrong but well you know what I

397
00:14:43,480 --> 00:14:41,630
mean the detector array oh yeah oh it's

398
00:14:45,850 --> 00:14:43,490
okay yes yeah but then you can read in

399
00:14:47,890 --> 00:14:45,860
those data and then you can get a better

400
00:14:49,630 --> 00:14:47,900
better time-dependent information from

401
00:14:50,860 --> 00:14:49,640
that so maybe temporal the temp the

402
00:14:53,430 --> 00:14:50,870
Signum the signature maybe in the

403
00:14:57,250 --> 00:14:53,440
temporal domain not the spectral domain

404
00:14:58,570 --> 00:14:57,260
is what your saw yeah so so yes yeah

405
00:15:00,820 --> 00:14:58,580
okay the twirl domain is another

406
00:15:03,220 --> 00:15:00,830
leverage point yes yes okay awesome

407
00:15:04,780 --> 00:15:03,230
thank you all right so we are done for

408
00:15:06,190 --> 00:15:04,790
this session the morning session and

409
00:15:07,150 --> 00:15:06,200
we'll meet again at 1:30