



ABS*ci*CON 2017

MESA, ARIZONA

1
00:00:15,990 --> 00:00:12,830

you

2
00:00:18,089 --> 00:00:16,000

here today

3
00:00:20,190 --> 00:00:18,099

so I think it's safe to say that we want

4
00:00:21,780 --> 00:00:20,200

more data on the habitability of planets

5
00:00:23,609 --> 00:00:21,790

around other stars and that we

6
00:00:25,440 --> 00:00:23,619

eventually want to search such planets

7
00:00:27,900 --> 00:00:25,450

for signs of life I'm going to talk

8
00:00:30,029 --> 00:00:27,910

today about one mission that is being

9
00:00:31,980 --> 00:00:30,039

studied by NASA in advance of the next

10
00:00:34,530 --> 00:00:31,990

astrophysics to Cadle survey and the

11
00:00:36,540 --> 00:00:34,540

United in the United States that has the

12
00:00:38,040 --> 00:00:36,550

goal of doing that but before I get

13
00:00:39,420 --> 00:00:38,050

there let me just for the folks that are

14

00:00:41,100 --> 00:00:39,430

in the astrobiology audience that may

15

00:00:44,280 --> 00:00:41,110

not be familiar with the decadal survey

16

00:00:45,600 --> 00:00:44,290

process every 10 years the astrophysics

17

00:00:47,460 --> 00:00:45,610

community here in the United States

18

00:00:49,439 --> 00:00:47,470

prioritizes the science that they think

19

00:00:53,100 --> 00:00:49,449

should be driving the following decade

20

00:00:54,570 --> 00:00:53,110

of of things done by NASA and by NSF and

21

00:00:56,640 --> 00:00:54,580

I believe by the Department of Energy as

22

00:00:59,520 --> 00:00:56,650

well in the field of astronomy and

23

00:01:01,320 --> 00:00:59,530

astrophysics and habit of exoplanets and

24

00:01:02,969 --> 00:01:01,330

habitable exoplanets is under the

25

00:01:05,189 --> 00:01:02,979

purview of the astrophysics decadal

26
00:01:07,109 --> 00:01:05,199
surveys and so the missions that would

27
00:01:08,130 --> 00:01:07,119
be studied in advance of that would be

28
00:01:09,899 --> 00:01:08,140
the ones that would be up for

29
00:01:11,850 --> 00:01:09,909
consideration for the next decades worth

30
00:01:13,950 --> 00:01:11,860
of missions that's also important

31
00:01:14,880 --> 00:01:13,960
important for the time scale because any

32
00:01:16,560 --> 00:01:14,890
of the missions that would be

33
00:01:18,149 --> 00:01:16,570
prioritized in that a Kittel survey

34
00:01:20,310 --> 00:01:18,159
probably wouldn't start we wouldn't

35
00:01:22,469 --> 00:01:20,320
start building them until 2025 till the

36
00:01:25,080 --> 00:01:22,479
mid-2020s and they probably would not

37
00:01:26,249 --> 00:01:25,090
launch until the 2030s so this is stuff

38
00:01:28,319 --> 00:01:26,259

that we're thinking about far in the

39

00:01:30,239 --> 00:01:28,329

future but the time is now to start

40

00:01:31,649 --> 00:01:30,249

prioritizing them and I'm not going to

41

00:01:33,690 --> 00:01:31,659

suggest what all of you should do in

42

00:01:35,340 --> 00:01:33,700

terms of what types of papers are what

43

00:01:37,109 --> 00:01:35,350

you should promote in the decadal survey

44

00:01:38,429 --> 00:01:37,119

but if you're interested in the search

45

00:01:39,510 --> 00:01:38,439

for life and in your if you're

46

00:01:41,669 --> 00:01:39,520

interested in the search for habitable

47

00:01:43,559 --> 00:01:41,679

planets I think as a community of

48

00:01:46,139 --> 00:01:43,569

astrobiologist it behooves us to be

49

00:01:48,330 --> 00:01:46,149

involved in that process as it occurs so

50

00:01:51,419 --> 00:01:48,340

without further ado this is have X this

51
00:01:53,340 --> 00:01:51,429
is one of the four here's the had X team

52
00:01:54,870 --> 00:01:53,350
I'll note that there are astrobiologists

53
00:01:57,959 --> 00:01:54,880
bona fide astrobiologists with degrees

54
00:01:59,129 --> 00:01:57,969
as such on the team and people that are

55
00:02:01,410 --> 00:01:59,139
well published in the astrobiology

56
00:02:02,550 --> 00:02:01,420
literature ties not in this picture but

57
00:02:04,590 --> 00:02:02,560
because I think he wasn't at the

58
00:02:06,359 --> 00:02:04,600
particular face-to-face meeting we also

59
00:02:07,950 --> 00:02:06,369
have Leslie Rodgers and Sara Seager is

60
00:02:10,919 --> 00:02:07,960
one of our co-chairs they've all been

61
00:02:13,050 --> 00:02:10,929
publishing astrobiology stuff so the

62
00:02:15,540 --> 00:02:13,060
goals have had the havok study are to

63
00:02:17,670 --> 00:02:15,550

develop an optimal Mich optimal mission

64

00:02:19,860 --> 00:02:17,680

concept for characterizing the nearest

65

00:02:22,200 --> 00:02:19,870

planetary systems and detecting and

66

00:02:23,910 --> 00:02:22,210

characterizing a handful of XO words so

67

00:02:25,530 --> 00:02:23,920

this is I'll get into this in a minute

68

00:02:26,250 --> 00:02:25,540

but this is unlike levar which is trying

69

00:02:28,559 --> 00:02:26,260

to get a

70

00:02:30,630 --> 00:02:28,569

statistical sampling of XO earths or

71

00:02:32,130 --> 00:02:30,640

potential XO words how about the school

72

00:02:34,259 --> 00:02:32,140

is basically how big do we have to be

73

00:02:36,270 --> 00:02:34,269

before we can get a few of them and then

74

00:02:37,949 --> 00:02:36,280

given that optimal concept maximize the

75

00:02:39,809 --> 00:02:37,959

general astrophysics science potential

76

00:02:41,160 --> 00:02:39,819

without sacrificing the primary

77

00:02:43,649 --> 00:02:41,170

exoplanet science goals and so what

78

00:02:45,630 --> 00:02:43,659

that's saying is we will optimize this

79

00:02:47,729 --> 00:02:45,640

for exoplanet science and then find out

80

00:02:49,229 --> 00:02:47,739

what kinds of other astrophysics we can

81

00:02:51,809 --> 00:02:49,239

do once we've optimized for the

82

00:02:53,580 --> 00:02:51,819

exoplanet science case so it's not just

83

00:02:55,470 --> 00:02:53,590

about exoplanets but it is the main

84

00:02:57,750 --> 00:02:55,480

architectural trades are primarily but

85

00:02:58,860 --> 00:02:57,760

not exclusively driven by exoplanets so

86

00:03:01,020 --> 00:02:58,870

if you've heard about leVoir which

87

00:03:02,520 --> 00:03:01,030

stands for the large UV optical infrared

88

00:03:03,839 --> 00:03:02,530

mission that's another thing that's

89

00:03:05,339 --> 00:03:03,849

being studied in advance of the

90

00:03:07,170 --> 00:03:05,349

astrophysics dakedo survey that would

91

00:03:09,479 --> 00:03:07,180

have a very similar science case it's

92

00:03:10,410 --> 00:03:09,489

looking for habitable worlds it's going

93

00:03:12,420 --> 00:03:10,420

to try to characterize them

94

00:03:14,610 --> 00:03:12,430

spectroscopically it's also going to do

95

00:03:15,660 --> 00:03:14,620

a lot of general astrophysics the differ

96

00:03:17,580 --> 00:03:15,670

we get the question what's the

97

00:03:20,819 --> 00:03:17,590

difference between the two well they

98

00:03:22,289 --> 00:03:20,829

have two a slight difference in in how

99

00:03:23,490 --> 00:03:22,299

they're balancing the primary science

100

00:03:25,170 --> 00:03:23,500

goals but they have the same primary

101
00:03:26,879 --> 00:03:25,180
science goals they're both going to do

102
00:03:28,800 --> 00:03:26,889
have it'll habitable exoplanets and bio

103
00:03:31,259 --> 00:03:28,810
signatures and a broad range of general

104
00:03:33,390 --> 00:03:31,269
astrophysics the two architectures will

105
00:03:35,460 --> 00:03:33,400
be different in focus as I mentioned

106
00:03:38,039 --> 00:03:35,470
before whereas Lavar is kind of balanced

107
00:03:41,360 --> 00:03:38,049
between exoplanet habitability searches

108
00:03:43,409 --> 00:03:41,370
and astrophysics have x is defined by

109
00:03:45,119 --> 00:03:43,419
optimizing for the exoplanet science

110
00:03:46,740 --> 00:03:45,129
case first and then doing the best we

111
00:03:49,500 --> 00:03:46,750
can give in that optimization for the

112
00:03:52,020 --> 00:03:49,510
rest of astrophysics and there's also

113
00:03:54,750 --> 00:03:52,030

different levels of ambition between the

114

00:03:56,970 --> 00:03:54,760

two missions leVair is trying to be big

115

00:03:58,199 --> 00:03:56,980

and ambitious and how X is trying to be

116

00:04:00,900 --> 00:03:58,209

more cost constrained and less

117

00:04:02,789 --> 00:04:00,910

technically risky but there so the way

118

00:04:04,229 --> 00:04:02,799

the analogy I give here is like and I

119

00:04:05,550 --> 00:04:04,239

apologize to the vegetarians in the room

120

00:04:07,349 --> 00:04:05,560

I just don't have the right analogy for

121

00:04:08,909 --> 00:04:07,359

this for a vegetarian menu but you can

122

00:04:10,050 --> 00:04:08,919

think of it as like the slider you know

123

00:04:11,610 --> 00:04:10,060

there's going to be for our Co textures

124

00:04:13,409 --> 00:04:11,620

study between the two missions you can

125

00:04:15,629 --> 00:04:13,419

think about the slider the cheeseburger

126

00:04:17,819 --> 00:04:15,639

you know the the sirloin steak and and

127

00:04:19,349 --> 00:04:17,829

like the filet mignon and if dr.

128

00:04:20,580 --> 00:04:19,359

Grunsfeld has his way and we assembled

129

00:04:24,180 --> 00:04:20,590

something in space that'd be the prime

130

00:04:25,529 --> 00:04:24,190

rib at the top of the menu and and and

131

00:04:27,540 --> 00:04:25,539

the goal really here is is that

132

00:04:30,300 --> 00:04:27,550

continuum is intentional strategically

133

00:04:31,409 --> 00:04:30,310

as an exoplanet scientist I'm happy that

134

00:04:33,450 --> 00:04:31,419

we're going to have a range of options

135

00:04:35,550 --> 00:04:33,460

presented to the de kado survey because

136

00:04:36,360 --> 00:04:35,560

the Cadle surveys are unpredictable and

137

00:04:38,339 --> 00:04:36,370

how they're going to operate we're

138

00:04:39,629 --> 00:04:38,349

talking about a large sample size of

139

00:04:39,990 --> 00:04:39,639

pastic it'll surveys and we're talking

140

00:04:41,970 --> 00:04:40,000

about

141

00:04:45,480 --> 00:04:41,980

predicting the actions of a few humans I

142

00:04:46,950 --> 00:04:45,490

think the the news over the last couple

143

00:04:48,390 --> 00:04:46,960

years has shown us that predicting the

144

00:04:50,460 --> 00:04:48,400

behavior of large groups of humans is

145

00:04:51,900 --> 00:04:50,470

hard enough predicting the behavior of

146

00:04:55,620 --> 00:04:51,910

small groups of humans is even more

147

00:04:57,180 --> 00:04:55,630

difficult and and I think it's wise for

148

00:04:59,640 --> 00:04:57,190

us to have multiple options going into

149

00:05:01,980 --> 00:04:59,650

that kind of scenario so if all that was

150

00:05:02,280 --> 00:05:01,990

just NASA speak just take this away from

151
00:05:04,110 --> 00:05:02,290
it

152
00:05:06,390 --> 00:05:04,120
the goal of the high-back study is to

153
00:05:07,770 --> 00:05:06,400
find out what what a smaller scale NASA

154
00:05:09,600 --> 00:05:07,780
led mission looked like if it was

155
00:05:11,430 --> 00:05:09,610
specifically designed for to hunt for

156
00:05:14,220 --> 00:05:11,440
planets around our nearest stellar

157
00:05:15,810 --> 00:05:14,230
neighbors so that brings us to the

158
00:05:17,850 --> 00:05:15,820
science cases and I've gone over these a

159
00:05:19,590 --> 00:05:17,860
few times so I won't go over them in

160
00:05:21,600 --> 00:05:19,600
detail now but it's you know habitable

161
00:05:23,400 --> 00:05:21,610
exoplanets exploring in details our

162
00:05:25,530 --> 00:05:23,410
nearest planetary systems beyond just

163
00:05:27,810 --> 00:05:25,540

the habitable world and then the broad

164

00:05:29,220 --> 00:05:27,820

range of astrophysics and so a lot of

165

00:05:30,630 --> 00:05:29,230

that's driven by looking for this pale

166

00:05:31,890 --> 00:05:30,640

blue dot and I think people in this

167

00:05:34,080 --> 00:05:31,900

audience are familiar with this concept

168

00:05:35,580 --> 00:05:34,090

of not just characterizing it on its

169

00:05:37,710 --> 00:05:35,590

blueness as a color but

170

00:05:39,090 --> 00:05:37,720

spectroscopically in addition to the

171

00:05:41,460 --> 00:05:39,100

blue what what molecular absorption

172

00:05:43,140 --> 00:05:41,470

features does it have does it have a red

173

00:05:47,100 --> 00:05:43,150

edge does it have carbon dioxide oxygen

174

00:05:49,140 --> 00:05:47,110

methane water vapor and so on and so

175

00:05:50,490 --> 00:05:49,150

these are some simulations by kat fung

176

00:05:51,960 --> 00:05:50,500

whose I believe going to be speaking

177

00:05:53,670 --> 00:05:51,970

later in this session and Tye Robinson

178

00:05:54,750 --> 00:05:53,680

who I believe is also going to be

179

00:05:56,760 --> 00:05:54,760

speaking later in this session that

180

00:06:00,090 --> 00:05:56,770

shows what we could do I believe this is

181

00:06:03,450 --> 00:06:00,100

a 200 hour integration time on a fairly

182

00:06:06,300 --> 00:06:03,460

nearby earth-like world and and this is

183

00:06:08,400 --> 00:06:06,310

this shows you that we can in fact we

184

00:06:11,670 --> 00:06:08,410

think resolve some very important

185

00:06:13,500 --> 00:06:11,680

features like water and on and oxygen we

186

00:06:15,270 --> 00:06:13,510

are going to try to go out past one

187

00:06:16,530 --> 00:06:15,280

micron here so this is a simulated

188

00:06:18,030 --> 00:06:16,540

spectrum from point three two one

189

00:06:19,440 --> 00:06:18,040

microns we're going to try to go out

190

00:06:21,600 --> 00:06:19,450

past one micron but it's going to be

191

00:06:22,860 --> 00:06:21,610

sort of a best-effort if the mission

192

00:06:25,350 --> 00:06:22,870

won't be designed from the ground up to

193

00:06:27,060 --> 00:06:25,360

be optimized to operating past one

194

00:06:28,560 --> 00:06:27,070

micron and we'll do sort of the best we

195

00:06:30,390 --> 00:06:28,570

can given the technologies we have at

196

00:06:32,430 --> 00:06:30,400

the time and we're also worried about

197

00:06:34,140 --> 00:06:32,440

the false positives this is the part of

198

00:06:36,060 --> 00:06:34,150

the mission or the the study that's the

199

00:06:37,830 --> 00:06:36,070

most near and dear to my heart I don't

200

00:06:39,990 --> 00:06:37,840

want to spend a large amount of taxpayer

201
00:06:42,150 --> 00:06:40,000
money and the entirety of my career and

202
00:06:43,409 --> 00:06:42,160
most of many other people's careers and

203
00:06:45,990 --> 00:06:43,419
then call the President and say we found

204
00:06:47,219 --> 00:06:46,000
signs of life and then have you know a

205
00:06:48,630 --> 00:06:47,229
bunch of papers in the look in the

206
00:06:50,880 --> 00:06:48,640
literature a week later saying no you

207
00:06:53,080 --> 00:06:50,890
found interesting photochemistry that's

208
00:06:55,330 --> 00:06:53,090
not what I'm dedicating my life to

209
00:06:57,040 --> 00:06:55,340
so we want to know about those potential

210
00:06:59,140 --> 00:06:57,050
false positives that could trip us up in

211
00:07:00,550 --> 00:06:59,150
advance and we're incorporating that

212
00:07:03,790 --> 00:07:00,560
into the types of things we want to look

213
00:07:05,380 --> 00:07:03,800

for this is not a habit formal slide

214

00:07:07,210 --> 00:07:05,390

this is something that just is my own

215

00:07:09,100 --> 00:07:07,220

brainchild of how we might do an

216

00:07:11,020 --> 00:07:09,110

observational run on a particular planet

217

00:07:12,490 --> 00:07:11,030

starting with finding out if just if

218

00:07:14,440 --> 00:07:12,500

there's too much dust in the exoplanet

219

00:07:15,520 --> 00:07:14,450

system and if and if there is we've got

220

00:07:16,840 --> 00:07:15,530

a picture that does because there's

221

00:07:17,500 --> 00:07:16,850

science there and then we move on to our

222

00:07:19,300 --> 00:07:17,510

next target

223

00:07:21,250 --> 00:07:19,310

there wasn't too much dust to cloud out

224

00:07:24,130 --> 00:07:21,260

the the planets we would start to look

225

00:07:25,750 --> 00:07:24,140

for planets orbit had planets great and

226

00:07:27,460 --> 00:07:25,760

actually to be honest if it had planets

227

00:07:28,810 --> 00:07:27,470

we wouldn't know what planets they were

228

00:07:31,060 --> 00:07:28,820

at first we'd have to revisit multiple

229

00:07:32,200 --> 00:07:31,070

times to define the orbits and maybe get

230

00:07:34,090 --> 00:07:32,210

some colors of the preliminary

231

00:07:35,350 --> 00:07:34,100

characterization scheme but eventually

232

00:07:36,640 --> 00:07:35,360

we would determine whether or not any of

233

00:07:38,590 --> 00:07:36,650

those planets were rocky and in the

234

00:07:41,020 --> 00:07:38,600

habitable zone we'd get a low-res

235

00:07:42,400 --> 00:07:41,030

spectrum of those rocky worlds find out

236

00:07:43,570 --> 00:07:42,410

if they had water and we look at water

237

00:07:45,430 --> 00:07:43,580

first because it's got whopping big

238

00:07:48,310 --> 00:07:45,440

absorption features that should be

239

00:07:50,980 --> 00:07:48,320

relatively easy to to detect if it had

240

00:07:53,470 --> 00:07:50,990

water we'd start to get excited we'd

241

00:07:55,030 --> 00:07:53,480

look for oxygen at a higher of a medium

242

00:07:58,090 --> 00:07:55,040

or medium to higher spectral resolution

243

00:07:59,469 --> 00:07:58,100

of around 150 if we found the oxygen now

244

00:08:00,850 --> 00:07:59,479

we're starting to get really excited but

245

00:08:03,760 --> 00:08:00,860

now I'm starting to sweat about those

246

00:08:06,640 --> 00:08:03,770

false positives for life we get a long

247

00:08:07,960 --> 00:08:06,650

wave spectrum if we could well first of

248

00:08:09,280 --> 00:08:07,970

all we try to quantify the oxygen if

249

00:08:10,360 --> 00:08:09,290

that's too much that's bad news for a

250

00:08:12,250 --> 00:08:10,370

reason I don't have time to go into

251
00:08:14,080 --> 00:08:12,260
detail on which is a false positive

252
00:08:15,430 --> 00:08:14,090
indicator but if it didn't have too much

253
00:08:17,409 --> 00:08:15,440
oxygen we'd look at the long wave

254
00:08:19,450 --> 00:08:17,419
spectrum we'd look for a methane which

255
00:08:21,850 --> 00:08:19,460
is the great pair to have with oxygen we

256
00:08:24,159 --> 00:08:21,860
found the methane that's well honest I

257
00:08:26,050 --> 00:08:24,169
honestly we'd probably be cracking open

258
00:08:28,150 --> 00:08:26,060
champagne bottles like after every one

259
00:08:29,350 --> 00:08:28,160
of these steps but that's the one where

260
00:08:31,270 --> 00:08:29,360
I'd probably open the bottle of

261
00:08:32,589 --> 00:08:31,280
champagne and then take it down to I

262
00:08:35,020 --> 00:08:32,599
don't know the Bahamas or something and

263
00:08:35,920 --> 00:08:35,030

start planning my retirement because

264

00:08:37,779 --> 00:08:35,930

that's when I would be comfortable

265

00:08:39,430 --> 00:08:37,789

putting my name on a paper saying we

266

00:08:41,469 --> 00:08:39,440

found signs of life on an exoplanet at

267

00:08:43,079 --> 00:08:41,479

least me personally that as whether or

268

00:08:45,400 --> 00:08:43,089

not that applies to you that's up to you

269

00:08:47,020 --> 00:08:45,410

now as we're doing all this we're going

270

00:08:48,760 --> 00:08:47,030

to also be able to observe other kinds

271

00:08:50,860 --> 00:08:48,770

of planets a diversity of worlds in that

272

00:08:52,060 --> 00:08:50,870

system so even though we're looking for

273

00:08:53,980 --> 00:08:52,070

Earth's the way that the instrumentation

274

00:08:56,050 --> 00:08:53,990

is set up we'll also be seeing other

275

00:08:57,850 --> 00:08:56,060

pale dots that may not be blue and they

276
00:08:59,770 --> 00:08:57,860
may not be quite as small as Earth and

277
00:09:01,480 --> 00:08:59,780
we're going to get Jupiter's at a range

278
00:09:03,850 --> 00:09:01,490
of distances we're going to get

279
00:09:04,900 --> 00:09:03,860
Neptune's and these weird super sub

280
00:09:06,750 --> 00:09:04,910
Neptune things and we're going to get

281
00:09:08,550 --> 00:09:06,760
spectra on those things too

282
00:09:10,500 --> 00:09:08,560
and so even if you aren't convinced that

283
00:09:12,270 --> 00:09:10,510
the search for earth is what we should

284
00:09:13,320 --> 00:09:12,280
put all our chips in I mean we should be

285
00:09:17,460 --> 00:09:13,330
thinking about comparative planetology

286
00:09:18,960 --> 00:09:17,470
how Dex is going to do that as well and

287
00:09:20,430 --> 00:09:18,970
the other way to think about this is how

288
00:09:23,250 --> 00:09:20,440

Dex is really designed to do all this

289

00:09:24,870 --> 00:09:23,260

science in our local system it's it's

290

00:09:27,480 --> 00:09:24,880

not it's not the the mission that's

291

00:09:29,040 --> 00:09:27,490

going to do a survey of everyone to put

292

00:09:30,120 --> 00:09:29,050

another analogy out there it's not the

293

00:09:32,160 --> 00:09:30,130

thing that's going to do the survey of

294

00:09:33,810 --> 00:09:32,170

everybody in the United States it's the

295

00:09:35,100 --> 00:09:33,820

thing that's going to knock on doors of

296

00:09:36,150 --> 00:09:35,110

a few neighbors and find out what

297

00:09:37,710 --> 00:09:36,160

they're thinking

298

00:09:39,870 --> 00:09:37,720

because have X is really is really

299

00:09:41,910 --> 00:09:39,880

designed just to look for these kinds of

300

00:09:45,420 --> 00:09:41,920

planets and do this kind of science in

301
00:09:46,830 --> 00:09:45,430
our nearest stellar neighbors so we are

302
00:09:48,930 --> 00:09:46,840
going to do some general astrophysics as

303
00:09:50,640 --> 00:09:48,940
well and because this is a habitability

304
00:09:52,710 --> 00:09:50,650
session I'd oh not going to go into it

305
00:09:54,630 --> 00:09:52,720
but a lot of this is astrobiology too

306
00:09:56,370 --> 00:09:54,640
because one thing that I love about

307
00:09:57,690 --> 00:09:56,380
astrobiology it's not just about the

308
00:09:59,960 --> 00:09:57,700
search for life it's about sort of the

309
00:10:02,360 --> 00:09:59,970
history of life and the history of

310
00:10:04,650 --> 00:10:02,370
Astrophysical and cosmological

311
00:10:06,270 --> 00:10:04,660
conditions that led to the origin of

312
00:10:08,340 --> 00:10:06,280
life on Earth and we'll learn a lot

313
00:10:10,800 --> 00:10:08,350

about how stars form and how planet

314

00:10:13,350 --> 00:10:10,810

systems form and how galaxies form and

315

00:10:14,040 --> 00:10:13,360

evolve over time with the hab X or loop

316

00:10:15,900 --> 00:10:14,050

our life mission

317

00:10:18,300 --> 00:10:15,910

and we'll also do some cool planetary

318

00:10:20,760 --> 00:10:18,310

science astrobiology we'd be able to get

319

00:10:23,070 --> 00:10:20,770

better resolution on for example geysers

320

00:10:27,510 --> 00:10:23,080

from Europa are we coming up on my time

321

00:10:29,340 --> 00:10:27,520

here okay so this is just for scale we

322

00:10:30,930 --> 00:10:29,350

have Hubble on the left half X is going

323

00:10:32,190 --> 00:10:30,940

to be looking at two sizes we've already

324

00:10:33,990 --> 00:10:32,200

looked at a four meter which I'll talk

325

00:10:35,190 --> 00:10:34,000

about in a moment and we're also going

326

00:10:37,590 --> 00:10:35,200

to be talking about a six and a half

327

00:10:39,210 --> 00:10:37,600

meter version of had X in the future we

328

00:10:41,070 --> 00:10:39,220

haven't considered that in detail quite

329

00:10:43,590 --> 00:10:41,080

yet but this gives you a sense of how

330

00:10:44,820 --> 00:10:43,600

large something like this might be the

331

00:10:47,190 --> 00:10:44,830

six and a half meter would borrow from

332

00:10:48,570 --> 00:10:47,200

JWST so this would be somewhere in size

333

00:10:51,630 --> 00:10:48,580

four the four meter version between

334

00:10:53,340 --> 00:10:51,640

Hubble and Webb now this is not an eye

335

00:10:56,070 --> 00:10:53,350

chart I don't expect you to read it this

336

00:10:57,660 --> 00:10:56,080

is how we made decisions on what kinds

337

00:10:59,820 --> 00:10:57,670

of starlight suppression technology and

338

00:11:01,200 --> 00:10:59,830

major architectures we would use to find

339

00:11:03,660 --> 00:11:01,210

these have double exoplanets it's a

340

00:11:05,160 --> 00:11:03,670

difficult engineering problem and we had

341

00:11:06,540 --> 00:11:05,170

four major choices we were considering

342

00:11:08,310 --> 00:11:06,550

as a team we could have used a

343

00:11:10,260 --> 00:11:08,320

coronagraph which blocks light inside

344

00:11:12,240 --> 00:11:10,270

the path of the telescope to from the

345

00:11:14,550 --> 00:11:12,250

star so you can see the earth-like

346

00:11:16,020 --> 00:11:14,560

worlds we considered a star shade which

347

00:11:17,579 --> 00:11:16,030

blocks the life of four it hits the

348

00:11:19,020 --> 00:11:17,589

telescope that that there's some

349

00:11:20,190 --> 00:11:19,030

difficulty in making the star shade

350

00:11:21,480 --> 00:11:20,200

itself but if

351
00:11:24,150 --> 00:11:21,490
you can make a star shade you can use a

352
00:11:26,460 --> 00:11:24,160
dumber telescope to put it simply to

353
00:11:27,900 --> 00:11:26,470
find your planets then we considered

354
00:11:29,130 --> 00:11:27,910
something with two star shades where

355
00:11:30,420 --> 00:11:29,140
you'd use warm star shade to search for

356
00:11:31,770 --> 00:11:30,430
planets because the problem with the

357
00:11:33,450 --> 00:11:31,780
star shade is it sloughs and as it's

358
00:11:35,370 --> 00:11:33,460
slowing you can't search for exoplanets

359
00:11:36,630 --> 00:11:35,380
so we would have one star shade finding

360
00:11:38,490 --> 00:11:36,640
planets while another one was slowing

361
00:11:40,140 --> 00:11:38,500
maybe to your next target or slowing to

362
00:11:41,850 --> 00:11:40,150
that target to do characterization of it

363
00:11:44,100 --> 00:11:41,860

and we considered a mission with one

364

00:11:45,330 --> 00:11:44,110

star shade and one coronagraph and

365

00:11:46,830 --> 00:11:45,340

there's some advantages to that which

366

00:11:49,440 --> 00:11:46,840

I'll get to in a minute now that what we

367

00:11:51,270 --> 00:11:49,450

did was we had a series of musts that

368

00:11:53,550 --> 00:11:51,280

the mission had to meet a series of

369

00:11:56,010 --> 00:11:53,560

wants that we wanted it to meet a series

370

00:11:57,630 --> 00:11:56,020

of risks to the mission and a series of

371

00:12:00,390 --> 00:11:57,640

opportunities to the mission and the

372

00:12:02,610 --> 00:12:00,400

colors from blue green yellow red are

373

00:12:04,080 --> 00:12:02,620

from best to worst for each of the four

374

00:12:05,940 --> 00:12:04,090

architectures we are considering this is

375

00:12:07,530 --> 00:12:05,950

how we made the decision you can see us

376

00:12:09,290 --> 00:12:07,540

like we had data on the left and the

377

00:12:11,700 --> 00:12:09,300

make the trade makes matrix on the right

378

00:12:14,010 --> 00:12:11,710

filling this in as we went along through

379

00:12:15,270 --> 00:12:14,020

grueling days the thing that really

380

00:12:16,770 --> 00:12:15,280

drove our decision in the end was the

381

00:12:18,210 --> 00:12:16,780

science return and the best science

382

00:12:18,660 --> 00:12:18,220

return came from the combination of the

383

00:12:20,370 --> 00:12:18,670

coronagraph

384

00:12:21,660 --> 00:12:20,380

and the star shade so that's what we're

385

00:12:24,330 --> 00:12:21,670

going to go forward with that's news we

386

00:12:26,370 --> 00:12:24,340

just decided this on Friday in Boston

387

00:12:27,960 --> 00:12:26,380

and so we're going to the the first

388

00:12:29,640 --> 00:12:27,970

architecture for how the X will be a

389

00:12:31,140 --> 00:12:29,650

four meter monolith with both an

390

00:12:33,480 --> 00:12:31,150

internal coronagraph and an external

391

00:12:35,670 --> 00:12:33,490

star shade and that's nice because

392

00:12:38,010 --> 00:12:35,680

they're complementary coronagraphs are

393

00:12:40,440 --> 00:12:38,020

nimble while star shades can do deep

394

00:12:41,580 --> 00:12:40,450

broad observations spectroscopically now

395

00:12:44,430 --> 00:12:41,590

that does mean we're going to carry more

396

00:12:45,660 --> 00:12:44,440

technological challenges with us the the

397

00:12:47,310 --> 00:12:45,670

thing we're going to do there is we're

398

00:12:50,010 --> 00:12:47,320

going to talk about D scopes if we have

399

00:12:51,810 --> 00:12:50,020

to so that's where I'm going to close to

400

00:12:53,370 --> 00:12:51,820

take questions about this but I'd like

401
00:12:55,740 --> 00:12:53,380
everyone to just think about the

402
00:12:57,450 --> 00:12:55,750
astrophysics future that they want and

403
00:12:58,890 --> 00:12:57,460
to participate in the activities that

404
00:13:04,040 --> 00:12:58,900
are going to determine that thank you

405
00:13:17,250 --> 00:13:06,600
we have time for one maybe two questions

406
00:13:18,389 --> 00:13:17,260
that they're quick um could you oh do we

407
00:13:21,600 --> 00:13:18,399
have someone walking up nevermind God

408
00:13:24,180 --> 00:13:21,610
thanks Eric so is generous yeah no I

409
00:13:26,100 --> 00:13:24,190
just wanted to say great talk I just

410
00:13:27,660 --> 00:13:26,110
wanted to say that when I think about

411
00:13:30,689 --> 00:13:27,670
the difference between leVoir and have X

412
00:13:32,040 --> 00:13:30,699
I do just like to re-emphasize reham

413
00:13:34,350 --> 00:13:32,050

office it's the point that you made these

414

00:13:36,449 --> 00:13:34,360

you know we're doing deep dive into our

415

00:13:38,550 --> 00:13:36,459

neighboring systems and finding out like

416

00:13:40,800 --> 00:13:38,560

whatever is there including the

417

00:13:42,269 --> 00:13:40,810

habitable planets but there's so many

418

00:13:45,420 --> 00:13:42,279

other kinds of planets that will be in

419

00:13:46,949 --> 00:13:45,430

that same discovery space that getting

420

00:13:49,139 --> 00:13:46,959

to know our neighbors really well is a

421

00:13:51,360 --> 00:13:49,149

major focus for this concept which i

422

00:13:53,310 --> 00:13:51,370

think is super exciting personally even

423

00:13:53,610 --> 00:13:53,320

more so than the big survey thanks

424

00:13:54,870 --> 00:13:53,620

Maggie

425

00:13:56,639 --> 00:13:54,880

totally agree and I should point out

426

00:13:58,410 --> 00:13:56,649

when I showed the photo we have another

427

00:13:59,550 --> 00:13:58,420

astrobiologist on EST DT which is Thank

428

00:14:05,819 --> 00:13:59,560

You Turnbull who just asked that

429

00:14:07,620 --> 00:14:05,829

question okay

430

00:14:09,540 --> 00:14:07,630

well let's give Sean another round of

431

00:14:12,540 --> 00:14:09,550

applause do you have a quick question

432

00:14:14,939 --> 00:14:12,550

yeah and Sean have you guys also thought

433

00:14:16,319 --> 00:14:14,949

about a broader general juror program or

434

00:14:19,949 --> 00:14:16,329

is that just in the future you're too

435

00:14:21,269 --> 00:14:19,959

concerned we have are so one of the one

436

00:14:23,040 --> 00:14:21,279

of the trades we were looking at is the

437

00:14:25,019 --> 00:14:23,050

amount of guaranteed general

438

00:14:26,370 --> 00:14:25,029

astrophysics / gas observer time that

439

00:14:28,860 --> 00:14:26,380

the different architectures would enable

440

00:14:30,210 --> 00:14:28,870

the the star shade only missions or the

441

00:14:32,610 --> 00:14:30,220

two star shade missions had the most

442

00:14:33,840 --> 00:14:32,620

there because they while those star

443

00:14:36,120 --> 00:14:33,850

shades are slowing you're guaranteed

444

00:14:38,610 --> 00:14:36,130

guest observer time to do other kinds of

445

00:14:40,740 --> 00:14:38,620

science but that's a guarantee that's

446

00:14:42,329 --> 00:14:40,750

like if all US exoplanet scientists are

447

00:14:44,100 --> 00:14:42,339

super greedy there's an upper limit to

448

00:14:45,420 --> 00:14:44,110

the star shade driven missions to the

449

00:14:48,300 --> 00:14:45,430

amount of time we could we could even

450

00:14:50,100 --> 00:14:48,310

like try to get that doesn't mean that

451
00:14:51,240 --> 00:14:50,110
that the coronagraph missions with the

452
00:14:53,759 --> 00:14:51,250
chronograph and a star shade or the

453
00:14:55,949 --> 00:14:53,769
chronograph only couldn't also decide in

454
00:14:58,230 --> 00:14:55,959
the future to have a similar amount of

455
00:15:00,150 --> 00:14:58,240
guest observer science so how much guest

456
00:15:01,379 --> 00:15:00,160
observer sensor is is really a decision

457
00:15:03,689 --> 00:15:01,389
that would be made by a future

458
00:15:06,240 --> 00:15:03,699
astrophysics community I personally

459
00:15:08,040 --> 00:15:06,250
think more is better though that's

460
00:15:09,540 --> 00:15:08,050
related to our architectures in the to

461
00:15:12,449 --> 00:15:09,550
the extent that certain architectures

462
00:15:14,340 --> 00:15:12,459
guarantee a floor and would that be

463
00:15:16,079 --> 00:15:14,350

guaranteed also by having sorry we're

464

00:15:16,420 --> 00:15:16,089

gonna have to cut the exact you know I

465

00:15:18,010 --> 00:15:16,430

can

466

00:15:19,180 --> 00:15:18,020

more about that later yeah all right

467

00:15:20,180 --> 00:15:19,190

let's give shine another round of