
AbSciCon
2017
MESA, ARIZONA

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

2
00:00:17,320 --> 00:00:14,160
[Music]

3
00:00:19,180 --> 00:00:17,330
hi my name is Kat and I would like to

4
00:00:23,200 --> 00:00:19,190
share with you one of my favorite images

5
00:00:25,749 --> 00:00:23,210
Earthrise so this was taken by Apollo 8

6
00:00:27,760 --> 00:00:25,759
in the 60s and it is a decade since then

7
00:00:33,189 --> 00:00:27,770
we've been able to explore the solar

8
00:00:34,810 --> 00:00:33,199
system further and beyond in fact we've

9
00:00:35,850 --> 00:00:34,820
been able to image planets around other

10
00:00:40,119 --> 00:00:35,860
stars

11
00:00:42,009 --> 00:00:40,129
this is HR 8799 one of the self-luminous

12
00:00:44,080 --> 00:00:42,019
giant planets that current direct

13
00:00:46,900 --> 00:00:44,090

imaging surveys are able to study in the

14
00:00:49,090 --> 00:00:46,910
near-infrared and then on a flip slide

15
00:00:51,459 --> 00:00:49,100
in terms of smaller planets we've been

16
00:00:54,729 --> 00:00:51,469
able to study those around ultra cool

17
00:00:59,920 --> 00:00:54,739
and low mass host stars using the using

18
00:01:03,520 --> 00:00:59,930
transit spectroscopy and then locating

19
00:01:05,580 --> 00:01:03,530
decades after today we have the James

20
00:01:09,370 --> 00:01:05,590
Webb Space Telescope coming online and

21
00:01:11,020 --> 00:01:09,380
we have w first hab X and d'Ivoire and

22
00:01:13,749 --> 00:01:11,030
what do these three have in common

23
00:01:16,300 --> 00:01:13,759
they're all interested in imaging

24
00:01:22,000 --> 00:01:16,310
exoplanets around sun-like stars in the

25
00:01:24,280 --> 00:01:22,010
visible take W first for example here we

26
00:01:26,920 --> 00:01:24,290
have the planet to start contrast ratio

27
00:01:28,480 --> 00:01:26,930
versus separation and this is what I was

28
00:01:30,160 --> 00:01:28,490
mentioning earlier about the self

29
00:01:32,830 --> 00:01:30,170
luminous giant planets for the current

30
00:01:34,120 --> 00:01:32,840
state of direct imaging with W first and

31
00:01:36,340 --> 00:01:34,130
it's coronagraph we're going to be able

32
00:01:38,380 --> 00:01:36,350
to cover this part of the regime to

33
00:01:40,149 --> 00:01:38,390
study non transiting planets and that

34
00:01:43,330 --> 00:01:40,159
are those that are cooler in temperature

35
00:01:45,399 --> 00:01:43,340
and then coming down over here if you

36
00:01:47,230 --> 00:01:45,409
recall - Maggie turn balls talked on

37
00:01:49,120 --> 00:01:47,240
Monday where she mentioned the

38
00:01:57,880 --> 00:01:49,130

possibility of pairing a star shade with

39
00:01:59,889 --> 00:01:57,890
W first this once we over plot the

40
00:02:02,530 --> 00:01:59,899
contrast curve for W first and star

41
00:02:04,780 --> 00:02:02,540
shade this is where we have the four

42
00:02:06,609 --> 00:02:04,790
system planets at ten parsecs so this

43
00:02:09,880 --> 00:02:06,619
tells us that W firs might have the

44
00:02:15,190 --> 00:02:09,890
possibility of imaging rocky exoplanets

45
00:02:17,350 --> 00:02:15,200
in the future and so when these missions

46
00:02:19,030 --> 00:02:17,360
take the images of the planets we're

47
00:02:21,160 --> 00:02:19,040
going to get spectroscopy on them and

48
00:02:23,410 --> 00:02:21,170
we're also get going to get data that

49
00:02:25,240 --> 00:02:23,420
are noisy and the challenge will be to

50
00:02:25,820 --> 00:02:25,250
backing out the properties of these

51
00:02:30,320 --> 00:02:25,830
planets

52
00:02:36,860 --> 00:02:30,330
and given the data quality we want to

53
00:02:44,930 --> 00:02:36,870
know how robustly will we be able to get

54
00:02:46,550 --> 00:02:44,940
those information and more importantly

55
00:02:50,030 --> 00:02:46,560
how do we quantify that so I'm going to

56
00:02:55,310 --> 00:02:50,040
be talking about how we use how we're

57
00:02:57,050 --> 00:02:55,320
going to simulate data in order to we're

58
00:02:58,760 --> 00:02:57,060
going to simulate data and then we're

59
00:03:00,740 --> 00:02:58,770
going to build a retrieval tool that

60
00:03:03,940 --> 00:03:00,750
will then help us constrain those

61
00:03:09,650 --> 00:03:03,950
properties based on our simulated data

62
00:03:13,100 --> 00:03:09,660
ok so let's start with a spectrum of the

63
00:03:14,240 --> 00:03:13,110

earth here we have the Geo Metro sources

64
00:03:16,400 --> 00:03:14,250
wavelengths going from the near

65
00:03:18,440 --> 00:03:16,410
ultraviolet to the infra red and all

66
00:03:20,000 --> 00:03:18,450
three missions that I mentioned are

67
00:03:22,190 --> 00:03:20,010
going to be interested in exploring the

68
00:03:24,200 --> 00:03:22,200
possibility of imaging the visible

69
00:03:25,970 --> 00:03:24,210
wavelengths and in this particular

70
00:03:28,400 --> 00:03:25,980
region there are many interesting

71
00:03:31,550 --> 00:03:28,410
features that we'd be that we will

72
00:03:36,560 --> 00:03:31,560
capture with our model to begin we have

73
00:03:40,400 --> 00:03:36,570
the nitrogen really scattering and then

74
00:03:43,940 --> 00:03:40,410
we have water absorption that I will

75
00:03:49,000 --> 00:03:43,950
mark somehow yes Rayleigh scattering

76
00:03:52,460 --> 00:03:49,010
water absorption ozone absorption is

77
00:03:58,340 --> 00:03:52,470
over here and then there are oxygen

78
00:04:02,120 --> 00:03:58,350
features as well oh all right

79
00:04:03,860 --> 00:04:02,130
thanks for the tip awesome great so

80
00:04:06,050 --> 00:04:03,870
those are the features that we're going

81
00:04:09,410 --> 00:04:06,060
to recreate in our model which is

82
00:04:11,240 --> 00:04:09,420
basically a planet it's visible

83
00:04:12,860 --> 00:04:11,250
hemisphere would be divided into 100

84
00:04:14,810 --> 00:04:12,870
points and for each point we're going to

85
00:04:16,310 --> 00:04:14,820
run radiative transfer on it as well as

86
00:04:19,039 --> 00:04:16,320
including scattering to determine the

87
00:04:20,630 --> 00:04:19,049
geometric albedo overall and then we're

88
00:04:22,640 --> 00:04:20,640

going to translate that into the planet

89
00:04:25,970 --> 00:04:22,650
2 star flux ratios which is what we're

90
00:04:27,140 --> 00:04:25,980
going to be able to observe and speaking

91
00:04:28,430 --> 00:04:27,150
of what we're actually going to be

92
00:04:30,740 --> 00:04:28,440
observing it's going to be something

93
00:04:32,450 --> 00:04:30,750
that's lower in resolution so here I

94
00:04:34,730 --> 00:04:32,460
have an example of Planet 2 star flux

95
00:04:36,980 --> 00:04:34,740
ratio versus wavelength at a resolution

96
00:04:38,900 --> 00:04:36,990
of 70

97
00:04:41,689 --> 00:04:38,910
and what's more is that these data are

98
00:04:44,990 --> 00:04:41,699
going to be noisy so in this case we

99
00:04:51,129 --> 00:04:45,000
have a data set that our signal-to-noise

100
00:04:53,870 --> 00:04:51,139
ratio or SNR of 20 what's going to be

101
00:04:58,700 --> 00:04:53,880
really informative is we if we have a

102
00:05:01,040 --> 00:04:58,710
way to justify a certain signal-to-noise

103
00:05:06,140 --> 00:05:01,050
ratio that will allow us to quantify

104
00:05:08,210 --> 00:05:06,150
constraints on water vapor or oxygen so

105
00:05:11,089 --> 00:05:08,220
in this case I have a spectrum that's

106
00:05:12,589 --> 00:05:11,099
signal-to-noise ratio of 10 and so how

107
00:05:16,100 --> 00:05:12,599
will that do in comparison to the

108
00:05:18,020 --> 00:05:16,110
signal-to-noise of 20 and would we be

109
00:05:19,850 --> 00:05:18,030
able to get away with signal-to-noise of

110
00:05:21,140 --> 00:05:19,860
5 and still get the amount of constraint

111
00:05:24,589 --> 00:05:21,150
that we would want on interested

112
00:05:26,600 --> 00:05:24,599
quantities so we aim to understand what

113
00:05:30,770 --> 00:05:26,610

information is present as a function of

114
00:05:32,420 --> 00:05:30,780
signal-to-noise ratio and to do that

115
00:05:35,390 --> 00:05:32,430
we're going to use a Bayesian retrieval

116
00:05:37,270 --> 00:05:35,400
framework that chiu-hung introduced the

117
00:05:39,260 --> 00:05:37,280
concept pretty well earlier this morning

118
00:05:41,629 --> 00:05:39,270
essentially we're going to have a bunch

119
00:05:43,760 --> 00:05:41,639
of input parameters that have prior

120
00:05:46,189 --> 00:05:43,770
distributions that we'll draw from and

121
00:05:47,570 --> 00:05:46,199
construct one set of parameters we're

122
00:05:49,730 --> 00:05:47,580
going to put it into the forward model

123
00:05:52,459 --> 00:05:49,740
which generates a high-resolution albedo

124
00:05:54,469 --> 00:05:52,469
spectrum that we then bend down to the

125
00:05:55,610 --> 00:05:54,479
resolution of the data and this is when

126
00:05:57,920 --> 00:05:55,620
we'll get to do the interesting

127
00:05:59,930 --> 00:05:57,930
goodness-of-fit comparison by feeding it

128
00:06:01,279 --> 00:05:59,940
into a chi-square likelihood function

129
00:06:02,990 --> 00:06:01,289
and it's going to be an iterative

130
00:06:05,439 --> 00:06:03,000
process where we'll draw from those

131
00:06:07,520 --> 00:06:05,449
prior distributions again and again and

132
00:06:09,770 --> 00:06:07,530
compare that goodness of fit again and

133
00:06:12,080 --> 00:06:09,780
again until we construct the posterior

134
00:06:17,990 --> 00:06:12,090
probability distributions for each of

135
00:06:21,100 --> 00:06:18,000
those parameters another way of thinking

136
00:06:24,589 --> 00:06:21,110
about a retrieval is this is a very

137
00:06:26,450 --> 00:06:24,599
data-driven method so for a given set of

138
00:06:28,430 --> 00:06:26,460

data and we propose a set of parameters

139
00:06:31,159 --> 00:06:28,440
there's going to be a corresponding

140
00:06:33,409 --> 00:06:31,169
spectrum that follows that proposed set

141
00:06:34,879 --> 00:06:33,419
of parameters and then for a given range

142
00:06:36,740 --> 00:06:34,889
of parameters because there's going to

143
00:06:38,990 --> 00:06:36,750
be a range of spectra and so we'll be

144
00:06:40,730 --> 00:06:39,000
able to visualize the spread and our

145
00:06:44,149 --> 00:06:40,740
confidence in terms of how well our

146
00:06:46,250 --> 00:06:44,159
model fit the data so here we have red

147
00:06:47,869 --> 00:06:46,260
is lunch Sigma for the spread we have

148
00:06:51,049 --> 00:06:47,879
coral that

149
00:06:53,989 --> 00:06:51,059
for the two sigma spread and then

150
00:06:55,640 --> 00:06:53,999
there's also a blue line over here and I

151
00:06:57,200 --> 00:06:55,650
just want to say that we're using the I

152
00:06:59,959 --> 00:06:57,210
think I forgot to mention we're using

153
00:07:03,170 --> 00:06:59,969
the noise model that Ty Robinson created

154
00:07:05,029 --> 00:07:03,180
for coronagraphs and in terms of the

155
00:07:06,829 --> 00:07:05,039
larger error bars over here in the red

156
00:07:08,749 --> 00:07:06,839
end this is partially due to the fact

157
00:07:10,999 --> 00:07:08,759
that there are fewer photons from the

158
00:07:14,809 --> 00:07:11,009
host star in this particular part of the

159
00:07:16,700 --> 00:07:14,819
spectrum and the texture quantum

160
00:07:19,730 --> 00:07:16,710
efficiency in the red end tends to fall

161
00:07:21,589 --> 00:07:19,740
off or at least that's the case for a W

162
00:07:25,339 --> 00:07:21,599
type W first type scenario we're

163
00:07:27,139 --> 00:07:25,349

considering so going back to this idea

164
00:07:28,760 --> 00:07:27,149
of posteriors I'm going to start with an

165
00:07:31,209 --> 00:07:28,770
example where we only have two free

166
00:07:33,739 --> 00:07:31,219
parameters so this is an atmosphere with

167
00:07:35,719 --> 00:07:33,749
a surface pressure that we're going to

168
00:07:38,989 --> 00:07:35,729
retrieve for and water vapor and we're

169
00:07:40,790 --> 00:07:38,999
assuming we know everything else so here

170
00:07:43,189 --> 00:07:40,800
are those posterior distributions after

171
00:07:44,839 --> 00:07:43,199
we perform the retrieval and you can see

172
00:07:46,219 --> 00:07:44,849
this is for water this is for surface

173
00:07:49,309 --> 00:07:46,229
pressure and then the blue lines

174
00:07:50,899 --> 00:07:49,319
indicate the truth input values and the

175
00:07:52,879 --> 00:07:50,909
power of the retrieval methods that were

176
00:07:57,949 --> 00:07:52,889
able to attach uncertainties to our

177
00:08:01,249 --> 00:07:57,959
estimates but of course life is not that

178
00:08:03,679 --> 00:08:01,259
easy we are not always going to only

179
00:08:05,300 --> 00:08:03,689
have two unknowns so we've developed a

180
00:08:07,699 --> 00:08:05,310
forward model where we have nine

181
00:08:09,949 --> 00:08:07,709
retrievable parameters and this is a set

182
00:08:11,570 --> 00:08:09,959
of parameters that we think represents a

183
00:08:13,279 --> 00:08:11,580
minimum number of parameters that are

184
00:08:16,159 --> 00:08:13,289
necessary in order to recreate an

185
00:08:18,350 --> 00:08:16,169
earth-like spectrum so we have surface

186
00:08:21,110 --> 00:08:18,360
pressure surface albedo the mixing

187
00:08:23,329 --> 00:08:21,120
ratios for water ozone and oxygen and we

188
00:08:26,839 --> 00:08:23,339

have a cloud layer that has a cloud top

189
00:08:28,639 --> 00:08:26,849
pressure of Delta P and obstacle depth

190
00:08:33,319 --> 00:08:28,649
and then an F cloud parameter to

191
00:08:35,870 --> 00:08:33,329
represent fractional cloudiness and for

192
00:08:37,370 --> 00:08:35,880
the sake of not being too complicated we

193
00:08:39,680 --> 00:08:37,380
decided that we want to assume that we

194
00:08:41,990 --> 00:08:39,690
know the radius the semi-major axis what

195
00:08:43,879 --> 00:08:42,000
the background gas is and we're also

196
00:08:48,319 --> 00:08:43,889
implementing an isothermal pressure

197
00:08:49,759 --> 00:08:48,329
temperature profile so once our forward

198
00:08:53,449 --> 00:08:49,769
model is assembled we're able to

199
00:08:56,269 --> 00:08:53,459
simulate the spectra between point four

200
00:08:57,590 --> 00:08:56,279
and one micron at a resolution of

201
00:09:01,280 --> 00:08:57,600
seventy and for four different

202
00:09:06,810 --> 00:09:04,680
so first up we have the results from the

203
00:09:08,970 --> 00:09:06,820
signal-to-noise ratio of five data and

204
00:09:11,550 --> 00:09:08,980
just by eye you can tell that there's

205
00:09:13,920 --> 00:09:11,560
not going to be much information that

206
00:09:15,600 --> 00:09:13,930
the data will be able to give us and we

207
00:09:17,670 --> 00:09:15,610
see that very well with the spectral

208
00:09:18,990 --> 00:09:17,680
Fitz and I've marked the water features

209
00:09:21,030 --> 00:09:19,000
over here because I'm about to walk

210
00:09:23,430 --> 00:09:21,040
through the posterior distribution for

211
00:09:25,710 --> 00:09:23,440
water for each signal-to-noise ratio so

212
00:09:29,220 --> 00:09:25,720
you can see how that changes once the

213
00:09:31,680 --> 00:09:29,230

data get better so first it's the same

214
00:09:34,890 --> 00:09:31,690
signal to noise and you can see so this

215
00:09:37,080 --> 00:09:34,900
is log of water vapor mixing ratio and

216
00:09:42,150 --> 00:09:37,090
this is the true value so there is no

217
00:09:45,600 --> 00:09:42,160
detection for this SNR going up to SNR

218
00:09:48,330 --> 00:09:45,610
of 10 there is still no detection and we

219
00:09:50,340 --> 00:09:48,340
step it up to SNR 15 and this is where

220
00:09:52,830 --> 00:09:50,350
it got really awesome where we were able

221
00:09:57,150 --> 00:09:52,840
to get a constraint on the water vapor

222
00:09:59,550 --> 00:09:57,160
pressure mixing ratio and returning to

223
00:10:01,680 --> 00:09:59,560
that comparison to the spectra you can

224
00:10:03,960 --> 00:10:01,690
see in this case we actually are able to

225
00:10:05,460 --> 00:10:03,970
trace out the features much better and

226
00:10:08,280 --> 00:10:05,470
that's because we have that constrained

227
00:10:11,970 --> 00:10:08,290
water vapor now however water is not the

228
00:10:14,550 --> 00:10:11,980
only thing we care about and if we look

229
00:10:16,320 --> 00:10:14,560
instead at the broader picture and we

230
00:10:19,530 --> 00:10:16,330
think about the gases were interested in

231
00:10:22,590 --> 00:10:19,540
water ozone and oxygen we see that in

232
00:10:26,340 --> 00:10:22,600
this case so this is water this is ozone

233
00:10:28,860 --> 00:10:26,350
this oxygen comparing SNR 15 and SNR 20

234
00:10:30,540 --> 00:10:28,870
you can see that it is only with SNR 20

235
00:10:33,210 --> 00:10:30,550
that we are able to actually constrain

236
00:10:35,600 --> 00:10:33,220
all three molecules so this shows us

237
00:10:37,980 --> 00:10:35,610
that retrievals are actually able to

238
00:10:39,810 --> 00:10:37,990

allow us to make these statements and

239
00:10:45,270 --> 00:10:39,820
not only that we're able to back it up

240
00:10:47,070 --> 00:10:45,280
with quantitative reasoning so moving

241
00:10:50,760 --> 00:10:47,080
forward what we're excited about

242
00:10:52,830 --> 00:10:50,770
implementing is connecting or expanding

243
00:10:54,660 --> 00:10:52,840
beyond just studying earth-like planets

244
00:10:55,950 --> 00:10:54,670
we want to be able to model super earth

245
00:10:58,740 --> 00:10:55,960
we want to be able to model many

246
00:11:00,660 --> 00:10:58,750
Neptune's because those are the Kepler

247
00:11:03,210 --> 00:11:00,670
mission found are the most common small

248
00:11:07,560 --> 00:11:03,220
planets in the galaxy

249
00:11:09,630 --> 00:11:07,570
and then as Sean alluded to earlier

250
00:11:11,730 --> 00:11:09,640
we're going to expand our wavelength

251
00:11:12,210 --> 00:11:11,740
range such that we can accommodate the

252
00:11:14,340 --> 00:11:12,220
interest

253
00:11:16,950 --> 00:11:14,350
5x and levar as we move forward in

254
00:11:20,760 --> 00:11:16,960
exploring what types of data we'll be

255
00:11:24,510 --> 00:11:20,770
able to enable our accurate inference

256
00:11:27,110 --> 00:11:24,520
about an atmosphere and then furthermore

257
00:11:29,730 --> 00:11:27,120
we want to be able to implement surface

258
00:11:31,260 --> 00:11:29,740
wavelength dependent surface albedo so

259
00:11:32,910 --> 00:11:31,270
Jake who's speaking after me will be

260
00:11:35,040 --> 00:11:32,920
able to tell us about how important it

261
00:11:42,150 --> 00:11:35,050
is to consider the heterogeneity for the

262
00:11:44,610 --> 00:11:42,160
surface of the planet so to wrap up we

263
00:11:47,730 --> 00:11:44,620

have created a retrieval framework that

264
00:11:51,000 --> 00:11:47,740
is able to allow us to quantitatively

265
00:11:52,650 --> 00:11:51,010
say how confident we are in our

266
00:11:54,720 --> 00:11:52,660
understanding of a terrestrial

267
00:11:56,850 --> 00:11:54,730
atmosphere when observed with a future

268
00:12:00,770 --> 00:11:56,860
space-based coronagraph or starshade

269
00:12:03,900 --> 00:12:00,780
imaging mission we have studied

270
00:12:06,930 --> 00:12:03,910
simulated spectra from 0.4 to 1 micron

271
00:12:09,030 --> 00:12:06,940
at a resolution of 70 and we found that

272
00:12:10,530 --> 00:12:09,040
it is only at a signal-to-noise ratio of

273
00:12:12,870 --> 00:12:10,540
20 that were able to constrain

274
00:12:15,780 --> 00:12:12,880
quantities like water ozone and oxygen

275
00:12:17,490 --> 00:12:15,790
all together moving forward there are

276
00:12:19,020 --> 00:12:17,500
lots of things we want to be able to

277
00:12:20,520 --> 00:12:19,030
implement and so I would like to hear

278
00:12:22,640 --> 00:12:20,530
what your thoughts are and take any

279
00:12:29,300 --> 00:12:22,650
questions thank you

280
00:12:33,270 --> 00:12:29,310
[Applause]

281
00:12:35,370 --> 00:12:33,280
that's great talk in terms of the inputs

282
00:12:37,230 --> 00:12:35,380
for your model let's let's say one of

283
00:12:40,680 --> 00:12:37,240
these flagships get selected is flying

284
00:12:43,140 --> 00:12:40,690
into the 2030s how important are the NA

285
00:12:44,730 --> 00:12:43,150
prior knowledge of the semi-major axis

286
00:12:46,260 --> 00:12:44,740
the radius or we might be able to get a

287
00:12:48,810 --> 00:12:46,270
limit on the radius from a dynamical

288
00:12:51,030 --> 00:12:48,820

Mass how important is the the

289
00:12:52,980 --> 00:12:51,040
information on the planet before the

290
00:12:55,710 --> 00:12:52,990
mission actually flies that we get a few

291
00:12:59,040 --> 00:12:55,720
images and how critical is it or is it

292
00:13:00,240 --> 00:12:59,050
is do you think you can there's not

293
00:13:02,700 --> 00:13:00,250
enough degeneracies you might be able to

294
00:13:04,830 --> 00:13:02,710
get away without that information so in

295
00:13:06,840 --> 00:13:04,840
terms of radius we have already tried

296
00:13:09,600 --> 00:13:06,850
retrieving on radius and in fact if you

297
00:13:11,580 --> 00:13:09,610
refer to Michael and IX 2016 paper where

298
00:13:12,780 --> 00:13:11,590
they're looking at jovian planets in the

299
00:13:15,420 --> 00:13:12,790
reflective light they retrieve for

300
00:13:16,950 --> 00:13:15,430
radius and so that is something that we

301
00:13:18,240 --> 00:13:16,960
might be able to put constraints on

302
00:13:19,710 --> 00:13:18,250
ourselves because it's going to be

303
00:13:22,950 --> 00:13:19,720
difficult to actually measure that for a

304
00:13:24,720 --> 00:13:22,960
planet but for semi-major axes I think

305
00:13:27,690 --> 00:13:24,730
that'll be really important to know well

306
00:13:31,740 --> 00:13:27,700
in terms of getting the uncertainties on

307
00:13:35,760 --> 00:13:31,750
that down because that could impact just

308
00:13:37,740 --> 00:13:35,770
where the the data sit and so but we

309
00:13:39,030 --> 00:13:37,750
haven't looked into throwing that into

310
00:13:41,130 --> 00:13:39,040
our retrieval so at least for the

311
00:13:42,900 --> 00:13:41,140
semi-major axis I would say that would

312
00:13:47,990 --> 00:13:42,910
be something in terms of a strong tree

313
00:13:51,210 --> 00:13:48,000

we want to be able to get well I can

314
00:13:53,280 --> 00:13:51,220
obviou mandel from goddard one common

315
00:13:54,780 --> 00:13:53,290
one question the comment is you probably

316
00:13:56,640 --> 00:13:54,790
are aware of this but I'd like to hear

317
00:13:59,640 --> 00:13:56,650
which if you guys have started exploring

318
00:14:01,770 --> 00:13:59,650
it each of those points or parts of the

319
00:14:04,340 --> 00:14:01,780
spectrum will be taken on with different

320
00:14:07,470 --> 00:14:04,350
observations with W first at least

321
00:14:09,960 --> 00:14:07,480
you'll get in on an optical band you'll

322
00:14:12,540 --> 00:14:09,970
get a certain ifs band and so it'd be

323
00:14:15,680 --> 00:14:12,550
really nice to be able to prioritize one

324
00:14:17,970 --> 00:14:15,690
observation or a set of observations

325
00:14:19,890 --> 00:14:17,980
rather than saying we need the whole

326
00:14:24,840 --> 00:14:19,900
spectrum have you guys started doing

327
00:14:26,670 --> 00:14:24,850
that or is that yeah so we have an

328
00:14:29,490 --> 00:14:26,680
instrument model set up right now where

329
00:14:33,509 --> 00:14:29,500
we have the two blue filters as well as

330
00:14:37,619 --> 00:14:33,519
the from 692

331
00:14:40,189 --> 00:14:37,629
600 - 600 to 900 nanometers in space so

332
00:14:43,259 --> 00:14:40,199
we have that set up we have yet to

333
00:14:45,269 --> 00:14:43,269
separate those three ifs bands though I

334
00:14:47,249 --> 00:14:45,279
mean I know that some parts of the

335
00:14:48,660 --> 00:14:47,259
spectra they overlap so it would be

336
00:14:50,850 --> 00:14:48,670
interesting to think about that in terms

337
00:14:53,850 --> 00:14:50,860
of having very good signal to noise

338
00:14:54,780 --> 00:14:53,860

ratios in that particular area so we're

339
00:14:57,389 --> 00:14:54,790
like halfway there

340
00:15:00,090 --> 00:14:57,399
okay and my question was are we going to

341
00:15:04,169 --> 00:15:00,100
have to cut the oh you're I just had one

342
00:15:06,269 --> 00:15:04,179
short question yeah you can I was just

343
00:15:08,189 --> 00:15:06,279
you you said you took all the points on

344
00:15:10,530 --> 00:15:08,199
a hemisphere and yet you have a globally

345
00:15:13,410 --> 00:15:10,540
averaged profile why do you have to use

346
00:15:18,660 --> 00:15:13,420
all of the individual points across your

347
00:15:20,970 --> 00:15:18,670
your atmosphere um maybe maybe it was my

348
00:15:22,169 --> 00:15:20,980
wording that was off about the global

349
00:15:24,780 --> 00:15:22,179
yawn so yeah we can talk later

350
00:15:25,580 --> 00:15:24,790
Thanks all right let's get cut another