



1
00:00:00,790 --> 00:00:07,320

[Music]

2
00:00:11,530 --> 00:00:09,209

[Applause]

3
00:00:13,299 --> 00:00:11,540

my name is Cynthia Phillips and I'm here

4
00:00:16,029 --> 00:00:13,309

representing the Europa Lander mission

5
00:00:19,060 --> 00:00:16,039

concept some of my partners in crime

6
00:00:21,490 --> 00:00:19,070

from the pre project project science

7
00:00:24,849 --> 00:00:21,500

group are a kevin hand morgan cable Amy

8
00:00:26,259 --> 00:00:24,859

Hoffman Kate craft as well as a number

9
00:00:27,759 --> 00:00:26,269

of people who are on the your plan

10
00:00:31,120 --> 00:00:27,769

they're pre project science and

11
00:00:31,920 --> 00:00:31,130

engineering teams so what is Europa

12
00:00:37,930 --> 00:00:31,930

Lander

13
00:00:41,080 --> 00:00:37,940

title says to land on the surface of

14
00:00:42,880 --> 00:00:41,090
Europa and one of the reasons why Europa

15
00:00:45,190 --> 00:00:42,890
is one of the best places to go in my

16
00:00:46,600 --> 00:00:45,200
opinion in the solar system is that it

17
00:00:48,310 --> 00:00:46,610
perhaps is one of the best places to

18
00:00:49,990 --> 00:00:48,320
look for life beyond the earth and it's

19
00:00:51,580 --> 00:00:50,000
a good place to look for extant life so

20
00:00:54,459 --> 00:00:51,590
life that can be there today

21
00:00:56,500 --> 00:00:54,469
and so the Europa Lander mission concept

22
00:00:59,139 --> 00:00:56,510
started with a set of top-level science

23
00:01:01,000 --> 00:00:59,149
goals these included a goal to search

24
00:01:03,999 --> 00:01:01,010
for evidence of bio signatures on Europa

25
00:01:06,790 --> 00:01:04,009
to assess the habitability of Europa via

26

00:01:08,290 --> 00:01:06,800

in situ techniques and to characterize

27

00:01:11,050 --> 00:01:08,300

the surface and the subsurface

28

00:01:13,300 --> 00:01:11,060

and as is typical when you have a

29

00:01:15,400 --> 00:01:13,310

science definition team the SCT took

30

00:01:19,719 --> 00:01:15,410

those set of goals and turned them into

31

00:01:21,160 --> 00:01:19,729

a set of objectives these goals and

32

00:01:23,589 --> 00:01:21,170

objectives then become addressed with a

33

00:01:27,070 --> 00:01:23,599

focus model payload and so in this

34

00:01:29,260 --> 00:01:27,080

mission concept we now can expand these

35

00:01:30,850 --> 00:01:29,270

set these three goals into a number of

36

00:01:33,100 --> 00:01:30,860

objectives that are shown around here

37

00:01:35,320 --> 00:01:33,110

and then you can think about what

38

00:01:37,839 --> 00:01:35,330

instruments you would need and so in

39

00:01:39,400 --> 00:01:37,849

this case we really wanted a focus

40

00:01:41,320 --> 00:01:39,410

payload that would include instruments

41

00:01:42,219 --> 00:01:41,330

that would address more than one of

42

00:01:45,010 --> 00:01:42,229

these aspects of the mission

43

00:01:46,779 --> 00:01:45,020

simultaneously and so the model payload

44

00:01:48,940 --> 00:01:46,789

has a gas chromatograph mass

45

00:01:51,699 --> 00:01:48,950

spectrometer it has a microscope it has

46

00:01:53,830 --> 00:01:51,709

something like a Raman it has context

47

00:01:56,529 --> 00:01:53,840

camera or cameras and it also has a

48

00:01:59,529 --> 00:01:56,539

geophone or a seismic package and so

49

00:02:01,809 --> 00:01:59,539

when we combine together the the those

50

00:02:04,300 --> 00:02:01,819

elements of the science payload we then

51
00:02:06,249 --> 00:02:04,310
have a robust mission concept and so the

52
00:02:09,180 --> 00:02:06,259
basic idea is that this D this is a

53
00:02:13,660 --> 00:02:09,190
large mission it has to launch on an SLS

54
00:02:15,699 --> 00:02:13,670
the cruise from Earth to Jupiter's about

55
00:02:18,160 --> 00:02:15,709
five years on an SLS and that's with a

56
00:02:20,560 --> 00:02:18,170
gravity assist either Mars or Earth

57
00:02:22,090 --> 00:02:20,570
depending on the launch date and then

58
00:02:23,590 --> 00:02:22,100
it's about another two years after

59
00:02:26,170 --> 00:02:23,600
before we actually land on the surface

60
00:02:27,910 --> 00:02:26,180
of Europa the carrier stage in this

61
00:02:29,830 --> 00:02:27,920
mission concept is that it's a dumb

62
00:02:31,720 --> 00:02:29,840
carrier so basically all the brains are

63
00:02:33,610 --> 00:02:31,730

on the lander itself you have a large

64

00:02:36,580 --> 00:02:33,620

carrier it's actually larger than the

65

00:02:38,560 --> 00:02:36,590

Europe a clipper wingspan but once it

66

00:02:40,510 --> 00:02:38,570

drops off its payload in Europe orbit

67

00:02:43,450 --> 00:02:40,520

the carrier flies off into a disposal

68

00:02:46,330 --> 00:02:43,460

orbit the just deorbit de-scented

69

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

landing stage uses a sky crane this is

70

00:02:49,600 --> 00:02:48,350

with a 10 meter tether and that's

71

00:02:51,040 --> 00:02:49,610

because on Europe but there is no

72

00:02:53,050 --> 00:02:51,050

preacher atmosphere so that means that

73

00:02:55,000 --> 00:02:53,060

aerobraking parachutes airbags just

74

00:02:56,320 --> 00:02:55,010

don't work there but fortunately a sky

75

00:02:58,150 --> 00:02:56,330

crane turns out to work really well for

76

00:02:59,650 --> 00:02:58,160

delivering payload to the surface and

77

00:03:02,500 --> 00:02:59,660

actually because there's no atmosphere

78

00:03:04,420 --> 00:03:02,510

you are able to land with a hundred

79

00:03:07,750 --> 00:03:04,430

meter accuracy there's nothing to blow

80

00:03:08,950 --> 00:03:07,760

you downstream you can just land you can

81

00:03:12,370 --> 00:03:08,960

basically pick a point on the surface

82

00:03:14,140 --> 00:03:12,380

and with some help along the way through

83

00:03:15,520 --> 00:03:14,150

terrain relative navigation and an

84

00:03:17,410 --> 00:03:15,530

onboard lidar for hazard avoidance

85

00:03:19,690 --> 00:03:17,420

you're able to land on the surface

86

00:03:22,540 --> 00:03:19,700

basically wherever you want to put this

87

00:03:24,730 --> 00:03:22,550

and once you're on the surface it's a

88

00:03:26,560 --> 00:03:24,740

bio signature science mission so the

89

00:03:28,390 --> 00:03:26,570

idea is that will excavate to about 10

90

00:03:30,520 --> 00:03:28,400

centimeters below the surface will

91

00:03:31,840 --> 00:03:30,530

collect a sample I'm using a sampling

92

00:03:33,460 --> 00:03:31,850

system and then analyze it

93

00:03:35,340 --> 00:03:33,470

onboard the spacecraft with that model

94

00:03:37,810 --> 00:03:35,350

payload that I just discussed and

95

00:03:39,910 --> 00:03:37,820

because Europa surfaces in such a high

96

00:03:42,310 --> 00:03:39,920

radiation environment what that means is

97

00:03:43,930 --> 00:03:42,320

that this is a short mission so we just

98

00:03:46,180 --> 00:03:43,940

heard about dragonfly which is about it

99

00:03:48,970 --> 00:03:46,190

two and a half year nominal mission here

100

00:03:51,760 --> 00:03:48,980

we're talking about 22 days so it's a

101
00:03:52,990 --> 00:03:51,770
short compressed mission and as you'll

102
00:03:55,570 --> 00:03:53,000
see in a bit that requires quite a bit

103
00:03:57,850 --> 00:03:55,580
of autonomy to perform the mission but

104
00:03:59,440 --> 00:03:57,860
we believe that we're able to to perform

105
00:04:01,990 --> 00:03:59,450
this mission we're able to complete our

106
00:04:04,990 --> 00:04:02,000
science goals robustly even given that

107
00:04:07,510 --> 00:04:05,000
limited time span and so here's just a

108
00:04:09,330 --> 00:04:07,520
nice overview because it's always easier

109
00:04:11,320 --> 00:04:09,340
to visualize something with a picture so

110
00:04:13,990 --> 00:04:11,330
here's the Europa Lander spacecraft

111
00:04:15,430 --> 00:04:14,000
coming into Jupiter orbit and you can

112
00:04:18,220 --> 00:04:15,440
see that the spacecraft here I'll just

113
00:04:20,590 --> 00:04:18,230

point out the mouse it's encased in a

114

00:04:22,030 --> 00:04:20,600

bio barrier planetary protection is an

115

00:04:23,800 --> 00:04:22,040

important concern when we're landing on

116

00:04:25,450 --> 00:04:23,810

the surface of Europa but we have a

117

00:04:26,920 --> 00:04:25,460

great team who's been addressing this

118

00:04:29,260 --> 00:04:26,930

and we think that we can do this in a

119

00:04:31,240 --> 00:04:29,270

way that that meets all of the planetary

120

00:04:32,950 --> 00:04:31,250

protection requirements so the

121

00:04:33,340 --> 00:04:32,960

spacecraft again we're on this very

122

00:04:35,230 --> 00:04:33,350

large

123

00:04:37,270 --> 00:04:35,240

solar-powered carrier stage that's

124

00:04:39,250 --> 00:04:37,280

larger than the than the wingspan of the

125

00:04:40,540 --> 00:04:39,260

Europa clipper spacecraft so that's

126
00:04:43,960 --> 00:04:40,550
about the size of a basketball field

127
00:04:46,150 --> 00:04:43,970
we're talking a lot of solar panels we

128
00:04:49,060 --> 00:04:46,160
dumped the carrier into a disposal orbit

129
00:04:51,310 --> 00:04:49,070
and here comes the deorbit descent and

130
00:04:54,070 --> 00:04:51,320
landing stage as the spacecraft is

131
00:04:57,160 --> 00:04:54,080
released from its from its bio barrier

132
00:04:59,080 --> 00:04:57,170
it then takes over and so you can see

133
00:05:00,160 --> 00:04:59,090
here this this animation shows slightly

134
00:05:01,810 --> 00:05:00,170
you'll see you'll see a number of

135
00:05:03,370 --> 00:05:01,820
different versions of the spacecraft

136
00:05:05,470 --> 00:05:03,380
throughout the imagery that I show in

137
00:05:07,180 --> 00:05:05,480
this talk in this one you'll see that

138
00:05:09,220 --> 00:05:07,190

the landing portion looks slightly

139

00:05:10,450 --> 00:05:09,230

different that's just because we still

140

00:05:12,820 --> 00:05:10,460

have a number of open trades on the

141

00:05:15,370 --> 00:05:12,830

engineering side as we proceed so here's

142

00:05:19,390 --> 00:05:15,380

the spacecraft we are continuing with

143

00:05:21,520 --> 00:05:19,400

the descent stage and so we have a

144

00:05:23,650 --> 00:05:21,530

series of thrusters that are on the

145

00:05:27,100 --> 00:05:23,660

spacecraft itself to basically

146

00:05:29,110 --> 00:05:27,110

decelerate it and take it down there we

147

00:05:31,690 --> 00:05:29,120

go keep to it to decelerate it and take

148

00:05:33,430 --> 00:05:31,700

it down to the surface once we get close

149

00:05:35,260 --> 00:05:33,440

to the surface we've already chosen a

150

00:05:36,340 --> 00:05:35,270

location on the surface to land using

151
00:05:38,650 --> 00:05:36,350
imagery from the Europa clipper

152
00:05:40,330 --> 00:05:38,660
spacecraft and now we're heading for

153
00:05:42,460 --> 00:05:40,340
that location using something called

154
00:05:43,780 --> 00:05:42,470
terrain relative navigation that means

155
00:05:46,240 --> 00:05:43,790
that we've loaded the highest resolution

156
00:05:48,340 --> 00:05:46,250
images we have of the landing site from

157
00:05:49,990 --> 00:05:48,350
Europe a clipper and then images that

158
00:05:52,180 --> 00:05:50,000
are taken during landing are matched to

159
00:05:54,250 --> 00:05:52,190
that as well as active hazard avoidance

160
00:05:55,660 --> 00:05:54,260
so that we can land on the surface so

161
00:05:58,270 --> 00:05:55,670
you saw those adaptable landing

162
00:05:59,530 --> 00:05:58,280
stabilizer legs as it came down the

163
00:06:01,600 --> 00:05:59,540

spacecraft is actually supported by a

164

00:06:04,000 --> 00:06:01,610

belly pan that's right in the center the

165

00:06:07,600 --> 00:06:04,010

stabilizers basically help so that if

166

00:06:10,210 --> 00:06:07,610

you land on an obstacle that's nominally

167

00:06:12,700 --> 00:06:10,220

about half a meter high up to as much as

168

00:06:15,280 --> 00:06:12,710

a meter you're still able to land you

169

00:06:16,900 --> 00:06:15,290

lock the stabilizer legs in place once

170

00:06:18,760 --> 00:06:16,910

the belly pan touches the surface and

171

00:06:21,160 --> 00:06:18,770

that holds the deck in a nice horizontal

172

00:06:23,710 --> 00:06:21,170

position even if you land on very rough

173

00:06:25,870 --> 00:06:23,720

terrain once the spacecraft has checked

174

00:06:29,770 --> 00:06:25,880

out the surroundings we then undock the

175

00:06:31,390 --> 00:06:29,780

sampling arm so this device had in in

176

00:06:33,520 --> 00:06:31,400

this this version and again this is also

177

00:06:36,160 --> 00:06:33,530

an open trade in this version we have a

178

00:06:38,860 --> 00:06:36,170

Bible aid saw tool which is able to dig

179

00:06:40,900 --> 00:06:38,870

about 10 centimeters below the surface

180

00:06:42,909 --> 00:06:40,910

and 10 centimeters is far enough down

181

00:06:45,250 --> 00:06:42,919

where you're below the bulk of the

182

00:06:46,930 --> 00:06:45,260

radiation processing and so what that

183

00:06:49,030 --> 00:06:46,940

means is that we can sample more

184

00:06:51,220 --> 00:06:49,040

in surface material to look for those

185

00:06:52,810 --> 00:06:51,230

evidence of bio signatures once we've

186

00:06:54,130 --> 00:06:52,820

dug that trench and of course in real

187

00:06:55,810 --> 00:06:54,140

life digging the trench would take a bit

188

00:06:57,760 --> 00:06:55,820

longer and yes and tailings to deal with

189

00:06:59,770 --> 00:06:57,770

but here you're basically collecting now

190

00:07:01,420 --> 00:06:59,780

a sample from the bottom of that trench

191

00:07:02,830 --> 00:07:01,430

and in this version we're using a sample

192

00:07:04,410 --> 00:07:02,840

acquisition system that's a little bit

193

00:07:06,460 --> 00:07:04,420

similar to what we did on Mars Phoenix

194

00:07:08,470 --> 00:07:06,470

and we're looking at multiple different

195

00:07:09,940 --> 00:07:08,480

ways of doing that the sample is then

196

00:07:11,380 --> 00:07:09,950

transferred to the spacecraft and then

197

00:07:13,810 --> 00:07:11,390

again onboard the spacecraft we have

198

00:07:16,210 --> 00:07:13,820

that model payload of analysis

199

00:07:18,970 --> 00:07:16,220

instruments including a GCMs a Raman a

200

00:07:21,130 --> 00:07:18,980

microscope and again we also have a

201
00:07:23,830 --> 00:07:21,140
seismometer a geophone as well as

202
00:07:27,100 --> 00:07:23,840
context cameras on the surface and so

203
00:07:31,210 --> 00:07:27,110
this would take place semi-autonomous Li

204
00:07:32,680 --> 00:07:31,220
there is room for ground input but a lot

205
00:07:35,140 --> 00:07:32,690
of the a lot of what needs to be done

206
00:07:37,060 --> 00:07:35,150
needs to be done autonomously by the

207
00:07:40,180 --> 00:07:37,070
spacecraft so here's just some details

208
00:07:42,790 --> 00:07:40,190
showing you can see here that the the

209
00:07:44,410 --> 00:07:42,800
landing feet here look a little bit more

210
00:07:46,150 --> 00:07:44,420
speed half spherical rather than the

211
00:07:47,580 --> 00:07:46,160
flat ones previously so we're looking at

212
00:07:51,040 --> 00:07:47,590
a number of different foot designs

213
00:07:52,840 --> 00:07:51,050

perhaps these here can be deformable so

214

00:07:54,340 --> 00:07:52,850

that again if you land on rough tree and

215

00:07:57,970 --> 00:07:54,350

you're able to stabilize yourself more

216

00:08:00,370 --> 00:07:57,980

carefully and so when we're thinking

217

00:08:00,880 --> 00:08:00,380

about the science surface operations of

218

00:08:02,980 --> 00:08:00,890

this mission

219

00:08:05,170 --> 00:08:02,990

we start with Europe a clipper data and

220

00:08:07,480 --> 00:08:05,180

that provides us with a scientifically

221

00:08:10,750 --> 00:08:07,490

compelling landing site with a number of

222

00:08:12,790 --> 00:08:10,760

these candidates and so the instruments

223

00:08:14,950 --> 00:08:12,800

on clipper will give us surface

224

00:08:17,200 --> 00:08:14,960

composition morphology degree of

225

00:08:19,570 --> 00:08:17,210

radiation processing etc and we'll use

226

00:08:21,070 --> 00:08:19,580

that data to help select a site that's

227

00:08:22,630 --> 00:08:21,080

scientifically interesting but is also

228

00:08:24,370 --> 00:08:22,640

viable from an engineering perspective

229

00:08:28,360 --> 00:08:24,380

we want to make sure we can land there

230

00:08:32,230 --> 00:08:28,370

safely the because again of that of the

231

00:08:34,300 --> 00:08:32,240

primary battery architecture that comes

232

00:08:36,040 --> 00:08:34,310

from the fact that radiation damage

233

00:08:37,990 --> 00:08:36,050

would probably destroy the spacecraft in

234

00:08:39,459 --> 00:08:38,000

approximately a month so there's no

235

00:08:41,050 --> 00:08:39,469

point in bringing more power than you

236

00:08:43,779 --> 00:08:41,060

need so this is a mission where it

237

00:08:46,750 --> 00:08:43,789

doesn't make sense to use an RTG using

238

00:08:48,310 --> 00:08:46,760

batteries that are sized to be able to

239

00:08:49,900 --> 00:08:48,320

survive to keep your spacecraft alive

240

00:08:51,760 --> 00:08:49,910

long enough to do its primary mission

241

00:08:53,410 --> 00:08:51,770

but you basically want to run out of

242

00:08:55,030 --> 00:08:53,420

battery power about the time when

243

00:08:57,070 --> 00:08:55,040

radiation damage would have killed your

244

00:08:58,120 --> 00:08:57,080

spacecraft anyway and so these are open

245

00:09:00,070 --> 00:08:58,130

trades that we're working with the

246

00:09:00,610 --> 00:09:00,080

engineering team but we'll need the

247

00:09:01,930 --> 00:09:00,620

lander to be

248

00:09:03,340 --> 00:09:01,940

highly automated we'll need it to be

249

00:09:06,460 --> 00:09:03,350

designed for uncertain surface

250

00:09:08,910 --> 00:09:06,470

topography and materials and again we'll

251
00:09:11,200 --> 00:09:08,920
need a high degree of autonomy for the

252
00:09:13,450 --> 00:09:11,210
location of the trench that we choose to

253
00:09:14,740 --> 00:09:13,460
take and how samples are acquired from

254
00:09:17,980 --> 00:09:14,750
that trench and analyzed by the

255
00:09:19,450 --> 00:09:17,990
instrumentation so an exciting bit of

256
00:09:23,170 --> 00:09:19,460
progress on the Europa Lander mission

257
00:09:24,760 --> 00:09:23,180
concept is that we recently had 14 teams

258
00:09:27,940 --> 00:09:24,770
that were selected as part of this ic2

259
00:09:29,800 --> 00:09:27,950
program through NASA roses and so those

260
00:09:30,940 --> 00:09:29,810
teams are listed here and you can see

261
00:09:32,530 --> 00:09:30,950
that many of these fit into the

262
00:09:34,780 --> 00:09:32,540
categories that were listed in the model

263
00:09:36,460 --> 00:09:34,790

payload there's with some interesting

264

00:09:40,300 --> 00:09:36,470

additions that are left to die down here

265

00:09:42,040 --> 00:09:40,310

on the right such as a and so so

266

00:09:44,200 --> 00:09:42,050

basically what this does is it allows us

267

00:09:45,730 --> 00:09:44,210

to work with these teams to really help

268

00:09:48,340 --> 00:09:45,740

to mature their technology and really

269

00:09:50,110 --> 00:09:48,350

help mature not just this not just their

270

00:09:51,760 --> 00:09:50,120

instrument concept but to think about

271

00:09:53,770 --> 00:09:51,770

how these instruments will work with the

272

00:09:55,720 --> 00:09:53,780

whole spacecraft because clearly on a

273

00:09:58,120 --> 00:09:55,730

spacecraft like this that is it's small

274

00:10:00,400 --> 00:09:58,130

it's very limited in mass power volume

275

00:10:01,750 --> 00:10:00,410

and time we have to have a payload that

276

00:10:04,480 --> 00:10:01,760

works very well together and that's

277

00:10:06,040 --> 00:10:04,490

highly integrated so as we think about

278

00:10:08,020 --> 00:10:06,050

the path forward for this Europa Lander

279

00:10:09,430 --> 00:10:08,030

mission concept again this is not a

280

00:10:11,590 --> 00:10:09,440

mission that has been funded yet we have

281

00:10:13,810 --> 00:10:11,600

not yet gone into phase a but the

282

00:10:15,580 --> 00:10:13,820

mission has years of development behind

283

00:10:18,550 --> 00:10:15,590

it and it's really a very mature and

284

00:10:22,780 --> 00:10:18,560

exciting mission concept and so over the

285

00:10:24,820 --> 00:10:22,790

next two years we have about 50 actually

286

00:10:26,770 --> 00:10:24,830

advanced development activities and so

287

00:10:29,110 --> 00:10:26,780

these include lab work on cryogenic ice

288

00:10:31,180 --> 00:10:29,120

properties improvements of the sampling

289

00:10:33,600 --> 00:10:31,190

system studies of surface autonomy

290

00:10:35,710 --> 00:10:33,610

better development of battery design

291

00:10:39,100 --> 00:10:35,720

more study of planetary protection

292

00:10:40,960 --> 00:10:39,110

constraints a detailed look at

293

00:10:43,510 --> 00:10:40,970

contamination control how can we make

294

00:10:46,000 --> 00:10:43,520

sure that the thrusters on the rocket

295

00:10:48,490 --> 00:10:46,010

don't actually don't actually disturb

296

00:10:50,260 --> 00:10:48,500

the surface to a to grade 2 degree for

297

00:10:53,740 --> 00:10:50,270

us to be able to sample pristine

298

00:10:55,330 --> 00:10:53,750

material and so the teams on IC 2

299

00:10:56,860 --> 00:10:55,340

they'll be working with the Europa

300

00:10:59,530 --> 00:10:56,870

Lander pre project for the next two

301
00:11:01,540 --> 00:10:59,540
years yesterday we had a very successful

302
00:11:03,310 --> 00:11:01,550
workshop called the instrumentation for

303
00:11:05,530 --> 00:11:03,320
the institute exploration of Europa and

304
00:11:07,510 --> 00:11:05,540
ocean world's we had about 150

305
00:11:09,430 --> 00:11:07,520
participants thank you to those of you

306
00:11:10,750 --> 00:11:09,440
came again we apologize for the very

307
00:11:12,790 --> 00:11:10,760
small room but that really shows the

308
00:11:14,420 --> 00:11:12,800
excitement about these but this future

309
00:11:16,310 --> 00:11:14,430
exploration

310
00:11:19,240 --> 00:11:16,320
and we're likely going to be hosting a

311
00:11:21,350 --> 00:11:19,250
full multi-day workshop early next year

312
00:11:23,870 --> 00:11:21,360
we also need to be thinking about the

313
00:11:26,090 --> 00:11:23,880

Takeda survey for those of us who think

314

00:11:28,190 --> 00:11:26,100

about in-situ exploration of ocean icy

315

00:11:30,920 --> 00:11:28,200

worlds Europa Lander needs to be a

316

00:11:32,960 --> 00:11:30,930

priority even with the exciting

317

00:11:35,870 --> 00:11:32,970

selection of dragonfly that's a very

318

00:11:39,470 --> 00:11:35,880

different end member from the surface of

319

00:11:41,060 --> 00:11:39,480

a place like Europa and so it'll be very

320

00:11:42,769 --> 00:11:41,070

interesting to see what dragonfly gives

321

00:11:44,180 --> 00:11:42,779

us but it would be really even more

322

00:11:46,519 --> 00:11:44,190

interesting if we could compare and

323

00:11:48,470 --> 00:11:46,529

contrast what we see on the surface of a

324

00:11:51,350 --> 00:11:48,480

world like Titan with what we see on the

325

00:11:51,740 --> 00:11:51,360

surface of a world like Europa and all

326

00:11:52,760 --> 00:11:51,750

in there

327

00:11:53,090 --> 00:11:52,770

thank you