Q&A Panel: Exploring Titan's Prebiotic Chemistry & Astrobiological Potential with the Dragonfly Mission

1
00:00:04,470 --> 00:00:02,149
we're gonna go ahead and get started

2
00:00:06,309 --> 00:00:04,480
thank you all for joining us um at this

3
00:00:08,710 --> 00:00:06,319
uh

4
00:00:09,990 --> 00:00:08,720
thursday town hall um

5
00:00:11,430 --> 00:00:10,000
the

6
00:00:13,350 --> 00:00:11,440
q a panel

7
00:00:16,070 --> 00:00:13,360
with the dragonfly team

8
00:00:19,269 --> 00:00:16,080
um it was at absycon

9
00:00:21,269 --> 00:00:19,279
uh the last apps icon that we learned

10
00:00:23,029 --> 00:00:21,279
that dragonfly was selected as the next

11
00:00:26,310 --> 00:00:23,039
new frontiers mission

12
00:00:28,150 --> 00:00:26,320
um so i was reminiscing a lot about um

13
00:00:30,390 --> 00:00:28,160

the last apps icon this morning as we

14
00:00:34,389 --> 00:00:30,400
were i was preparing for this panel

15
00:00:37,110 --> 00:00:34,399
um so in in that spirit and wanting to

16
00:00:39,510 --> 00:00:37,120
make sure that the um this mission

17
00:00:41,430 --> 00:00:39,520
that's going to be really pioneering our

18
00:00:43,750 --> 00:00:41,440
understanding of prebiotic chemistry and

19
00:00:45,029 --> 00:00:43,760
ash biology reflects the astrobiology

20
00:00:47,910 --> 00:00:45,039
community we want to make sure that

21
00:00:49,910 --> 00:00:47,920
we're fostering dialogue uh between the

22
00:00:51,590 --> 00:00:49,920
team and and the broader community so

23
00:00:52,950 --> 00:00:51,600
that's the purpose of today

24
00:00:55,110 --> 00:00:52,960
and what i

25
00:00:57,990 --> 00:00:55,120
to put that in even fewer words please

26
00:00:59,750 --> 00:00:58,000
ask us your questions we we want to have

27
00:01:02,709 --> 00:00:59,760
a discussion today

28
00:01:05,350 --> 00:01:02,719
and use this time to to to build

29
00:01:07,270 --> 00:01:05,360
so uh without any further ado i'm going

30
00:01:09,350 --> 00:01:07,280
to turn it over to the principal

31
00:01:10,550 --> 00:01:09,360
investigator of dragonfly zibby turtle

32
00:01:19,350 --> 00:01:10,560
who's going to

33
00:01:24,070 --> 00:01:21,510
thank you shannon uh and and thanks

34
00:01:26,149 --> 00:01:24,080
everyone for for being here today um i'm

35
00:01:27,670 --> 00:01:26,159
gonna start with just a very brief

36
00:01:29,910 --> 00:01:27,680
hopefully

37
00:01:31,350 --> 00:01:29,920
overview of dragonfly and what we want

38
00:01:33,270 --> 00:01:31,360

to do at titan for people who aren't

39
00:01:35,670 --> 00:01:33,280
already familiar with the mission but we

40
00:01:38,230 --> 00:01:35,680
really do as shannon said want to

41
00:01:39,990 --> 00:01:38,240
want this to be a conversation um so

42
00:01:44,789 --> 00:01:40,000
we're going to keep that short and then

43
00:01:51,350 --> 00:01:48,469
um right so titan is a moon of saturn

44
00:01:55,590 --> 00:01:51,360
it's a very unique moon in our solar

45
00:01:58,870 --> 00:01:55,600
system in that it has a dense atmosphere

46
00:02:01,190 --> 00:01:58,880
and it gives us an opportunity a number

47
00:02:03,429 --> 00:02:01,200
of opportunities scientifically it gives

48
00:02:05,270 --> 00:02:03,439
us a place to look for answers to

49
00:02:06,870 --> 00:02:05,280
aspects of what makes targets in the

50
00:02:08,469 --> 00:02:06,880
solar system especially the outer solar

51
00:02:11,990 --> 00:02:08,479
system habitable

52
00:02:13,589 --> 00:02:12,000
and what are the chemical processes uh

53
00:02:14,869 --> 00:02:13,599
similar you know what chemical processes

54
00:02:16,550 --> 00:02:14,879
are happening there and what can they

55
00:02:18,630 --> 00:02:16,560
tell us about the chemical processes

56
00:02:20,309 --> 00:02:18,640
that happened here early on uh in the

57
00:02:21,750 --> 00:02:20,319
history of earth

58
00:02:23,350 --> 00:02:21,760
and of course we all have the question

59
00:02:27,030 --> 00:02:23,360
as to whether life has developed

60
00:02:29,270 --> 00:02:27,040
elsewhere in our in our solar system

61
00:02:31,670 --> 00:02:29,280
right so titan um

62
00:02:33,190 --> 00:02:31,680
is the surface gravity is one-seventh

63
00:02:35,270 --> 00:02:33,200

the gravity here that will come into

64
00:02:38,390 --> 00:02:35,280
play in a couple more slides the surface

65
00:02:41,430 --> 00:02:38,400
temperature is a balmy 94 kelvin it is

66
00:02:43,990 --> 00:02:41,440
not a it is not a warm place uh being an

67
00:02:47,509 --> 00:02:44,000
icy satellite the bedrock composition is

68
00:02:49,030 --> 00:02:47,519
is water ice um and like many of the

69
00:02:50,710 --> 00:02:49,040
moons in the outer solar system it's an

70
00:02:51,830 --> 00:02:50,720
ocean world with a deep interior liquid

71
00:02:53,750 --> 00:02:51,840
water ocean

72
00:02:56,070 --> 00:02:53,760
it has an atmospheric composition that

73
00:02:59,350 --> 00:02:56,080
is mostly nitrogen with a little bit of

74
00:03:01,030 --> 00:02:59,360
methane um which chemically makes things

75
00:03:03,270 --> 00:03:01,040
super interesting

76
00:03:04,790 --> 00:03:03,280
and the surface atmospheric pressure is

77
00:03:06,309 --> 00:03:04,800
actually higher than the atmospheric

78
00:03:09,670 --> 00:03:06,319
pressure here which will also come into

79
00:03:14,070 --> 00:03:11,270
so

80
00:03:16,070 --> 00:03:14,080
there is uh the the photochemistry in

81
00:03:18,949 --> 00:03:16,080
the upper atmosphere produces very

82
00:03:20,229 --> 00:03:18,959
complex carbon compounds and this

83
00:03:21,830 --> 00:03:20,239
material falls out through the

84
00:03:23,830 --> 00:03:21,840
atmosphere and covers the surface and

85
00:03:26,869 --> 00:03:23,840
this is the reason that titan gives us

86
00:03:27,830 --> 00:03:26,879
such a cool opportunity because

87
00:03:39,030 --> 00:03:27,840
the

88
00:03:41,190 --> 00:03:39,040

cryovolcano possibly certainly at sites

89
00:03:43,589 --> 00:03:41,200
of impact cratering where the

90
00:03:45,270 --> 00:03:43,599
surface will be melted and stay melted

91
00:03:48,869 --> 00:03:45,280
uh for possible for extended periods of

92
00:03:50,390 --> 00:03:48,879
time so that's one of the the key

93
00:03:51,350 --> 00:03:50,400
aspects that makes it such an

94
00:03:54,869 --> 00:03:51,360
interesting target from an

95
00:03:56,070 --> 00:03:54,879
astrobiological perspective

96
00:03:57,509 --> 00:03:56,080
all right so i mentioned that the

97
00:03:59,589 --> 00:03:57,519
gravity and the atmospheric density are

98
00:04:02,070 --> 00:03:59,599
going to come into play because we have

99
00:04:05,190 --> 00:04:02,080
higher atmospheric pressure and density

100
00:04:07,830 --> 00:04:05,200
at titan and lower gravity it's actually

101
00:04:10,149 --> 00:04:07,840
physically easier to fly at titan than

102
00:04:12,470 --> 00:04:10,159
it is here at earth

103
00:04:14,710 --> 00:04:12,480
and so that gives us the opportunity to

104
00:04:17,110 --> 00:04:14,720
take advantage of the atmosphere not

105
00:04:21,270 --> 00:04:17,120
only for its chemistry but also as a

106
00:04:25,430 --> 00:04:21,280
means of transport of traveling across

107
00:04:27,110 --> 00:04:25,440
titan so like the mars rovers we

108
00:04:29,430 --> 00:04:27,120
bring everything with us from place to

109
00:04:33,990 --> 00:04:29,440
place but on titan we're able to fly

110
00:04:40,150 --> 00:04:36,710
the schedule for the the mission is we

111
00:04:43,590 --> 00:04:40,160
launch in 2027 this gets us to titan by

112
00:04:44,870 --> 00:04:43,600
2034 where we'll explore for over three

113
00:04:46,749 --> 00:04:44,880

years

114
00:04:49,110 --> 00:04:46,759
traveling up to

115
00:04:51,670 --> 00:04:49,120
180 kilometers depending on where we

116
00:04:53,749 --> 00:04:51,680
land in our landing ellipse to explore

117
00:04:54,950 --> 00:04:53,759
the deposits associated with this impact

118
00:04:58,710 --> 00:04:54,960
crater

119
00:05:00,710 --> 00:04:58,720
titan is a really earth-like place in

120
00:05:02,790 --> 00:05:00,720
terms of its geology even though the

121
00:05:04,469 --> 00:05:02,800
materials are very different titan's

122
00:05:06,469 --> 00:05:04,479
equatorial region these dark areas

123
00:05:08,550 --> 00:05:06,479
around the equator are actually dunes

124
00:05:09,990 --> 00:05:08,560
they're organic sand dunes

125
00:05:13,110 --> 00:05:10,000
which are fascinating in and of

126
00:05:15,029 --> 00:05:13,120
themselves and so this area gives us the

127
00:05:16,150 --> 00:05:15,039
opportunity to

128
00:05:17,029 --> 00:05:16,160
um

129
00:05:19,350 --> 00:05:17,039
to

130
00:05:20,870 --> 00:05:19,360
explore a variety of different geologic

131
00:05:22,469 --> 00:05:20,880
settings and sample a variety of

132
00:05:25,110 --> 00:05:22,479
different materials from this organic

133
00:05:27,749 --> 00:05:25,120
sand from water ice rich inter-dune

134
00:05:29,990 --> 00:05:27,759
materials and then deposits associated

135
00:05:32,230 --> 00:05:30,000
with the impact crater where organics

136
00:05:33,990 --> 00:05:32,240
and liquid water may have mixed

137
00:05:36,870 --> 00:05:34,000
as i said for for possibly extended

138
00:05:41,110 --> 00:05:39,670

so the focus of our mission is prebiotic

139
00:05:42,950 --> 00:05:41,120
chemistry

140
00:05:45,029 --> 00:05:42,960
we want to know what chemical components

141
00:05:46,469 --> 00:05:45,039
are available on titan's surface and

142
00:05:48,230 --> 00:05:46,479
what processes are at work and whether

143
00:05:50,469 --> 00:05:48,240
they're producing biologically relevant

144
00:05:53,590 --> 00:05:50,479
compounds and then we want to put that

145
00:05:56,309 --> 00:05:53,600
into the context of the habitability of

146
00:05:58,390 --> 00:05:56,319
titan as a system the methane cycle in

147
00:06:01,830 --> 00:05:58,400
its atmosphere the

148
00:06:03,830 --> 00:06:01,840
organic cycle the processes that move

149
00:06:05,270 --> 00:06:03,840
transport modify and mix materials on

150
00:06:08,070 --> 00:06:05,280
the surface and that mix them with

151
00:06:10,070 --> 00:06:08,080
liquid reservoirs

152
00:06:11,670 --> 00:06:10,080
the we not only have had the opportunity

153
00:06:13,990 --> 00:06:11,680
to mix with liquid water tightened

154
00:06:15,510 --> 00:06:14,000
surface and in titan's interior possibly

155
00:06:17,990 --> 00:06:15,520
in that deep ocean

156
00:06:20,550 --> 00:06:18,000
but there's also methane in the

157
00:06:23,430 --> 00:06:20,560
the methane in titan's system

158
00:06:26,070 --> 00:06:23,440
has a cycle like our water cycle so

159
00:06:29,029 --> 00:06:26,080
methane actually forms clouds and rain

160
00:06:31,590 --> 00:06:29,039
and lakes and rivers and seas on titan

161
00:06:33,590 --> 00:06:31,600
and so there's the opportunity that uh

162
00:06:35,670 --> 00:06:33,600
methane could support exotic biological

163
00:06:38,309 --> 00:06:35,680

systems

164
00:06:40,950 --> 00:06:38,319
so we have a suite of instruments the we

165
00:06:42,950 --> 00:06:40,960
have a mass spectrometer a sampling

166
00:06:45,110 --> 00:06:42,960
system called draco

167
00:06:46,710 --> 00:06:45,120
and then we have a

168
00:06:48,870 --> 00:06:46,720
geophysics and meteorology package with

169
00:06:51,270 --> 00:06:48,880
a suite of sensors

170
00:06:53,270 --> 00:06:51,280
to measure aspects of the environment we

171
00:06:56,230 --> 00:06:53,280
have a camera suite and we have a gamma

172
00:06:58,790 --> 00:06:56,240
ray and neutron spectrometer

173
00:07:01,589 --> 00:06:58,800
so with these instruments we'll do

174
00:07:03,589 --> 00:07:01,599
a detailed investigation

175
00:07:06,150 --> 00:07:03,599
of the not only the composition of

176
00:07:08,150 --> 00:07:06,160
surface materials at landing sites but

177
00:07:10,150 --> 00:07:08,160
also putting those into the context of

178
00:07:12,309 --> 00:07:10,160
titan so the gamma-ray and neutron

179
00:07:14,230 --> 00:07:12,319
spectrometer gives us information about

180
00:07:16,950 --> 00:07:14,240
elemental abundances in the surface

181
00:07:19,830 --> 00:07:16,960
underneath the lander and then the mass

182
00:07:21,830 --> 00:07:19,840
spectrometer gives us an inventory of

183
00:07:23,510 --> 00:07:21,840
the uh the organics

184
00:07:26,309 --> 00:07:23,520
which we can use to look for different

185
00:07:29,430 --> 00:07:26,319
aspects of the the um

186
00:07:32,550 --> 00:07:29,440
the surface materials

187
00:07:34,950 --> 00:07:32,560
um so we have the opportunity to

188
00:07:37,029 --> 00:07:34,960

identify potential

189
00:07:39,430 --> 00:07:37,039
biomolecular components

190
00:07:42,390 --> 00:07:39,440
to look for patterns of complexity

191
00:07:43,830 --> 00:07:42,400
within the the materials we sample on

192
00:07:46,390 --> 00:07:43,840
the surface

193
00:07:48,869 --> 00:07:46,400
to identify whether there is an

194
00:07:51,189 --> 00:07:48,879
antimeric preference

195
00:07:53,510 --> 00:07:51,199
and to understand a number of or to make

196
00:07:57,270 --> 00:07:53,520
measurements relevant to a number of uh

197
00:08:01,909 --> 00:08:00,070
with the drag met system we have the

198
00:08:04,710 --> 00:08:01,919
ability to monitor atmospheric

199
00:08:06,230 --> 00:08:04,720
temperature pressure wind speed etc and

200
00:08:08,230 --> 00:08:06,240
to make uh measurements of different

201
00:08:10,230 --> 00:08:08,240
aspects of the uh

202
00:08:12,469 --> 00:08:10,240
of the regolith the thermal response

203
00:08:16,309 --> 00:08:12,479
understanding its porosity and we have

204
00:08:17,589 --> 00:08:16,319
the capability potentially uh to

205
00:08:20,230 --> 00:08:17,599
um

206
00:08:22,309 --> 00:08:20,240
detect aspects of the the subsurface so

207
00:08:23,990 --> 00:08:22,319
we have seismometers that can or we have

208
00:08:26,070 --> 00:08:24,000
a seismometer and some geophones that

209
00:08:29,189 --> 00:08:26,080
will be able to listen to understand the

210
00:08:30,469 --> 00:08:29,199
level of seismic activity on titan um

211
00:08:32,469 --> 00:08:30,479
and

212
00:08:34,389 --> 00:08:32,479
as well as e-field measurements electric

213
00:08:35,990 --> 00:08:34,399

field measurements that will uh

214
00:08:37,269 --> 00:08:36,000
be able to inform us about the schumann

215
00:08:39,350 --> 00:08:37,279
resonance

216
00:08:41,990 --> 00:08:39,360
and then with the suite of cameras

217
00:08:44,149 --> 00:08:42,000
we have the ability to take panoramas

218
00:08:46,470 --> 00:08:44,159
around the of the landscape around the

219
00:08:48,470 --> 00:08:46,480
lander we have forward and downward

220
00:08:49,990 --> 00:08:48,480
cameras that will image not only on the

221
00:08:51,990 --> 00:08:50,000
surface but while we're flying so we'll

222
00:08:55,750 --> 00:08:52,000
have aerial imagery of titan

223
00:08:57,990 --> 00:08:55,760
and we have microscopic imagers that are

224
00:09:00,710 --> 00:08:58,000
designed to get very high resolution

225
00:09:03,110 --> 00:09:00,720
imaging of the uh the sampling sites

226
00:09:04,389 --> 00:09:03,120
where the uh the sampling system the the

227
00:09:06,150 --> 00:09:04,399
pneumatic drills

228
00:09:08,310 --> 00:09:06,160
will pick up or the the rotary

229
00:09:09,990 --> 00:09:08,320
percussive drills will pick up materials

230
00:09:12,630 --> 00:09:10,000
to transfer into the mass spectrometer

231
00:09:14,790 --> 00:09:12,640
via pneumatic system

232
00:09:17,509 --> 00:09:14,800
uh and the uh the image here is just

233
00:09:21,030 --> 00:09:17,519
showing uh simulated well

234
00:09:22,949 --> 00:09:21,040
uh lab tests uh illumination of the of

235
00:09:23,750 --> 00:09:22,959
similar titan materials

236
00:09:26,710 --> 00:09:23,760
with

237
00:09:29,590 --> 00:09:26,720
different leds that we have on board to

238
00:09:30,949 --> 00:09:29,600

illuminate the surface at titan

239
00:09:32,310 --> 00:09:30,959
so i know that was a really brief

240
00:09:33,910 --> 00:09:32,320
overview but like i said we really

241
00:09:36,310 --> 00:09:33,920
wanted to

242
00:09:37,829 --> 00:09:36,320
focus the time here on questions we're

243
00:09:39,269 --> 00:09:37,839
happy to go into more detail about

244
00:09:40,870 --> 00:09:39,279
different aspects

245
00:09:43,350 --> 00:09:40,880
of the um

246
00:09:45,990 --> 00:09:43,360
of dragonfly and what we'll do at titan

247
00:09:47,829 --> 00:09:46,000
uh so i wanted to introduce the panel uh

248
00:09:50,870 --> 00:09:47,839
shannon mckenzie who you've already met

249
00:09:53,110 --> 00:09:50,880
um as our moderator is our assistant

250
00:09:55,670 --> 00:09:53,120
project scientist um

251
00:09:58,150 --> 00:09:55,680
jason barnes is one of the deputy

252
00:09:59,350 --> 00:09:58,160
principal investigators melissa traynor

253
00:10:01,430 --> 00:09:59,360
is the other deputy principal

254
00:10:03,750 --> 00:10:01,440
investigator as well as the lead for the

255
00:10:06,790 --> 00:10:03,760
mass spectrometer the drams instrument

256
00:10:09,030 --> 00:10:06,800
and ken hibbard who is hopefully online

257
00:10:11,910 --> 00:10:09,040
from apl is our

258
00:10:14,310 --> 00:10:11,920
mission systems engineer

259
00:10:16,150 --> 00:10:14,320
i also wanted to mention that of course

260
00:10:18,630 --> 00:10:16,160
any mission like this

261
00:10:20,949 --> 00:10:18,640
is the product of a very large group of

262
00:10:24,230 --> 00:10:20,959
people and many of those people are here

263
00:10:25,990 --> 00:10:24,240

in the the room uh with us today um and

264
00:10:27,829 --> 00:10:26,000
if when we're doing the questions and

265
00:10:30,230 --> 00:10:27,839
answers if people

266
00:10:31,509 --> 00:10:30,240
uh on the dragonfly team have answers to

267
00:10:33,509 --> 00:10:31,519
questions or want to chime in in

268
00:10:35,110 --> 00:10:33,519
response just uh wave your hand and go

269
00:10:36,389 --> 00:10:35,120
up to the microphone

270
00:10:39,829 --> 00:10:36,399
like i said we really want this to be a

271
00:10:39,839 --> 00:10:46,870
thank you

272
00:10:51,590 --> 00:10:48,710
thanks dibby uh for getting us all on

273
00:10:53,910 --> 00:10:51,600
the same page since uh we realized uh

274
00:10:55,990 --> 00:10:53,920
not everyone probably had time to come

275
00:10:58,630 --> 00:10:56,000
to all of the titan talks on tuesday so

276
00:11:01,350 --> 00:10:58,640
hopefully now we're all ready and primed

277
00:11:04,150 --> 00:11:01,360
to to dive into dragonfly um i will also

278
00:11:06,949 --> 00:11:04,160
be monitoring uh the vimeo chat for

279
00:11:10,710 --> 00:11:06,959
people who are online um so folks online

280
00:11:12,389 --> 00:11:10,720
can also ask questions um so come on up

281
00:11:13,990 --> 00:11:12,399
if you have a question come on up to the

282
00:11:16,790 --> 00:11:14,000
mics we've got one over here one over

283
00:11:19,590 --> 00:11:16,800
here oh and we have uh one already i

284
00:11:20,470 --> 00:11:19,600
don't even have to kick it off thanks

285
00:11:22,310 --> 00:11:20,480
thank you

286
00:11:24,069 --> 00:11:22,320
my question is more from the engineering

287
00:11:25,430 --> 00:11:24,079
perspective but i was wondering what

288
00:11:27,670 --> 00:11:25,440

sorts of things do you have to do to

289
00:11:30,470 --> 00:11:27,680
combat the cold temperatures of titan

290
00:11:33,110 --> 00:11:30,480
for the dragonfly mission

291
00:11:36,790 --> 00:11:33,120
do we have ken online yep

292
00:11:38,630 --> 00:11:36,800
oh uh jalen chakras uh bellarmine prep

293
00:11:40,870 --> 00:11:38,640
thank you

294
00:11:43,350 --> 00:11:40,880
go ahead ken take it away

295
00:11:44,230 --> 00:11:43,360
can you folks hear me yep

296
00:11:45,190 --> 00:11:44,240
okay

297
00:11:46,389 --> 00:11:45,200
all right so i think i heard the

298
00:11:48,550 --> 00:11:46,399
question is what do we have to do to

299
00:11:49,990 --> 00:11:48,560
combat the thermal environment

300
00:11:52,389 --> 00:11:50,000
yes

301
00:11:55,430 --> 00:11:52,399
so um it's challenging so titan's very

302
00:11:58,470 --> 00:11:55,440
cold as many of you i assume know um and

303
00:12:00,870 --> 00:11:58,480
so some of the things we're doing is the

304
00:12:02,870 --> 00:12:00,880
lander down on the surface is entirely

305
00:12:06,310 --> 00:12:02,880
encapsulated in foam

306
00:12:08,470 --> 00:12:06,320
and we use the waste heat from the mmrtg

307
00:12:11,910 --> 00:12:08,480
and distribute that within the lander

308
00:12:15,030 --> 00:12:11,920
body to keep everything warm so the rtg

309
00:12:17,829 --> 00:12:15,040
puts out about 2 000 watts of thermal

310
00:12:20,389 --> 00:12:17,839
waste heat and so we circulate that

311
00:12:22,230 --> 00:12:20,399
using a forced convection system move

312
00:12:23,590 --> 00:12:22,240
that heat throughout the lander and try

313
00:12:26,949 --> 00:12:23,600

to maintain kind of a nominal

314
00:12:28,949 --> 00:12:26,959
environment for the internal electronics

315
00:12:32,310 --> 00:12:28,959
anything that lives outside of the

316
00:12:34,310 --> 00:12:32,320
lander is being deliberately designed to

317
00:12:36,230 --> 00:12:34,320
survive and then perform in the

318
00:12:38,069 --> 00:12:36,240
cryogenic environment

319
00:12:40,629 --> 00:12:38,079
so everything has to be able to survive

320
00:12:44,550 --> 00:12:40,639
at 94 kelvin if it lives outside the

321
00:12:46,629 --> 00:12:44,560
body and then um we will preheat

322
00:12:49,030 --> 00:12:46,639
motors and drills and things like that

323
00:12:51,509 --> 00:12:49,040
into an operational range before we use

324
00:12:53,430 --> 00:12:51,519
them and then while we use them maintain

325
00:12:55,030 --> 00:12:53,440
them warm and let them cool back off

326
00:12:58,310 --> 00:12:55,040
when they're not in use

327
00:12:59,509 --> 00:12:58,320
um so it is quite the challenging design

328
00:13:00,870 --> 00:12:59,519
that's very cool thank you much

329
00:13:02,310 --> 00:13:00,880
appreciated

330
00:13:04,310 --> 00:13:02,320
my pleasure

331
00:13:06,710 --> 00:13:04,320
thanks ken we've got another question in

332
00:13:08,710 --> 00:13:06,720
the room

333
00:13:11,509 --> 00:13:08,720
hi my name is

334
00:13:14,470 --> 00:13:11,519
from tokyo institute of technology

335
00:13:17,750 --> 00:13:14,480
and my question is concerning for the

336
00:13:23,670 --> 00:13:20,550
my question is can we access

337
00:13:25,910 --> 00:13:23,680
five micrometer bright deposit or nike

338
00:13:29,910 --> 00:13:25,920

vapor price because it is

339
00:13:32,310 --> 00:13:29,920
also important for organic chemistry

340
00:13:35,269 --> 00:13:32,320
due to concentration and polymerization

341
00:13:38,069 --> 00:13:35,279
of organics and there are

342
00:13:41,509 --> 00:13:38,079
very large large

343
00:13:42,389 --> 00:13:41,519
deposits like forte and to indigo but

344
00:13:46,870 --> 00:13:42,399
this

345
00:13:48,870 --> 00:13:46,880
landing site so

346
00:13:51,350 --> 00:13:48,880
do you have any idea

347
00:13:53,269 --> 00:13:51,360
or plan to access these organic

348
00:13:59,110 --> 00:13:53,279
materials

349
00:14:01,910 --> 00:13:59,990
yep

350
00:14:03,430 --> 00:14:01,920
um yes we as you point out we're not

351
00:14:05,269 --> 00:14:03,440
landing near the evaporites but we're

352
00:14:06,949 --> 00:14:05,279
still very interested in them uh of

353
00:14:09,430 --> 00:14:06,959
course our imaging of titan is pretty

354
00:14:11,030 --> 00:14:09,440
coarse um and so we only have pixels

355
00:14:12,150 --> 00:14:11,040
that are kilometer in size there very

356
00:14:14,310 --> 00:14:12,160
well may be

357
00:14:15,750 --> 00:14:14,320
evaporite outcrops that are smaller than

358
00:14:19,030 --> 00:14:15,760
that that we will be have be able to

359
00:14:21,269 --> 00:14:19,040
have access to but our primary

360
00:14:23,509 --> 00:14:21,279
uh research focus for organics will be

361
00:14:25,269 --> 00:14:23,519
those sand dunes we'll be landing within

362
00:14:27,189 --> 00:14:25,279
the sand dune region

363
00:14:29,269 --> 00:14:27,199

and it turns out and i didn't know this

364
00:14:31,189 --> 00:14:29,279
because i wasn't a geologist turns out

365
00:14:33,750 --> 00:14:31,199
sand dunes on earth are not all covered

366
00:14:35,509 --> 00:14:33,760
in sand okay in fact in the mid desert

367
00:14:38,710 --> 00:14:35,519
uh in southwest africa for instance is

368
00:14:41,350 --> 00:14:38,720
40 covered in sand dunes and in between

369
00:14:43,030 --> 00:14:41,360
are these sand free intro dunes so we'll

370
00:14:45,509 --> 00:14:43,040
be accessing

371
00:14:47,350 --> 00:14:45,519
water in the sand free inter dooms water

372
00:14:49,110 --> 00:14:47,360
ice and then we'll be able to fly over

373
00:14:51,110 --> 00:14:49,120
to the the sand dunes which are made of

374
00:14:53,990 --> 00:14:51,120
organics and may ultimately derive from

375
00:14:56,230 --> 00:14:54,000
the evaporites we don't know um and

376
00:14:58,710 --> 00:14:56,240
we'll be accessing those for sure and we

377
00:15:00,310 --> 00:14:58,720
will be able to hopefully uh if we have

378
00:15:01,750 --> 00:15:00,320
if we see any evaporates along the way

379
00:15:03,269 --> 00:15:01,760
we'll be able to stop and sample them

380
00:15:04,949 --> 00:15:03,279
but you're right we're not going to be

381
00:15:06,790 --> 00:15:04,959
able to get into into the large

382
00:15:08,230 --> 00:15:06,800
evaporate deposits

383
00:15:10,550 --> 00:15:08,240
thank you

384
00:15:12,310 --> 00:15:10,560
although i will just add that i am

385
00:15:14,069 --> 00:15:12,320
crossing all of my fingers and toes that

386
00:15:16,629 --> 00:15:14,079
we're going to come across some kind of

387
00:15:18,230 --> 00:15:16,639
playa in the inter dunes and we can

388
00:15:19,670 --> 00:15:18,240

taste those evaporites and figure out

389
00:15:20,710 --> 00:15:19,680
what they are

390
00:15:23,509 --> 00:15:20,720
and then you and i are going to write a

391
00:15:24,949 --> 00:15:23,519
cool paper about it

392
00:15:26,230 --> 00:15:24,959
thanks

393
00:15:27,430 --> 00:15:26,240
all right we'll take one more from this

394
00:15:29,110 --> 00:15:27,440
side

395
00:15:30,790 --> 00:15:29,120
oh hello hi

396
00:15:32,470 --> 00:15:30,800
uh my name is natalie gruffenstein i'm a

397
00:15:34,629 --> 00:15:32,480
postdoc at the santa fe institute and

398
00:15:37,269 --> 00:15:34,639
blue marble space institute of science

399
00:15:39,110 --> 00:15:37,279
and very excited about this mission um

400
00:15:40,949 --> 00:15:39,120
my questions related to the life

401
00:15:42,550 --> 00:15:40,959
detection aspect of this so as you

402
00:15:44,790 --> 00:15:42,560
mentioned we're kind of intuitively

403
00:15:46,790 --> 00:15:44,800
thinking that if we do come across life

404
00:15:49,269 --> 00:15:46,800
or proto-biological systems there they'd

405
00:15:51,590 --> 00:15:49,279
be very different from life on earth

406
00:15:53,829 --> 00:15:51,600
because of a whole interesting chemistry

407
00:15:56,150 --> 00:15:53,839
thing sorry putting in enough that's

408
00:15:58,069 --> 00:15:56,160
happening there so

409
00:15:59,910 --> 00:15:58,079
question is about um

410
00:16:02,949 --> 00:15:59,920
how are you integrating that the fact

411
00:16:04,310 --> 00:16:02,959
that it might be so different with uh

412
00:16:06,710 --> 00:16:04,320
looking for a question about

413
00:16:08,629 --> 00:16:06,720

habitability or life detection

414
00:16:12,150 --> 00:16:08,639
and are you planning on doing that

415
00:16:13,269 --> 00:16:12,160
in-house within the team or expecting to

416
00:16:15,030 --> 00:16:13,279
collaborate with the rest of the

417
00:16:17,350 --> 00:16:15,040
community on that and

418
00:16:19,030 --> 00:16:17,360
if you are how can we help and what are

419
00:16:23,590 --> 00:16:19,040
you wanting from the community and from

420
00:16:25,590 --> 00:16:23,600
funding sources to keep this work going

421
00:16:28,069 --> 00:16:25,600
okay

422
00:16:29,670 --> 00:16:28,079
um so thanks for your question one thing

423
00:16:31,189 --> 00:16:29,680
we do want to emphasize is that

424
00:16:33,030 --> 00:16:31,199
dragonfly is not a life detection

425
00:16:35,350 --> 00:16:33,040
mission that that is not our goal right

426
00:16:37,509 --> 00:16:35,360
our goal is to understand prebiotic

427
00:16:39,509 --> 00:16:37,519
chemistry so we're very interested in

428
00:16:41,829 --> 00:16:39,519
looking at the composition of the areas

429
00:16:45,030 --> 00:16:41,839
of titan surface that we're exploring as

430
00:16:47,509 --> 00:16:45,040
well as how that chemistry has advanced

431
00:16:49,269 --> 00:16:47,519
towards something that might look

432
00:16:51,350 --> 00:16:49,279
familiar to us as a potential

433
00:16:53,189 --> 00:16:51,360
biochemistry right so

434
00:16:54,790 --> 00:16:53,199
um but to kind of pivot from your

435
00:16:56,470 --> 00:16:54,800
question though what what is related is

436
00:16:58,710 --> 00:16:56,480
well how will we interpret the molecules

437
00:17:01,910 --> 00:16:58,720
we find in whether or not they could be

438
00:17:03,829 --> 00:17:01,920

either potentially prebiotic or

439
00:17:06,230 --> 00:17:03,839
perhaps you know maybe even chemical

440
00:17:08,150 --> 00:17:06,240
biosignatures and so the way we'll do

441
00:17:09,909 --> 00:17:08,160
that of course we're targeting molecules

442
00:17:11,669 --> 00:17:09,919
that would be very familiar to us from

443
00:17:13,909 --> 00:17:11,679
life on earth things like amino acids

444
00:17:16,630 --> 00:17:13,919
and nucleobases things we suspect could

445
00:17:18,549 --> 00:17:16,640
be forming during um process aqueous

446
00:17:20,789 --> 00:17:18,559
processing on the surface

447
00:17:23,189 --> 00:17:20,799
but a lot of how we interpret the

448
00:17:25,750 --> 00:17:23,199
information that we get back is going to

449
00:17:27,669 --> 00:17:25,760
be how we answer some of these questions

450
00:17:29,430 --> 00:17:27,679
so we look at different patterns of

451
00:17:32,150 --> 00:17:29,440
molecules that we may find and try to

452
00:17:34,070 --> 00:17:32,160
understand if there's perhaps um a

453
00:17:36,390 --> 00:17:34,080
distribution that we wouldn't predict

454
00:17:38,470 --> 00:17:36,400
from antibiotic chemistry or we'll look

455
00:17:40,070 --> 00:17:38,480
at the if we do for lefty and we find

456
00:17:42,230 --> 00:17:40,080
amino acids and we we measure their

457
00:17:44,549 --> 00:17:42,240
chirality we see a big enhancement of a

458
00:17:45,909 --> 00:17:44,559
one enantiomer over another so we'll be

459
00:17:47,270 --> 00:17:45,919
looking at those things and then we'll

460
00:17:49,590 --> 00:17:47,280
be understanding how to interpret them

461
00:17:50,789 --> 00:17:49,600
in the context and i i do want to say

462
00:17:51,990 --> 00:17:50,799
i'm sure you speak for everyone i mean

463
00:17:53,830 --> 00:17:52,000

this is the

464
00:17:55,350 --> 00:17:53,840
we're going to want the whole input and

465
00:17:57,990 --> 00:17:55,360
the full understanding of the whole

466
00:18:00,070 --> 00:17:58,000
science community on how we interpret

467
00:18:02,070 --> 00:18:00,080
the types of data that we that we find

468
00:18:05,029 --> 00:18:02,080
with that and and all of the advancement

469
00:18:07,830 --> 00:18:05,039
i mean we're landing in 2013 by 2034

470
00:18:09,590 --> 00:18:07,840
right so so even by then we may have a

471
00:18:11,909 --> 00:18:09,600
lot of great work is being done in this

472
00:18:13,350 --> 00:18:11,919
area and in understanding how to

473
00:18:14,710 --> 00:18:13,360
interpret some of the chemicals that

474
00:18:16,230 --> 00:18:14,720
we're finding

475
00:18:18,150 --> 00:18:16,240
yeah if you want to add something i just

476
00:18:19,350 --> 00:18:18,160
wanted to add from a programmatic

477
00:18:20,230 --> 00:18:19,360
perspective

478
00:18:21,990 --> 00:18:20,240
um

479
00:18:24,150 --> 00:18:22,000
the expectation as it said that they

480
00:18:26,549 --> 00:18:24,160
will do a participating scientist call

481
00:18:28,150 --> 00:18:26,559
for dragonfly uh the expectation is that

482
00:18:29,750 --> 00:18:28,160
that will be in phase although if they

483
00:18:31,510 --> 00:18:29,760
want to do that earlier that would be

484
00:18:33,590 --> 00:18:31,520
excellent um

485
00:18:35,430 --> 00:18:33,600
so we're really looking forward to a

486
00:18:37,590 --> 00:18:35,440
participating scientist program for the

487
00:18:39,590 --> 00:18:37,600
mission uh i would hope that there would

488
00:18:42,150 --> 00:18:39,600

also be a new frontiers data analysis

489
00:18:44,390 --> 00:18:42,160
program uh within nasa that's typically

490
00:18:46,950 --> 00:18:44,400
the uh one of the the way they one of

491
00:18:49,029 --> 00:18:46,960
the ways they've they've done funding uh

492
00:18:50,630 --> 00:18:49,039
for uh mission data analysis so we would

493
00:18:53,270 --> 00:18:50,640
hope there would be something like that

494
00:18:54,630 --> 00:18:53,280
um as well in the in the future so there

495
00:18:56,310 --> 00:18:54,640
should be there should be opportunities

496
00:18:58,789 --> 00:18:56,320
and we'll keep working with nasa to uh

497
00:19:00,549 --> 00:18:58,799
to understand uh what what they'll be

498
00:19:02,150 --> 00:19:00,559
able to do on that side

499
00:19:03,510 --> 00:19:02,160
great thank you

500
00:19:05,270 --> 00:19:03,520
all right let's jump to the other side

501
00:19:06,950 --> 00:19:05,280
of the room

502
00:19:09,110 --> 00:19:06,960
my name is garrett roberts pigman i'm a

503
00:19:10,310 --> 00:19:09,120
postdoc at ames research center i was

504
00:19:11,750 --> 00:19:10,320
wondering if you could speak a little

505
00:19:14,549 --> 00:19:11,760
bit more about

506
00:19:16,710 --> 00:19:14,559
limits on the upper bounds of molecular

507
00:19:18,390 --> 00:19:16,720
sizes that can be definitively

508
00:19:22,870 --> 00:19:18,400
identified by the mass vector and other

509
00:19:25,350 --> 00:19:23,830
sorry i just want to make sure i

510
00:19:26,870 --> 00:19:25,360
understood the question did you ask

511
00:19:29,430 --> 00:19:26,880
about like the mass range of the mass

512
00:19:32,310 --> 00:19:29,440
spectrometer yes okay sure yeah

513
00:19:33,510 --> 00:19:32,320

so the mass spectrometer operates in um

514
00:19:35,909 --> 00:19:33,520
two different modes when we're looking

515
00:19:37,909 --> 00:19:35,919
at solid signals that we're analyzing

516
00:19:40,950 --> 00:19:37,919
from the surface one of these is a laser

517
00:19:41,830 --> 00:19:40,960
absorption and ionization mode and in

518
00:19:42,710 --> 00:19:41,840
that

519
00:19:45,190 --> 00:19:42,720
we

520
00:19:48,390 --> 00:19:45,200
um have a requirement to measure up to

521
00:19:49,909 --> 00:19:48,400
550 daltons mass units but we actually

522
00:19:51,590 --> 00:19:49,919
um right now we're showing performance

523
00:19:53,590 --> 00:19:51,600
up to almost 2000

524
00:19:56,230 --> 00:19:53,600
and so we'll have a very wide mass range

525
00:19:57,669 --> 00:19:56,240
we expect to be able to probe um

526
00:19:59,430 --> 00:19:57,679
with the surface samples and they would

527
00:20:00,870 --> 00:19:59,440
be minimally processed just processed by

528
00:20:01,750 --> 00:20:00,880
the sampling system and delivered to us

529
00:20:03,029 --> 00:20:01,760
and then we'll be looking at the

530
00:20:05,669 --> 00:20:03,039
molecules that are that are in those

531
00:20:07,110 --> 00:20:05,679
samples when we operate in our

532
00:20:08,710 --> 00:20:07,120
gas chromatography mode is our other

533
00:20:10,470 --> 00:20:08,720
mode gcms and that's where we can do a

534
00:20:12,310 --> 00:20:10,480
more selective separation of some of the

535
00:20:14,950 --> 00:20:12,320
compounds we find looking for things

536
00:20:16,870 --> 00:20:14,960
like amino acids and separating um

537
00:20:18,549 --> 00:20:16,880
perhaps chiral pairs and in that case we

538
00:20:20,470 --> 00:20:18,559

have a lower mass range but that's

539
00:20:21,590 --> 00:20:20,480
partly imposed not just by the mass

540
00:20:23,270 --> 00:20:21,600
spectrometer actually but just the

541
00:20:25,029 --> 00:20:23,280
ability to get molecules through the gas

542
00:20:27,190 --> 00:20:25,039
pressure system and they have to be

543
00:20:29,590 --> 00:20:27,200
volatile enough to sail through and then

544
00:20:31,029 --> 00:20:29,600
again there's a requirement about 260

545
00:20:32,830 --> 00:20:31,039
daltons but a capability that goes up

546
00:20:37,029 --> 00:20:32,840
above depending on the compounds that we

547
00:20:40,789 --> 00:20:39,029
please

548
00:20:43,190 --> 00:20:40,799
uh hi my name is louis chao i'm a

549
00:20:45,590 --> 00:20:43,200
postdoc at nasa goddard and my question

550
00:20:47,430 --> 00:20:45,600
is so i understand that dragonfly is not

551
00:20:48,870 --> 00:20:47,440
supposed to be a life detection mission

552
00:20:51,830 --> 00:20:48,880
um but i couldn't help noticing that one

553
00:20:53,669 --> 00:20:51,840
of the objectives states that uh uh to

554
00:20:55,830 --> 00:20:53,679
search or understand the potential

555
00:20:57,990 --> 00:20:55,840
existence of

556
00:21:00,390 --> 00:20:58,000
hydrocarbon-based life uh could you

557
00:21:01,110 --> 00:21:00,400
speak a little bit more about um

558
00:21:06,950 --> 00:21:01,120
the

559
00:21:09,669 --> 00:21:06,960
affected or how that's going to affect

560
00:21:11,270 --> 00:21:09,679
what you're going to see uh depending on

561
00:21:13,270 --> 00:21:11,280
where this potential hydrocarbon based

562
00:21:15,190 --> 00:21:13,280
life could be because i would imagine

563
00:21:17,669 --> 00:21:15,200

them existing in the lakes and we're not

564
00:21:19,510 --> 00:21:17,679
going to the lakes um and how you

565
00:21:21,830 --> 00:21:19,520
interpret the data that could be coming

566
00:21:23,510 --> 00:21:21,840
from these potential really exotic

567
00:21:24,470 --> 00:21:23,520
biosignatures which is super super

568
00:21:27,110 --> 00:21:24,480
interesting

569
00:21:30,390 --> 00:21:27,120
do you want to take that jason

570
00:21:32,230 --> 00:21:30,400
um sure so uh you're right in that

571
00:21:34,470 --> 00:21:32,240
presumably any any hydrocarbon-based

572
00:21:36,710 --> 00:21:34,480
life is going to be uh primarily based

573
00:21:39,110 --> 00:21:36,720
in the lakes um we will be sampling the

574
00:21:40,149 --> 00:21:39,120
sand dunes which are a primary organic

575
00:21:42,149 --> 00:21:40,159
sink

576
00:21:43,669 --> 00:21:42,159
for titan a lot of the organics that are

577
00:21:45,669 --> 00:21:43,679
produced in the atmosphere and are

578
00:21:47,590 --> 00:21:45,679
processed in some way in order to

579
00:21:49,350 --> 00:21:47,600
produce those sand dunes and they in

580
00:21:51,830 --> 00:21:49,360
fact may be processed within the lakes

581
00:21:53,350 --> 00:21:51,840
themselves either by coagulating smaller

582
00:21:55,830 --> 00:21:53,360
particles or

583
00:21:59,270 --> 00:21:57,750
producing evaporites and then blowing

584
00:22:00,870 --> 00:21:59,280
them around so

585
00:22:02,310 --> 00:22:00,880
you're right that we won't be directly

586
00:22:04,390 --> 00:22:02,320
sampling the lakes but we will be

587
00:22:06,149 --> 00:22:04,400
sampling a lot of the organic material

588
00:22:08,149 --> 00:22:06,159

and in fact the bulk of the organic

589
00:22:10,789 --> 00:22:08,159
material that's been on titan and that

590
00:22:13,430 --> 00:22:10,799
may be able to allow us to sort of

591
00:22:15,430 --> 00:22:13,440
provide a remote sampling essentially uh

592
00:22:16,870 --> 00:22:15,440
by able to by sampling those sand dunes

593
00:22:19,270 --> 00:22:16,880
now we don't know that they come from

594
00:22:22,549 --> 00:22:19,280
the lakes but uh once we measure them we

595
00:22:23,590 --> 00:22:22,559
hope to to know the answer after that

596
00:22:26,390 --> 00:22:23,600
um

597
00:22:28,630 --> 00:22:26,400
briefly uh i did want to talk to one of

598
00:22:29,830 --> 00:22:28,640
the reasons we're not going to the uh

599
00:22:32,630 --> 00:22:29,840
the lakes and seas because they're

600
00:22:34,390 --> 00:22:32,640
obviously a really fascinating target

601
00:22:37,029 --> 00:22:34,400
um

602
00:22:39,110 --> 00:22:37,039
if you noticed in the video the uh you

603
00:22:41,830 --> 00:22:39,120
saw the high gain antenna deploy

604
00:22:43,909 --> 00:22:41,840
um for because we don't have

605
00:22:46,310 --> 00:22:43,919
a fleet of orbiters that tighten sadly

606
00:22:48,310 --> 00:22:46,320
the way we do at mars dragonfly does

607
00:22:49,830 --> 00:22:48,320
director of communication from the

608
00:22:51,190 --> 00:22:49,840
surface of titan

609
00:22:53,669 --> 00:22:51,200
um

610
00:22:56,470 --> 00:22:53,679
and at the time of year when we will

611
00:22:57,750 --> 00:22:56,480
arrive it will be northern winter

612
00:22:58,549 --> 00:22:57,760
so

613
00:23:15,750 --> 00:22:58,559

the

614
00:23:18,549 --> 00:23:15,760
north pole this season on titan so this

615
00:23:19,750 --> 00:23:18,559
gives us access to this this destination

616
00:23:21,590 --> 00:23:19,760
at the

617
00:23:23,750 --> 00:23:21,600
lower latitudes gives us access to a

618
00:23:26,390 --> 00:23:23,760
crater where water and organics may have

619
00:23:28,630 --> 00:23:26,400
mixed um but but as jason alluded to

620
00:23:30,630 --> 00:23:28,640
we're kind of depending on the transport

621
00:23:33,190 --> 00:23:30,640
of materials that may contain

622
00:23:37,350 --> 00:23:33,200
biosignatures from other places on titan

623
00:23:39,110 --> 00:23:37,360
uh for possible based systems but also

624
00:23:42,230 --> 00:23:39,120
but also just understanding you know

625
00:23:44,149 --> 00:23:42,240
what materials are available for

626
00:23:45,669 --> 00:23:44,159
chemistry you know whatever prefix you

627
00:23:47,669 --> 00:23:45,679
want to put on that on the surface of

628
00:23:49,990 --> 00:23:47,679
titan we don't know that yet

629
00:23:52,149 --> 00:23:50,000
we we will in the 2030s but we don't

630
00:23:54,950 --> 00:23:52,159
know it yet and so providing that really

631
00:23:56,950 --> 00:23:54,960
critical input on um you know what's

632
00:23:59,269 --> 00:23:56,960
available to play with on the surface i

633
00:24:04,070 --> 00:23:59,279
think will have implications even

634
00:24:06,149 --> 00:24:04,080
um tens of degrees latitude southward

635
00:24:08,549 --> 00:24:06,159
thank you

636
00:24:11,430 --> 00:24:08,559
great we'll come over here

637
00:24:13,430 --> 00:24:11,440
hi ben hurwitz georgia tech um

638
00:24:15,510 --> 00:24:13,440

i'm you mentioned something about

639
00:24:17,590 --> 00:24:15,520
atmospheric and sampling atmosphere

640
00:24:19,669 --> 00:24:17,600
sampling the atmosphere

641
00:24:21,590 --> 00:24:19,679
how high is dragonfly going and is there

642
00:24:22,870 --> 00:24:21,600
capability of actually sampling while

643
00:24:25,269 --> 00:24:22,880
you're flying

644
00:24:27,190 --> 00:24:25,279
at 90.

645
00:24:28,789 --> 00:24:27,200
um so

646
00:24:30,870 --> 00:24:28,799
there are different aspects of the

647
00:24:33,990 --> 00:24:30,880
atmosphere that we'll be measuring so we

648
00:24:36,630 --> 00:24:34,000
can do with the uh with the meteorology

649
00:24:39,029 --> 00:24:36,640
sensors we'll be able to do measurements

650
00:24:41,110 --> 00:24:39,039
in flight um

651
00:24:44,070 --> 00:24:41,120
and we actually intend to do some

652
00:24:45,430 --> 00:24:44,080
profiling flights to get measurements at

653
00:24:48,149 --> 00:24:45,440
different altitudes in the lower

654
00:24:51,590 --> 00:24:48,159
atmosphere those will only go up to

655
00:24:54,149 --> 00:24:51,600
an altitude of a few kilometers um

656
00:24:55,750 --> 00:24:54,159
because the primary goal of the mission

657
00:24:57,350 --> 00:24:55,760
isn't the the atmospheric sampling but

658
00:24:59,029 --> 00:24:57,360
of course it's fascinating and something

659
00:25:00,870 --> 00:24:59,039
we want to try to do even if it's at the

660
00:25:02,789 --> 00:25:00,880
lower part of the atmosphere but in

661
00:25:05,750 --> 00:25:02,799
terms of measuring the

662
00:25:07,750 --> 00:25:05,760
uh the noble gases the atmospheric inlet

663
00:25:11,669 --> 00:25:07,760

uh to the drams instrument those

664
00:25:17,269 --> 00:25:15,190
did that answer the question

665
00:25:19,590 --> 00:25:17,279
thanks turn it over to this side of the

666
00:25:22,549 --> 00:25:19,600
room hi i'm martin rohn at child merch

667
00:25:23,750 --> 00:25:22,559
university i was i have an engineering

668
00:25:25,750 --> 00:25:23,760
question actually

669
00:25:27,669 --> 00:25:25,760
i was hoping you could speak to the

670
00:25:30,470 --> 00:25:27,679
degree of automation that will be

671
00:25:32,630 --> 00:25:30,480
engineered into dragonfly how will it be

672
00:25:34,549 --> 00:25:32,640
responding in case it loses contact or

673
00:25:37,830 --> 00:25:34,559
if it's sense that it's it's about to

674
00:25:39,750 --> 00:25:37,840
tip over or sync or something

675
00:25:41,269 --> 00:25:39,760
ken did you hear the question

676
00:25:44,390 --> 00:25:41,279
i did um

677
00:25:46,710 --> 00:25:44,400
so we we use some level of autonomy when

678
00:25:49,110 --> 00:25:46,720
we fly the system right so the

679
00:25:51,990 --> 00:25:49,120
round-trip light time to tighten could

680
00:25:54,230 --> 00:25:52,000
be as long as three hours so obviously

681
00:25:55,029 --> 00:25:54,240
when we're traversing on the surface you

682
00:25:57,269 --> 00:25:55,039
can't

683
00:25:59,750 --> 00:25:57,279
fly by joystick and so the system has to

684
00:26:00,870 --> 00:25:59,760
be able to autonomously move from point

685
00:26:04,549 --> 00:26:00,880
to point

686
00:26:07,149 --> 00:26:04,559
um it has a predefined flight sequence

687
00:26:10,310 --> 00:26:07,159
if you will and the ground will load up

688
00:26:13,350 --> 00:26:10,320

destinations uh cruise altitude things

689
00:26:16,549 --> 00:26:13,360
like that and so then the system largely

690
00:26:19,029 --> 00:26:16,559
executes that that onboard uh flight

691
00:26:22,390 --> 00:26:19,039
plan that has been kind of rehearsed and

692
00:26:24,390 --> 00:26:22,400
tested and verified on the ground um so

693
00:26:26,789 --> 00:26:24,400
i view it as a set of parameters that

694
00:26:28,950 --> 00:26:26,799
you upload flight to flight but then in

695
00:26:30,390 --> 00:26:28,960
general we execute a very similar flight

696
00:26:31,269 --> 00:26:30,400
plan every time

697
00:26:34,549 --> 00:26:31,279
um

698
00:26:37,350 --> 00:26:34,559
the navigation is done with image to

699
00:26:40,070 --> 00:26:37,360
image correlation so because we don't

700
00:26:44,470 --> 00:26:40,080
have a detailed dem of the titan surface

701
00:26:46,630 --> 00:26:44,480
a priori um we we track features in one

702
00:26:48,549 --> 00:26:46,640
image and compare it to features in a

703
00:26:50,070 --> 00:26:48,559
subsequent image where there's overlap

704
00:26:53,909 --> 00:26:50,080
and so we use that image to image

705
00:26:54,710 --> 00:26:53,919
correlation to navigate um our goal is

706
00:26:57,510 --> 00:26:54,720
um

707
00:26:59,990 --> 00:26:57,520
kind of bulk navigation not precision so

708
00:27:02,549 --> 00:27:00,000
perhaps an analogy for anybody who's a

709
00:27:04,390 --> 00:27:02,559
small aircraft pilot uh often when

710
00:27:06,310 --> 00:27:04,400
you're learning to fly you navigate by

711
00:27:07,909 --> 00:27:06,320
following a highway beneath you it

712
00:27:09,590 --> 00:27:07,919
doesn't really matter if you're to the

713
00:27:11,110 --> 00:27:09,600

right of the highway or the left of the

714
00:27:13,029 --> 00:27:11,120
highway you just want to know that

715
00:27:16,149 --> 00:27:13,039
you're going in the right general

716
00:27:18,870 --> 00:27:16,159
direction and when we look to land

717
00:27:21,190 --> 00:27:18,880
we use both the the onboard cameras and

718
00:27:23,909 --> 00:27:21,200
the lidar system to look for a safe

719
00:27:26,710 --> 00:27:23,919
landing zone which we've defined as a

720
00:27:29,830 --> 00:27:26,720
slope less than 10 degrees and

721
00:27:32,870 --> 00:27:29,840
um eight to ten meters diameter

722
00:27:34,710 --> 00:27:32,880
uh absent of any hazards where hazard is

723
00:27:36,070 --> 00:27:34,720
anything larger than a quarter meter

724
00:27:36,950 --> 00:27:36,080
scale rock

725
00:27:39,830 --> 00:27:36,960
um

726
00:27:41,350 --> 00:27:39,840
and in terms of landing precision

727
00:27:43,669 --> 00:27:41,360
imagine you're landing in an empty

728
00:27:45,590 --> 00:27:43,679
parking lot we want to set down safely

729
00:27:48,310 --> 00:27:45,600
in the parking lot i don't care what

730
00:27:50,710 --> 00:27:48,320
specific spot i'm in if that makes sense

731
00:27:52,549 --> 00:27:50,720
as long as it meets our safety criteria

732
00:27:55,430 --> 00:27:52,559
um and so that that's in terms of the

733
00:27:58,230 --> 00:27:55,440
surface navigation um the rest of the

734
00:27:59,830 --> 00:27:58,240
operations take place when we are on the

735
00:28:03,029 --> 00:27:59,840
surface stable

736
00:28:05,750 --> 00:28:03,039
and so they're really similar to most

737
00:28:08,470 --> 00:28:05,760
any other robotic mission um there'll be

738
00:28:11,750 --> 00:28:08,480

a set of on-board pre-loaded time tag

739
00:28:13,990 --> 00:28:11,760
sequences and those will execute macros

740
00:28:16,310 --> 00:28:14,000
within the different instruments and

741
00:28:18,389 --> 00:28:16,320
between the different instruments that

742
00:28:20,710 --> 00:28:18,399
coordinate specific measurements and

743
00:28:22,950 --> 00:28:20,720
activities on board the lander happening

744
00:28:25,590 --> 00:28:22,960
on a time-based system

745
00:28:26,549 --> 00:28:25,600
we do have an autonomy rule engine on

746
00:28:28,950 --> 00:28:26,559
board

747
00:28:30,789 --> 00:28:28,960
this is derived from our historical

748
00:28:33,430 --> 00:28:30,799
autonomy system we've used on a lot of

749
00:28:35,990 --> 00:28:33,440
our past missions which is a set of

750
00:28:37,990 --> 00:28:36,000
onboard monitoring we track telemetry

751
00:28:40,230 --> 00:28:38,000
and and all the data indicators we have

752
00:28:42,310 --> 00:28:40,240
in the vehicle and then when we detect

753
00:28:44,549 --> 00:28:42,320
anomalous behavior there's a set of

754
00:28:47,990 --> 00:28:44,559
predefined responses that are also done

755
00:28:48,950 --> 00:28:48,000
via command macros um

756
00:28:51,110 --> 00:28:48,960
so

757
00:28:52,950 --> 00:28:51,120
that's largely the extent of the

758
00:28:54,870 --> 00:28:52,960
automation we have

759
00:28:57,590 --> 00:28:54,880
and then there are safeguards in the

760
00:29:00,149 --> 00:28:57,600
design to prevent things like tipping

761
00:29:02,549 --> 00:29:00,159
over or things like that um it's not so

762
00:29:04,549 --> 00:29:02,559
much a real time response it's more

763
00:29:06,470 --> 00:29:04,559

making sure the design

764
00:29:08,870 --> 00:29:06,480
ahead of time is robust to those kinds

765
00:29:11,029 --> 00:29:08,880
of threats or faults

766
00:29:13,350 --> 00:29:11,039
okay thank you but if it loses contact

767
00:29:14,870 --> 00:29:13,360
it won't fly back or something to it

768
00:29:17,029 --> 00:29:14,880
previously no

769
00:29:20,789 --> 00:29:17,039
we don't need contact with the earth

770
00:29:23,669 --> 00:29:20,799
during the surface flights we intend to

771
00:29:25,430 --> 00:29:23,679
have contact on a best effort basis

772
00:29:27,669 --> 00:29:25,440
mostly because there are critical events

773
00:29:29,190 --> 00:29:27,679
to us and we want to have monitoring but

774
00:29:31,750 --> 00:29:29,200
communications with the earth is not

775
00:29:34,630 --> 00:29:31,760
required during the surface flights and

776
00:29:36,870 --> 00:29:34,640
again once we land on the surface

777
00:29:39,510 --> 00:29:36,880
if we lose contact with the earth we

778
00:29:42,149 --> 00:29:39,520
have a scheme on board

779
00:29:43,110 --> 00:29:42,159
to search for signal coming from the

780
00:29:45,590 --> 00:29:43,120
earth

781
00:29:48,710 --> 00:29:45,600
and worst case if we lose all knowledge

782
00:29:50,630 --> 00:29:48,720
of our uh inertial reference position uh

783
00:29:52,149 --> 00:29:50,640
the earth is largely co-aligned with the

784
00:29:53,750 --> 00:29:52,159
sun so if we can figure out where the

785
00:29:55,990 --> 00:29:53,760
sun is we can figure out where the earth

786
00:29:57,430 --> 00:29:56,000
is and re-establish calm

787
00:29:58,630 --> 00:29:57,440
thank you

788
00:30:00,310 --> 00:29:58,640

thanks

789
00:30:03,190 --> 00:30:00,320
all right take it away mike hey mike

790
00:30:04,389 --> 00:30:03,200
malaska jpl so i had a question on the

791
00:30:06,630 --> 00:30:04,399
the dune

792
00:30:07,750 --> 00:30:06,640
growth mechanisms that y'all were

793
00:30:10,310 --> 00:30:07,760
investigating

794
00:30:12,149 --> 00:30:10,320
so one of the questions that we

795
00:30:15,029 --> 00:30:12,159
titan community was whether it was how

796
00:30:16,630 --> 00:30:15,039
the dunes uh sands grow

797
00:30:18,950 --> 00:30:16,640
and whether they were all like tiny

798
00:30:20,630 --> 00:30:18,960
little chunks of a major corroded piece

799
00:30:22,230 --> 00:30:20,640
or if they were somehow coated and you

800
00:30:23,669 --> 00:30:22,240
had like a series of concentric layers

801
00:30:25,590 --> 00:30:23,679
being built up

802
00:30:27,510 --> 00:30:25,600
in your sampling system

803
00:30:30,070 --> 00:30:27,520
do you have a way to be able to

804
00:30:32,470 --> 00:30:30,080
deconvolve um those two possibilities

805
00:30:34,630 --> 00:30:32,480
like do you have the ability to do like

806
00:30:40,549 --> 00:30:34,640
hold onto a grain and do successive

807
00:30:43,110 --> 00:30:42,149
so i'll answer the part about the

808
00:30:44,389 --> 00:30:43,120
sampling system and the mass

809
00:30:46,710 --> 00:30:44,399
spectrometer and then i'll let other

810
00:30:48,149 --> 00:30:46,720
people weigh in on the kind of imaging

811
00:30:50,310 --> 00:30:48,159
and other measurements that we can do to

812
00:30:53,029 --> 00:30:50,320
help with this question uh so the short

813
00:30:56,230 --> 00:30:53,039

answer is is no so the way the sampling

814
00:30:59,350 --> 00:30:56,240
system works is that um we either ingest

815
00:31:00,870 --> 00:30:59,360
already you know particulate matter or

816
00:31:02,549 --> 00:31:00,880
um we use the rotary progressive field

817
00:31:05,590 --> 00:31:02,559
to generate particulate matter that then

818
00:31:07,909 --> 00:31:05,600
gets pneumatically transferred into the

819
00:31:10,870 --> 00:31:07,919
the sampling cup and so we're not

820
00:31:13,430 --> 00:31:10,880
presenting like a fresh rock face or or

821
00:31:14,630 --> 00:31:13,440
a core right but we're already sort of

822
00:31:16,630 --> 00:31:14,640
homogenized

823
00:31:19,590 --> 00:31:16,640
to some extent and so

824
00:31:20,870 --> 00:31:19,600
we do are we are looking for variation

825
00:31:22,389 --> 00:31:20,880
in the sample when we do laser

826
00:31:24,789 --> 00:31:22,399
absorption mass spectrometry but we

827
00:31:26,630 --> 00:31:24,799
won't be correlating it with the spatial

828
00:31:27,990 --> 00:31:26,640
um information in the sample so much as

829
00:31:29,750 --> 00:31:28,000
it will be we'll just kind of scan

830
00:31:31,190 --> 00:31:29,760
across the face that is in front of us

831
00:31:32,950 --> 00:31:31,200
just to look for

832
00:31:34,789 --> 00:31:32,960
variations without being able to

833
00:31:36,549 --> 00:31:34,799
correlate it to a location a particular

834
00:31:37,590 --> 00:31:36,559
you know depth or something depth

835
00:31:39,750 --> 00:31:37,600
profile

836
00:31:41,110 --> 00:31:39,760
um so that's the answer about the

837
00:31:43,190 --> 00:31:41,120
sampling system but there's other things

838
00:31:44,870 --> 00:31:43,200

that we can do to learn about the dunes

839
00:31:47,509 --> 00:31:44,880
so

840
00:31:49,669 --> 00:31:47,519
yeah our microscopic imager will have

841
00:31:51,909 --> 00:31:49,679
very small pixels um and we'll be able

842
00:31:53,590 --> 00:31:51,919
to resolve individual sand grains and so

843
00:31:55,830 --> 00:31:53,600
we hope to at least be able to see their

844
00:31:58,549 --> 00:31:55,840
their their size uh whether or not

845
00:31:59,990 --> 00:31:58,559
they're uh built from you know uh

846
00:32:02,070 --> 00:32:00,000
smaller material or there were their

847
00:32:04,070 --> 00:32:02,080
symbolistic chunks and uh their

848
00:32:05,590 --> 00:32:04,080
roundedness to try to ascertain how long

849
00:32:07,590 --> 00:32:05,600
they how far they may have traveled so

850
00:32:09,029 --> 00:32:07,600
that's how we're going to try to get a a

851
00:32:11,190 --> 00:32:09,039
handle on what you're doing

852
00:32:12,789 --> 00:32:11,200
and the gamma and neutron spectrometer

853
00:32:14,950 --> 00:32:12,799
will give us the bulk elemental

854
00:32:18,070 --> 00:32:14,960
composition and so with the context of

855
00:32:21,190 --> 00:32:18,080
the other information we may be able to

856
00:32:23,909 --> 00:32:21,200
uh to understand aspects of that as well

857
00:32:25,430 --> 00:32:23,919
so if we're in a situation for example

858
00:32:27,430 --> 00:32:25,440
where there's

859
00:32:29,430 --> 00:32:27,440
organic material mantling

860
00:32:31,269 --> 00:32:29,440
water ice we may be able to measure you

861
00:32:33,430 --> 00:32:31,279
know the shallow depth to that water ice

862
00:32:34,549 --> 00:32:33,440
but if we know we're on a deep length of

863
00:32:36,630 --> 00:32:34,559

sand

864
00:32:38,789 --> 00:32:36,640
and we're still seeing water ice then

865
00:32:41,430 --> 00:32:38,799
that would be indicative that there are

866
00:32:42,870 --> 00:32:41,440
water ice cores for example in the sand

867
00:32:44,549 --> 00:32:42,880
grain so there are a number of ways we

868
00:32:46,710 --> 00:32:44,559
have that getting at it but it's going

869
00:32:49,509 --> 00:32:46,720
to be a um it's going to be kind of a

870
00:32:51,909 --> 00:32:49,519
systemic uh process to combine the

871
00:32:54,789 --> 00:32:51,919
different data sets

872
00:32:57,029 --> 00:32:54,799
so so um with your imaging system if you

873
00:32:58,310 --> 00:32:57,039
did see like some uh some of the grains

874
00:33:00,070 --> 00:32:58,320
have been chipped and revealing the

875
00:33:01,590 --> 00:33:00,080
coating about what's the resolution

876
00:33:05,190 --> 00:33:01,600
scale of a coating that you'd be able to

877
00:33:08,789 --> 00:33:07,110
the resolution of the microscope i mean

878
00:33:09,909 --> 00:33:08,799
we don't actually i mean if it's a

879
00:33:11,509 --> 00:33:09,919
coating it's going to be everywhere

880
00:33:13,590 --> 00:33:11,519
right you have to cross-section it i'm

881
00:33:16,149 --> 00:33:13,600
trying to the chip if you if you somehow

882
00:33:17,029 --> 00:33:16,159
had a cross-section um

883
00:33:19,350 --> 00:33:17,039
you know

884
00:33:21,269 --> 00:33:19,360
the pixels are going to be of order 60

885
00:33:25,110 --> 00:33:21,279
microns so

886
00:33:26,710 --> 00:33:25,120
you know 100 microns 100 uh 150 microns

887
00:33:28,470 --> 00:33:26,720
depending on what the you know the

888
00:33:30,630 --> 00:33:28,480

contrast is between the material inside

889
00:33:33,269 --> 00:33:30,640
of the material

890
00:33:36,710 --> 00:33:34,950
hi i'm francesca carey i'm from the

891
00:33:38,389 --> 00:33:36,720
university of flight manila can you

892
00:33:40,149 --> 00:33:38,399
speak a little closer into the mic is

893
00:33:42,630 --> 00:33:40,159
this better yes thank you great thank

894
00:33:45,269 --> 00:33:42,640
you uh francescary from the university

895
00:33:47,029 --> 00:33:45,279
of hawaii at manoa so if one of your

896
00:33:49,110 --> 00:33:47,039
primary interests is analyzing

897
00:33:50,310 --> 00:33:49,120
programmatic chemistry at the surface i

898
00:33:52,549 --> 00:33:50,320
was wondering if there's anything you're

899
00:33:54,630 --> 00:33:52,559
hoping to learn from dragonfly about how

900
00:33:57,590 --> 00:33:54,640
chemistry fundamentally operates in a

901
00:33:59,750 --> 00:33:57,600
cryogenic temperature regime to

902
00:34:01,509 --> 00:33:59,760
sort of understand how these periodic

903
00:34:03,990 --> 00:34:01,519
molecules of interest have changed over

904
00:34:07,750 --> 00:34:05,590
thanks that's a great question that i

905
00:34:09,109 --> 00:34:07,760
think melissa probably wants to answer

906
00:34:10,629 --> 00:34:09,119
i'm going to apologize i just want to

907
00:34:11,750 --> 00:34:10,639
apologize to everyone in the room i

908
00:34:13,270 --> 00:34:11,760
don't know i'm having a lot of trouble

909
00:34:15,750 --> 00:34:13,280
understanding some of the questions

910
00:34:17,750 --> 00:34:15,760
coming from the speakers um the audio at

911
00:34:19,510 --> 00:34:17,760
the table here is not great i think it's

912
00:34:21,589 --> 00:34:19,520
better for people online

913
00:34:23,589 --> 00:34:21,599

um so do you mind repeating the second

914
00:34:24,629 --> 00:34:23,599
half of like the the questions the

915
00:34:26,869 --> 00:34:24,639
question

916
00:34:29,190 --> 00:34:26,879
yes of course um so the second part of

917
00:34:31,829 --> 00:34:29,200
the question was how we might be able to

918
00:34:34,389 --> 00:34:31,839
better understand how chemistry itself

919
00:34:35,990 --> 00:34:34,399
operates at cryogenic temperatures so

920
00:34:37,750 --> 00:34:36,000
that we can better understand how the

921
00:34:40,069 --> 00:34:37,760
prebiotic chemistry and the molecules

922
00:34:42,790 --> 00:34:40,079
you're interested in have changed over

923
00:34:44,310 --> 00:34:42,800
time okay yes okay so um

924
00:34:45,510 --> 00:34:44,320
i'll give a little bit of an answer to

925
00:34:47,829 --> 00:34:45,520
that question i mean some of that has

926
00:34:50,069 --> 00:34:47,839
already come from scientific research

927
00:34:52,310 --> 00:34:50,079
that has taken place over decades that

928
00:34:54,470 --> 00:34:52,320
led us to the point to even you know

929
00:34:56,950 --> 00:34:54,480
hypothesize that we could see this kind

930
00:34:59,270 --> 00:34:56,960
of hydrolysis on the tightening surface

931
00:35:01,510 --> 00:34:59,280
if there are melt pools for example and

932
00:35:03,510 --> 00:35:01,520
the organics from the atmosphere can be

933
00:35:04,630 --> 00:35:03,520
hydrolyzed or react in other ways to

934
00:35:06,150 --> 00:35:04,640
form the kind of molecules we're

935
00:35:08,069 --> 00:35:06,160
interested in so a lot of that has come

936
00:35:11,510 --> 00:35:08,079
from laboratory-based work

937
00:35:12,790 --> 00:35:11,520
um and and i expect it to to continue um

938
00:35:13,990 --> 00:35:12,800

you know there's some projects looking

939
00:35:19,109 --> 00:35:14,000
at

940
00:35:21,109 --> 00:35:19,119
kind of chemistry do you expect in a

941
00:35:22,790 --> 00:35:21,119
melt pool of a crater environment for

942
00:35:24,390 --> 00:35:22,800
modeling and laboratory research

943
00:35:27,190 --> 00:35:24,400
understand how those things could uh

944
00:35:30,069 --> 00:35:27,200
form potentially um and then and then

945
00:35:32,069 --> 00:35:30,079
evolve i mean once the ice is frozen

946
00:35:34,069 --> 00:35:32,079
we're kind of assuming that that the

947
00:35:35,829 --> 00:35:34,079
molecules are then fairly static and are

948
00:35:37,430 --> 00:35:35,839
not continuing to degrade there's not

949
00:35:38,630 --> 00:35:37,440
really a lot of radiation or anything on

950
00:35:39,510 --> 00:35:38,640
the surface

951
00:35:41,349 --> 00:35:39,520
um

952
00:35:43,030 --> 00:35:41,359
and then other types of chemistries that

953
00:35:45,270 --> 00:35:43,040
could be taking place again a lot of

954
00:35:47,670 --> 00:35:45,280
what we're we're understanding is based

955
00:35:49,349 --> 00:35:47,680
on um laboratory research that has been

956
00:35:51,589 --> 00:35:49,359
going and it's very and will continue to

957
00:35:53,190 --> 00:35:51,599
go and it's very complementary

958
00:35:54,310 --> 00:35:53,200
oh you want to disturb more of this oh

959
00:35:56,310 --> 00:35:54,320
yeah i mean i'm going to pass it over to

960
00:35:58,790 --> 00:35:56,320
one of our co-authors who is happy to

961
00:35:59,829 --> 00:35:58,800
jump in and take over from beverly well

962
00:36:03,990 --> 00:35:59,839
you were

963
00:36:05,990 --> 00:36:04,000

don't think

964
00:36:08,230 --> 00:36:06,000
how's this is this better yeah great

965
00:36:09,270 --> 00:36:08,240
yeah you were doing a great job melissa

966
00:36:12,710 --> 00:36:09,280
but yeah there

967
00:36:16,310 --> 00:36:12,720
is a really impressive community of

968
00:36:18,710 --> 00:36:16,320
organic chemists cryogenic experts that

969
00:36:19,910 --> 00:36:18,720
are all working on a lot of laboratory

970
00:36:21,750 --> 00:36:19,920
experiments

971
00:36:24,390 --> 00:36:21,760
to be able to

972
00:36:26,790 --> 00:36:24,400
inform and interpret the data but as

973
00:36:28,310 --> 00:36:26,800
zippy pointed out a data analysis

974
00:36:30,630 --> 00:36:28,320
program to follow

975
00:36:33,190 --> 00:36:30,640
would be a really important component as

976
00:36:36,069 --> 00:36:33,200
well i'd also like to point out that we

977
00:36:37,589 --> 00:36:36,079
have a student investigator program that

978
00:36:39,910 --> 00:36:37,599
there's a deadline coming up i believe

979
00:36:41,910 --> 00:36:39,920
it's may 27th that program is more

980
00:36:44,150 --> 00:36:41,920
targeted for students who aren't already

981
00:36:45,670 --> 00:36:44,160
connected to a mission

982
00:36:47,910 --> 00:36:45,680
and would like to get that kind of

983
00:36:49,430 --> 00:36:47,920
experience um and

984
00:36:51,270 --> 00:36:49,440
some of the the

985
00:36:53,829 --> 00:36:51,280
research that we're doing as part of

986
00:36:55,589 --> 00:36:53,839
that program is to help inform

987
00:36:57,670 --> 00:36:55,599
some of those measurements

988
00:36:59,109 --> 00:36:57,680

thank you thanks morgan

989
00:37:01,030 --> 00:36:59,119
and just to further plug the guest

990
00:37:02,550 --> 00:37:01,040
investigator program if you are a

991
00:37:03,670 --> 00:37:02,560
graduate student

992
00:37:05,349 --> 00:37:03,680
without

993
00:37:06,870 --> 00:37:05,359
connections already to

994
00:37:10,310 --> 00:37:06,880
planetary science and planetary science

995
00:37:13,510 --> 00:37:10,320
missions if you go to the dragonfly

996
00:37:15,990 --> 00:37:13,520
team website so just google dragonfly

997
00:37:17,750 --> 00:37:16,000
titan um unfortunately you do have to

998
00:37:20,150 --> 00:37:17,760
add an extra qualifier because there are

999
00:37:22,069 --> 00:37:20,160
other dragonflies out there

1000
00:37:23,670 --> 00:37:22,079
and then at the top of the page it says

1001
00:37:26,630 --> 00:37:23,680
student opportunities and you'll get all

1002
00:37:29,670 --> 00:37:26,640
the information that you need there

1003
00:37:35,190 --> 00:37:31,750
hi uh brady o'connor from mcgill

1004
00:37:38,069 --> 00:37:35,200
university um i was just curious to know

1005
00:37:40,870 --> 00:37:38,079
how robust the drill is going to be

1006
00:37:42,710 --> 00:37:40,880
because you guys don't or we don't know

1007
00:37:44,630 --> 00:37:42,720
all the types of samples or the types of

1008
00:37:47,910 --> 00:37:44,640
material that we're going to discover so

1009
00:37:50,630 --> 00:37:47,920
how robust is that drill to be able to

1010
00:37:52,950 --> 00:37:50,640
get samples if let's say we see

1011
00:37:54,950 --> 00:37:52,960
you know water ice mixed with sand or

1012
00:37:57,430 --> 00:37:54,960
just a sand core like things like that i

1013
00:37:59,589 --> 00:37:57,440

was wondering if you could do that

1014
00:38:01,589 --> 00:37:59,599
that's a that's a great question and we

1015
00:38:03,589 --> 00:38:01,599
are very lucky to have

1016
00:38:05,750 --> 00:38:03,599
one of the representatives from our

1017
00:38:07,270 --> 00:38:05,760
drill team here catherine bywaters who

1018
00:38:08,950 --> 00:38:07,280
will help answer

1019
00:38:11,030 --> 00:38:08,960
because yeah we're

1020
00:38:12,550 --> 00:38:11,040
our fundamental question is what is on

1021
00:38:14,550 --> 00:38:12,560
the surface of titan

1022
00:38:15,670 --> 00:38:14,560
how do you design a drill when you don't

1023
00:38:17,270 --> 00:38:15,680
know what the surface is that you're

1024
00:38:19,910 --> 00:38:17,280
going to go sample take it away

1025
00:38:21,270 --> 00:38:19,920
catherine so honeybee has a great motto

1026
00:38:24,230 --> 00:38:21,280
that you test on can you step a little

1027
00:38:27,750 --> 00:38:25,829
okay

1028
00:38:29,990 --> 00:38:27,760
this better yeah thanks

1029
00:38:33,510 --> 00:38:30,000
so honeybee has a great motto test as

1030
00:38:35,510 --> 00:38:33,520
you fly so we do a lot of work uh with

1031
00:38:37,270 --> 00:38:35,520
different making different simulations

1032
00:38:39,430 --> 00:38:37,280
testing as well as testing with

1033
00:38:41,349 --> 00:38:39,440
everything that we can find here on

1034
00:38:44,150 --> 00:38:41,359
earth different types of basalts which

1035
00:38:46,550 --> 00:38:44,160
are are very difficult to drill into

1036
00:38:49,750 --> 00:38:46,560
uh so it really comes down to a lot of

1037
00:38:52,069 --> 00:38:49,760
testing in simulated bill as well as

1038
00:38:53,510 --> 00:38:52,079

other materials that are known to be

1039
00:38:55,910 --> 00:38:53,520
you know some of the hardest that you

1040
00:38:57,829 --> 00:38:55,920
find here on earth so

1041
00:38:58,630 --> 00:38:57,839
i think that's the long and the short of

1042
00:39:00,630 --> 00:38:58,640
it

1043
00:39:03,109 --> 00:39:00,640
so what if we encounter something that's

1044
00:39:05,349 --> 00:39:03,119
very hard well we test with basalt what

1045
00:39:07,910 --> 00:39:05,359
if we what if some of these organics are

1046
00:39:09,670 --> 00:39:07,920
kind of sticky well we add some oil and

1047
00:39:11,829 --> 00:39:09,680
some walnut shells together and see how

1048
00:39:14,230 --> 00:39:11,839
that hand gets handled by the draco

1049
00:39:17,670 --> 00:39:14,240
system

1050
00:39:21,190 --> 00:39:17,680
so it is being uh designed to be as uh

1051
00:39:23,589 --> 00:39:21,200
white as possible or right as as robust

1052
00:39:26,230 --> 00:39:23,599
as possible with all of the different

1053
00:39:29,349 --> 00:39:26,240
conditions that we can think of

1054
00:39:30,870 --> 00:39:29,359
like you said walnut shavings and and

1055
00:39:33,510 --> 00:39:30,880
different uh oils and different

1056
00:39:35,589 --> 00:39:33,520
materials to characterize how it's going

1057
00:39:38,790 --> 00:39:35,599
to handle and make sure that we can at

1058
00:39:41,349 --> 00:39:38,800
least require enough sample for analysis

1059
00:39:44,069 --> 00:39:41,359
thank you and i'll just add to that if i

1060
00:39:45,109 --> 00:39:44,079
may which is that we um also have a lot

1061
00:39:47,910 --> 00:39:45,119
of

1062
00:39:50,150 --> 00:39:47,920
we're going to be doing before we even

1063
00:39:52,230 --> 00:39:50,160

make the decision to drill and if we

1064
00:39:53,910 --> 00:39:52,240
suspect that there is a material that is

1065
00:39:56,470 --> 00:39:53,920
there that is maybe you know too sticky

1066
00:39:57,990 --> 00:39:56,480
and would completely gum up the drill or

1067
00:39:59,990 --> 00:39:58,000
if we do it we're going to do a pilot

1068
00:40:02,470 --> 00:40:00,000
drill hole if we do decide to move

1069
00:40:04,309 --> 00:40:02,480
forward and if and if we get data back

1070
00:40:06,630 --> 00:40:04,319
that indicates that maybe that that

1071
00:40:08,630 --> 00:40:06,640
surface is you know out of the bounds of

1072
00:40:09,990 --> 00:40:08,640
what we had imagined and therefore might

1073
00:40:11,670 --> 00:40:10,000
be problematic you know we're not

1074
00:40:13,910 --> 00:40:11,680
required to drill at every single

1075
00:40:15,510 --> 00:40:13,920
location and so we'll also be making

1076
00:40:18,550 --> 00:40:15,520
those decisions the ground in the loop

1077
00:40:19,589 --> 00:40:18,560
as to whether or not a sample you know

1078
00:40:21,589 --> 00:40:19,599
we're going to be able to drill in a

1079
00:40:23,750 --> 00:40:21,599
sample and also another good point is we

1080
00:40:26,630 --> 00:40:23,760
have two right so there's two throws so

1081
00:40:27,589 --> 00:40:26,640
if one does fail it's not we have a

1082
00:40:29,430 --> 00:40:27,599
backup

1083
00:40:32,950 --> 00:40:29,440
sorry just quickly how deep will the

1084
00:40:34,950 --> 00:40:32,960
drill be able to get samples from

1085
00:40:36,309 --> 00:40:34,960
i think that's six centimeters

1086
00:40:38,630 --> 00:40:36,319
like below the

1087
00:40:43,109 --> 00:40:38,640
skin that you see okay so still still

1088
00:40:43,119 --> 00:40:46,950

thanks

1089
00:40:51,030 --> 00:40:48,630
uh hi

1090
00:40:52,790 --> 00:40:51,040
christoph richmond from stone aerospace

1091
00:40:55,349 --> 00:40:52,800
uh i was wondering uh what kind of

1092
00:40:57,190 --> 00:40:55,359
weather we expect on titan and can

1093
00:40:58,710 --> 00:40:57,200
dragonfly handle a rainstorm or a

1094
00:41:01,349 --> 00:40:58,720
sandstorm

1095
00:41:04,069 --> 00:41:01,359
uh right so we we absolutely have to be

1096
00:41:08,470 --> 00:41:04,079
aware of the titan weather uh titan's

1097
00:41:09,270 --> 00:41:08,480
year is 29 and a half years long

1098
00:41:10,790 --> 00:41:09,280
and

1099
00:41:12,870 --> 00:41:10,800
with cassini

1100
00:41:15,270 --> 00:41:12,880
when cassini was in orbit around saturn

1101
00:41:16,230 --> 00:41:15,280
it got to observe the seasonal cycle on

1102
00:41:19,349 --> 00:41:16,240
titan

1103
00:41:21,030 --> 00:41:19,359
for 13 years so we saw almost half of a

1104
00:41:23,510 --> 00:41:21,040
titan year

1105
00:41:25,430 --> 00:41:23,520
dragonfly will be arriving

1106
00:41:27,190 --> 00:41:25,440
basically one titan year

1107
00:41:30,069 --> 00:41:27,200
after the beginning of the cassini

1108
00:41:31,829 --> 00:41:30,079
mission and when cassini arrived it was

1109
00:41:34,150 --> 00:41:31,839
uh southern summer when dragonfly

1110
00:41:37,109 --> 00:41:34,160
arrives it will be southern summer so at

1111
00:41:40,390 --> 00:41:37,119
that season most of the cloud activity

1112
00:41:43,510 --> 00:41:40,400
um was at the south pole and so we'll be

1113
00:41:44,630 --> 00:41:43,520

at the the low latitudes we did not see

1114
00:41:46,390 --> 00:41:44,640
weather

1115
00:41:49,349 --> 00:41:46,400
cloud systems or rain

1116
00:41:51,430 --> 00:41:49,359
near the low latitudes until a year

1117
00:41:52,470 --> 00:41:51,440
after the northern vernal equinox with

1118
00:41:55,750 --> 00:41:52,480
cassini

1119
00:41:59,109 --> 00:41:55,760
so we wouldn't expect there to be

1120
00:42:00,790 --> 00:41:59,119
uh clouds or rain or storms

1121
00:42:03,990 --> 00:42:00,800
at these la at the latitudes we're

1122
00:42:05,750 --> 00:42:04,000
exploring until several years after we

1123
00:42:08,069 --> 00:42:05,760
arrive

1124
00:42:10,550 --> 00:42:08,079
but weather doesn't always do what you

1125
00:42:12,710 --> 00:42:10,560
know it's predicted to do um and so we

1126
00:42:16,870 --> 00:42:12,720
do need to make sure that the dragonfly

1127
00:42:20,710 --> 00:42:16,880
as a system is robust to methane rain um

1128
00:42:22,710 --> 00:42:20,720
etc if uh if it uh you know were to to

1129
00:42:23,910 --> 00:42:22,720
rain while we're uh during the nominal

1130
00:42:26,950 --> 00:42:23,920
mission

1131
00:42:28,710 --> 00:42:26,960
the flights themselves are short

1132
00:42:32,309 --> 00:42:28,720
we uh i didn't i don't think i've got

1133
00:42:34,870 --> 00:42:32,319
into this in the um in the overview but

1134
00:42:36,309 --> 00:42:34,880
the plan is to fly basically every other

1135
00:42:38,390 --> 00:42:36,319
titan day

1136
00:42:40,950 --> 00:42:38,400
which is once a month

1137
00:42:42,150 --> 00:42:40,960
and the flight itself will be about 30

1138
00:42:42,950 --> 00:42:42,160

minutes

1139
00:42:44,390 --> 00:42:42,960
um

1140
00:42:45,510 --> 00:42:44,400
so

1141
00:42:47,190 --> 00:42:45,520
we can

1142
00:42:48,710 --> 00:42:47,200
change that depending you know if it

1143
00:42:49,510 --> 00:42:48,720
turned out that the you know that there

1144
00:42:51,829 --> 00:42:49,520
were

1145
00:42:54,790 --> 00:42:51,839
that the the weather sensors indicated

1146
00:42:56,550 --> 00:42:54,800
there was rain or you know high wind or

1147
00:42:58,630 --> 00:42:56,560
something like that we wouldn't we

1148
00:43:00,309 --> 00:42:58,640
wouldn't fly and we don't expect the

1149
00:43:02,470 --> 00:43:00,319
weather to change on the kind of half

1150
00:43:05,270 --> 00:43:02,480
hour time scale at titan

1151
00:43:07,829 --> 00:43:05,280
so we would know before we flew and make

1152
00:43:09,670 --> 00:43:07,839
a decision based on that not to fly if

1153
00:43:12,870 --> 00:43:09,680
the the weather conditions were adverse

1154
00:43:14,790 --> 00:43:12,880
and we'll just stay on the surface

1155
00:43:16,870 --> 00:43:14,800
we're going to take one of our online

1156
00:43:18,230 --> 00:43:16,880
questions next

1157
00:43:20,309 --> 00:43:18,240
i'm going to bring my laptop up here so

1158
00:43:22,230 --> 00:43:20,319
i read it correctly if organics are

1159
00:43:24,470 --> 00:43:22,240
sticky are there any potential issues

1160
00:43:27,030 --> 00:43:24,480
with cross contamination or carryover in

1161
00:43:29,190 --> 00:43:27,040
the sampling system

1162
00:43:30,710 --> 00:43:29,200
okay so again the question is about um

1163
00:43:32,470 --> 00:43:30,720

if we have because i mentioned sticky

1164
00:43:33,670 --> 00:43:32,480
organics and potential cross

1165
00:43:36,230 --> 00:43:33,680
contamination

1166
00:43:38,150 --> 00:43:36,240
um so we what we've done is we've set a

1167
00:43:39,910 --> 00:43:38,160
requirement to minimize cross

1168
00:43:43,190 --> 00:43:39,920
contamination as much as possible it's

1169
00:43:44,790 --> 00:43:43,200
it's you can't live a perfect

1170
00:43:46,470 --> 00:43:44,800
uh completely restricting uh

1171
00:43:47,750 --> 00:43:46,480
cross-contamination but to reduce it as

1172
00:43:49,750 --> 00:43:47,760
much as possible

1173
00:43:51,349 --> 00:43:49,760
we have a couple ways that we can

1174
00:43:53,270 --> 00:43:51,359
deal with that in the sampling system

1175
00:43:55,589 --> 00:43:53,280
one is that because it's a pneumatic

1176
00:43:57,349 --> 00:43:55,599
system and because we're basically we're

1177
00:43:58,630 --> 00:43:57,359
actually flushing a lot of the material

1178
00:44:00,790 --> 00:43:58,640
through every time a lot more than we

1179
00:44:03,990 --> 00:44:00,800
necessarily are are capturing for a

1180
00:44:05,990 --> 00:44:04,000
sample and so we have the ability to

1181
00:44:07,510 --> 00:44:06,000
flush the lines with a little bit of new

1182
00:44:09,750 --> 00:44:07,520
sample as well

1183
00:44:11,190 --> 00:44:09,760
to to make sure that you know you're

1184
00:44:13,670 --> 00:44:11,200
kind of getting rid of any residual

1185
00:44:14,470 --> 00:44:13,680
material from a previous run

1186
00:44:16,870 --> 00:44:14,480
um

1187
00:44:18,710 --> 00:44:16,880
similarly the drill has has a percussive

1188
00:44:20,069 --> 00:44:18,720

aspect and it can kind of like

1189
00:44:22,230 --> 00:44:20,079
you know shake itself a little bit and

1190
00:44:25,030 --> 00:44:22,240
help clean off the material on on the

1191
00:44:27,190 --> 00:44:25,040
drill as well and and again the just the

1192
00:44:29,109 --> 00:44:27,200
nature of the pneumatic system and why

1193
00:44:31,430 --> 00:44:29,119
we wanted to to do that is it's a lot

1194
00:44:33,430 --> 00:44:31,440
less likely to have a material sticking

1195
00:44:35,349 --> 00:44:33,440
to the sides than with a scoop for

1196
00:44:38,710 --> 00:44:35,359
example and that was a choice that we

1197
00:44:39,990 --> 00:44:38,720
made um partly to help with the fact

1198
00:44:41,589 --> 00:44:40,000
that we know there's a wide range of

1199
00:44:42,790 --> 00:44:41,599
materials in a wide range of material

1200
00:44:44,230 --> 00:44:42,800
properties and to limit things like

1201
00:44:45,910 --> 00:44:44,240
cross-contamination

1202
00:44:46,630 --> 00:44:45,920
um and then another thing we do is that

1203
00:44:48,870 --> 00:44:46,640
for

1204
00:44:50,790 --> 00:44:48,880
the ldms analysis we have

1205
00:44:52,950 --> 00:44:50,800
single-use cups and so

1206
00:44:54,470 --> 00:44:52,960
each time we take a sample it's a it's a

1207
00:44:58,069 --> 00:44:54,480
fresh new cup and that's another way

1208
00:44:59,589 --> 00:44:58,079
that we can address that that concern

1209
00:45:01,910 --> 00:44:59,599
thanks melissa we'll come back to the

1210
00:45:06,790 --> 00:45:04,710
hello i'm katerina yocum i'm an npp at

1211
00:45:09,430 --> 00:45:06,800
nasa goddard and i'm really curious

1212
00:45:11,349 --> 00:45:09,440
about the gcms measurements

1213
00:45:13,270 --> 00:45:11,359

because melissa you said that of course

1214
00:45:16,069 --> 00:45:13,280
they have to be volatile

1215
00:45:18,390 --> 00:45:16,079
and at 95 kelvin amino acids certainly

1216
00:45:20,470 --> 00:45:18,400
will not be in the gas phase um so what

1217
00:45:22,470 --> 00:45:20,480
are the target molecules and what do you

1218
00:45:24,230 --> 00:45:22,480
hope to search for for the enantiomeric

1219
00:45:25,670 --> 00:45:24,240
assets yeah thank you so much so the

1220
00:45:27,349 --> 00:45:25,680
requirement for them to be volatile is

1221
00:45:30,150 --> 00:45:27,359
for them to go to volatile in our

1222
00:45:31,670 --> 00:45:30,160
analysis which um but we don't want them

1223
00:45:34,069 --> 00:45:31,680
developed on the surface we want them to

1224
00:45:35,430 --> 00:45:34,079
be solid or stable on the surface so

1225
00:45:38,069 --> 00:45:35,440
that we can sample them

1226
00:45:39,589 --> 00:45:38,079
so the samples are kept very pulled uh

1227
00:45:41,030 --> 00:45:39,599
through the pneumatic transfer system

1228
00:45:42,870 --> 00:45:41,040
and then once they are captured in a

1229
00:45:45,190 --> 00:45:42,880
sample cup we still try to keep them

1230
00:45:47,510 --> 00:45:45,200
well below the freezing point of water

1231
00:45:49,910 --> 00:45:47,520
or the peritectic point of for example a

1232
00:45:51,910 --> 00:45:49,920
water ammonia mixture to try to preserve

1233
00:45:53,750 --> 00:45:51,920
the bulk um

1234
00:45:55,670 --> 00:45:53,760
solid depending on where we're sampling

1235
00:45:57,109 --> 00:45:55,680
but then for the gcms analysis the next

1236
00:45:58,630 --> 00:45:57,119
step is that we heat them up

1237
00:46:00,710 --> 00:45:58,640
deliberately right to volatilize and

1238
00:46:03,190 --> 00:46:00,720

drive off materials and we can do that

1239
00:46:05,270 --> 00:46:03,200
to either directly measure molecules

1240
00:46:07,670 --> 00:46:05,280
that um you know in a paralysis mode

1241
00:46:10,069 --> 00:46:07,680
that are able to evolve up to about 600

1242
00:46:11,910 --> 00:46:10,079
degrees celsius okay and so then we can

1243
00:46:13,349 --> 00:46:11,920
see things like you know alcohols and

1244
00:46:15,349 --> 00:46:13,359
the means and lots of different

1245
00:46:17,829 --> 00:46:15,359
components but then we also carry the

1246
00:46:19,030 --> 00:46:17,839
ability to do a chemical derivatization

1247
00:46:21,910 --> 00:46:19,040
and that's the way that we're going to

1248
00:46:24,470 --> 00:46:21,920
target things like amino acids and so

1249
00:46:26,790 --> 00:46:24,480
the verbization is happens inside the

1250
00:46:27,910 --> 00:46:26,800
cup in the oven it's a single step and

1251
00:46:30,630 --> 00:46:27,920
this is something that has been done

1252
00:46:33,190 --> 00:46:30,640
before for example on mars with um the

1253
00:46:34,150 --> 00:46:33,200
same instrument on curiosity

1254
00:46:35,750 --> 00:46:34,160
and

1255
00:46:37,910 --> 00:46:35,760
that allows us to sort you do a chemical

1256
00:46:39,829 --> 00:46:37,920
substitution now you've made a molecule

1257
00:46:41,990 --> 00:46:39,839
that is less polar and it's more

1258
00:46:43,990 --> 00:46:42,000
volatile and was able to pass through

1259
00:46:46,069 --> 00:46:44,000
the gc system

1260
00:46:46,870 --> 00:46:46,079
so beyond amino acids are there any

1261
00:46:48,390 --> 00:46:46,880
other

1262
00:46:50,710 --> 00:46:48,400
forms of molecules that you're searching

1263
00:46:53,910 --> 00:46:50,720

for yeah sure we're we're looking for

1264
00:46:55,910 --> 00:46:53,920
whatever we can see right so uh targets

1265
00:46:57,990 --> 00:46:55,920
that are mentioned you know in our high

1266
00:47:00,150 --> 00:46:58,000
level requirements are things like amino

1267
00:47:01,670 --> 00:47:00,160
acids and nucleobases um we're

1268
00:47:04,150 --> 00:47:01,680
interested in seeing if there's fatty

1269
00:47:06,790 --> 00:47:04,160
acids there um you know things that

1270
00:47:10,710 --> 00:47:06,800
would be of interest for uh biochemistry

1271
00:47:12,069 --> 00:47:10,720
and morgan are you wanting to add okay

1272
00:47:14,390 --> 00:47:12,079
um you know we're certainly expecting to

1273
00:47:15,510 --> 00:47:14,400
see lots of aromatics ph's based on our

1274
00:47:19,270 --> 00:47:15,520
understanding of the chemistry that

1275
00:47:21,109 --> 00:47:19,280
happens in the atmosphere um

1276
00:47:22,870 --> 00:47:21,119
that means i mean we could go we could

1277
00:47:25,030 --> 00:47:22,880
go on and on i could talk to you offline

1278
00:47:26,710 --> 00:47:25,040
sometime

1279
00:47:28,549 --> 00:47:26,720
and just a quick reminder that that's

1280
00:47:29,990 --> 00:47:28,559
one of the benefits of having mass

1281
00:47:32,069 --> 00:47:30,000
spectrometry because it's such an

1282
00:47:33,430 --> 00:47:32,079
agnostic technique when it comes to you

1283
00:47:35,829 --> 00:47:33,440
know of course the molecules have to be

1284
00:47:38,470 --> 00:47:35,839
volatilized they have to have a charge

1285
00:47:40,309 --> 00:47:38,480
but otherwise we're relatively agnostic

1286
00:47:42,069 --> 00:47:40,319
compared to other techniques so that's a

1287
00:47:43,829 --> 00:47:42,079
really powerful that's the reason why it

1288
00:47:45,349 --> 00:47:43,839

was selected

1289
00:47:47,349 --> 00:47:45,359
preach morgan

1290
00:47:50,069 --> 00:47:47,359
all right let's take uh the next

1291
00:47:51,750 --> 00:47:50,079
question from the side hey i'm hero at

1292
00:47:53,190 --> 00:47:51,760
jpl

1293
00:47:55,430 --> 00:47:53,200
i am an

1294
00:47:57,910 --> 00:47:55,440
ignorant engineer asking a stupid

1295
00:47:59,430 --> 00:47:57,920
question so bear with me um no stupid

1296
00:48:02,549 --> 00:47:59,440
questions in this room

1297
00:48:04,390 --> 00:48:02,559
but i i i am super excited about it so

1298
00:48:07,030 --> 00:48:04,400
um i understand that the

1299
00:48:07,750 --> 00:48:07,040
the landsat is at the lower latitude

1300
00:48:09,990 --> 00:48:07,760
just

1301
00:48:11,829 --> 00:48:10,000
curious you know is there any

1302
00:48:14,150 --> 00:48:11,839
possibility

1303
00:48:19,190 --> 00:48:14,160
long term to visit all the way to the

1304
00:48:26,230 --> 00:48:22,950
um it's a it's a pretty long way to the

1305
00:48:29,270 --> 00:48:26,240
the northern lakes uh the

1306
00:48:31,910 --> 00:48:29,280
the nominal mission is to find a

1307
00:48:34,630 --> 00:48:31,920
3.3 years is defined by the the time

1308
00:48:36,630 --> 00:48:34,640
scale to get from the

1309
00:48:38,470 --> 00:48:36,640
anywhere you know from the you know the

1310
00:48:39,829 --> 00:48:38,480
landing ellipses is reasonably large

1311
00:48:43,349 --> 00:48:39,839
because the dispersion in titan's

1312
00:48:45,589 --> 00:48:43,359
atmosphere so the um

1313
00:48:47,670 --> 00:48:45,599

uh the nominal time scale is is set to

1314
00:48:49,589 --> 00:48:47,680
allow us to get from places within that

1315
00:48:51,750 --> 00:48:49,599
landing ellipse into the deposits

1316
00:48:54,870 --> 00:48:51,760
associated with the crater to make the

1317
00:48:57,109 --> 00:48:54,880
you know the key the key measurements uh

1318
00:48:59,750 --> 00:48:57,119
of the the chemistry of those uh those

1319
00:49:01,190 --> 00:48:59,760
materials uh the

1320
00:49:04,549 --> 00:49:01,200
because we were designed to be powered

1321
00:49:21,510 --> 00:49:06,630
the

1322
00:49:24,390 --> 00:49:21,520
3.3 years uh possibly by a factor of two

1323
00:49:26,790 --> 00:49:24,400
or so uh so there is hopefully the

1324
00:49:30,150 --> 00:49:26,800
possibility for an extended mission of

1325
00:49:34,309 --> 00:49:30,160
some sort but whether one could get that

1326
00:49:36,630 --> 00:49:34,319
far um is uh is a i think that would be

1327
00:49:38,309 --> 00:49:36,640
a long shot

1328
00:49:39,750 --> 00:49:38,319
and we'll probably find a lot of other

1329
00:49:42,309 --> 00:49:39,760
things that we want to explore in the

1330
00:49:43,990 --> 00:49:42,319
nearer area to expand upon questions

1331
00:49:44,790 --> 00:49:44,000
that are raised by the measurements we

1332
00:49:45,750 --> 00:49:44,800
make

1333
00:49:47,589 --> 00:49:45,760
um

1334
00:49:49,750 --> 00:49:47,599
so i think we're going to have to leave

1335
00:49:51,670 --> 00:49:49,760
the northern links in seas for uh for a

1336
00:49:53,990 --> 00:49:51,680
future mission

1337
00:49:56,630 --> 00:49:54,000
i'm still hoping for some sub cassini

1338
00:49:58,950 --> 00:49:56,640

resolution little lakes at latitudes we

1339
00:50:01,270 --> 00:49:58,960
might be able to there is evidence in

1340
00:50:04,150 --> 00:50:01,280
some places of possible you know

1341
00:50:06,309 --> 00:50:04,160
temperate latitude lakes and as you say

1342
00:50:08,390 --> 00:50:06,319
there might be um

1343
00:50:10,309 --> 00:50:08,400
playas or things like that in and among

1344
00:50:11,990 --> 00:50:10,319
the dunes we've definitely seen rainfall

1345
00:50:14,390 --> 00:50:12,000
evidence of rainfall at these low

1346
00:50:17,030 --> 00:50:14,400
latitudes so we know that there is

1347
00:50:19,030 --> 00:50:17,040
moisture there at some times of year

1348
00:50:20,470 --> 00:50:19,040
even the huygens probe when it landed at

1349
00:50:22,549 --> 00:50:20,480
the latitude

1350
00:50:24,390 --> 00:50:22,559
in the southern

1351
00:50:26,390 --> 00:50:24,400
uh the southern summer

1352
00:50:28,870 --> 00:50:26,400
there was moisture in the you know in

1353
00:50:32,069 --> 00:50:28,880
the material at the the landing site of

1354
00:50:33,750 --> 00:50:32,079
the huygens uh the vegans probe so there

1355
00:50:34,950 --> 00:50:33,760
there are certainly surprises that await

1356
00:50:37,750 --> 00:50:34,960
and maybe we'll be able to make some

1357
00:50:41,109 --> 00:50:37,760
measurements in the local vicinity

1358
00:50:43,430 --> 00:50:41,119
thanks super exciting thank you

1359
00:50:45,589 --> 00:50:43,440
go ahead i am joey pastorski from the

1360
00:50:48,309 --> 00:50:45,599
university of illinois in chicago um it

1361
00:50:49,990 --> 00:50:48,319
sounds like a lot of the gcms and ldms

1362
00:50:53,109 --> 00:50:50,000
experiments will be sort of force

1363
00:50:54,950 --> 00:50:53,119

intensive um the same with drilling so

1364
00:50:56,230 --> 00:50:54,960
for kind of lack of a better term before

1365
00:50:57,430 --> 00:50:56,240
you want to do some of analysis you're

1366
00:50:58,950 --> 00:50:57,440
going to want to kind of poke something

1367
00:51:00,309 --> 00:50:58,960
with a stick

1368
00:51:01,670 --> 00:51:00,319
so then what's like your analytical

1369
00:51:08,069 --> 00:51:01,680
stick that you're poking before you

1370
00:51:12,870 --> 00:51:10,950
um sure so the the plan is to utilize

1371
00:51:14,309 --> 00:51:12,880
the entire payload to understand the

1372
00:51:16,230 --> 00:51:14,319
landing site before you make the the

1373
00:51:18,309 --> 00:51:16,240
choice to drill so

1374
00:51:20,950 --> 00:51:18,319
that includes um all the imaging that

1375
00:51:23,589 --> 00:51:20,960
we'll have as the context of where we're

1376
00:51:25,510 --> 00:51:23,599
located you know are we did we land in a

1377
00:51:26,790 --> 00:51:25,520
you know point of dune material are we

1378
00:51:27,829 --> 00:51:26,800
sitting on ice

1379
00:51:29,990 --> 00:51:27,839
um

1380
00:51:32,230 --> 00:51:30,000
then the even the microscopic imagers

1381
00:51:33,510 --> 00:51:32,240
are pointed to the areas where the drill

1382
00:51:40,950 --> 00:51:33,520
would drill and so all of the

1383
00:51:44,630 --> 00:51:42,630
as part of the drag mag instrument

1384
00:51:46,870 --> 00:51:44,640
package and so we'll be understanding

1385
00:51:49,430 --> 00:51:46,880
things like surface porosity

1386
00:51:51,430 --> 00:51:49,440
dielectric constant a lot of information

1387
00:51:53,430 --> 00:51:51,440
just that we can get from that

1388
00:51:54,950 --> 00:51:53,440

and and then of course we have the um

1389
00:51:57,030 --> 00:51:54,960
gamma-ray neutron spectrometer dragons

1390
00:51:59,910 --> 00:51:57,040
which will give us the bulk elemental

1391
00:52:01,829 --> 00:51:59,920
um abundance around around the lander so

1392
00:52:03,829 --> 00:52:01,839
all of those things will be employed at

1393
00:52:05,990 --> 00:52:03,839
each landing site to best understand the

1394
00:52:08,150 --> 00:52:06,000
surface to make a decision you know the

1395
00:52:10,870 --> 00:52:08,160
two things we will always be asking is

1396
00:52:12,549 --> 00:52:10,880
is it safe to drill um and then of

1397
00:52:14,470 --> 00:52:12,559
course as we go from site to site it may

1398
00:52:15,910 --> 00:52:14,480
be that we have you know moved and we're

1399
00:52:17,829 --> 00:52:15,920
in a new location that's giving us

1400
00:52:19,430 --> 00:52:17,839
almost exactly the same information so

1401
00:52:21,270 --> 00:52:19,440
we probably haven't left that geologic

1402
00:52:22,630 --> 00:52:21,280
unit you know so it's probably not quite

1403
00:52:24,150 --> 00:52:22,640
worth it and that because that's the

1404
00:52:26,390 --> 00:52:24,160
valuable question

1405
00:52:28,950 --> 00:52:26,400
about drilling and then if we make the

1406
00:52:30,549 --> 00:52:28,960
decision with all of that data that it's

1407
00:52:32,390 --> 00:52:30,559
that we want to give it give it a shot

1408
00:52:34,630 --> 00:52:32,400
we'll have um as i mentioned an

1409
00:52:37,030 --> 00:52:34,640
interrogation drill what we'll do just a

1410
00:52:39,510 --> 00:52:37,040
little pilot drill hole to get an idea

1411
00:52:40,710 --> 00:52:39,520
of how the material responds to drilling

1412
00:52:42,470 --> 00:52:40,720
you know and then we can do detailed

1413
00:52:43,750 --> 00:52:42,480

imaging and

1414
00:52:45,430 --> 00:52:43,760
you know what kind of particles there

1415
00:52:47,270 --> 00:52:45,440
are and even look for things like does

1416
00:52:48,710 --> 00:52:47,280
it glint a little bit do we think it's

1417
00:52:50,230 --> 00:52:48,720
wet because we may not want to sample

1418
00:52:53,270 --> 00:52:50,240
something wet because it's more likely

1419
00:52:55,109 --> 00:52:53,280
to be sticky um so all of that kind of

1420
00:52:57,589 --> 00:52:55,119
information will go into deciding to

1421
00:52:59,670 --> 00:52:57,599
proceed with a sample

1422
00:53:01,349 --> 00:52:59,680
and then even once we do that the way

1423
00:53:02,790 --> 00:53:01,359
that the mass spectrometer operations

1424
00:53:04,309 --> 00:53:02,800
are designed is that we'll always start

1425
00:53:05,430 --> 00:53:04,319
with an ldi measurement a laser

1426
00:53:07,750 --> 00:53:05,440
absorption measurement and that will be

1427
00:53:09,829 --> 00:53:07,760
our first assessment of the composition

1428
00:53:11,190 --> 00:53:09,839
and that information will then also come

1429
00:53:13,670 --> 00:53:11,200
back around in the loop to make a

1430
00:53:15,589 --> 00:53:13,680
decision do we go on to gcms which is

1431
00:53:17,589 --> 00:53:15,599
the most resource intensive of the

1432
00:53:18,549 --> 00:53:17,599
options so that's that's all going to

1433
00:53:20,950 --> 00:53:18,559
play out

1434
00:53:23,109 --> 00:53:20,960
during our surface operations to be very

1435
00:53:30,309 --> 00:53:23,119
exciting

1436
00:53:31,910 --> 00:53:30,319
i am martin cordner from nasa goddard

1437
00:53:33,670 --> 00:53:31,920
i was wondering if you have a sense for

1438
00:53:36,309 --> 00:53:33,680

the ages of the materials you'll be

1439
00:53:37,829 --> 00:53:36,319
sampling given the um the ongoing

1440
00:53:39,910 --> 00:53:37,839
precipitation of organics from the

1441
00:53:42,950 --> 00:53:39,920
atmosphere and the possibility of

1442
00:53:46,470 --> 00:53:42,960
exposing older surface materials by

1443
00:53:51,750 --> 00:53:49,829
sure um i think one of the most exciting

1444
00:53:54,150 --> 00:53:51,760
capabilities of our mission is our

1445
00:53:55,109 --> 00:53:54,160
ability to sort of follow up on things

1446
00:53:57,829 --> 00:53:55,119
we see

1447
00:53:59,190 --> 00:53:57,839
so um when we do imaging we're hoping

1448
00:54:01,829 --> 00:53:59,200
we'll be able to see things like

1449
00:54:05,109 --> 00:54:01,839
different geologic units outcropping um

1450
00:54:07,589 --> 00:54:05,119
or perhaps you know exposed in

1451
00:54:09,750 --> 00:54:07,599
crater walls or other places different

1452
00:54:11,829 --> 00:54:09,760
individual geologic layers that we'll be

1453
00:54:13,430 --> 00:54:11,839
able to identify and then be able to to

1454
00:54:15,270 --> 00:54:13,440
sample the material that's that's fallen

1455
00:54:17,190 --> 00:54:15,280
out of them by flying over to it and

1456
00:54:19,510 --> 00:54:17,200
getting to it so

1457
00:54:21,109 --> 00:54:19,520
we won't be able to get absolute ages

1458
00:54:23,030 --> 00:54:21,119
obviously because we don't have a you

1459
00:54:24,710 --> 00:54:23,040
know a radio isotope

1460
00:54:26,710 --> 00:54:24,720
dating system that would we know will

1461
00:54:27,750 --> 00:54:26,720
work on titan uh we don't carry one with

1462
00:54:29,430 --> 00:54:27,760
us

1463
00:54:31,990 --> 00:54:29,440

but we hope to

1464
00:54:34,549 --> 00:54:32,000
build up a picture over time of what the

1465
00:54:36,309 --> 00:54:34,559
geological history of the area has been

1466
00:54:38,630 --> 00:54:36,319
based on um

1467
00:54:39,990 --> 00:54:38,640
structural relationships and outcrops

1468
00:54:41,910 --> 00:54:40,000
and being able to

1469
00:54:43,190 --> 00:54:41,920
follow up on what we see and fly over

1470
00:54:45,510 --> 00:54:43,200
and investigate

1471
00:54:47,990 --> 00:54:45,520
what we need to to be able to build up

1472
00:54:49,750 --> 00:54:48,000
that picture over time so uh we won't be

1473
00:54:51,829 --> 00:54:49,760
able to do that you know right off right

1474
00:54:53,109 --> 00:54:51,839
all right in one single observation but

1475
00:54:55,829 --> 00:54:53,119
we hope over the course of the mission

1476
00:54:57,109 --> 00:54:55,839
to be able to build up a sense for um

1477
00:54:59,270 --> 00:54:57,119
you know the ages of the various

1478
00:55:01,030 --> 00:54:59,280
materials i guess i just had this naive

1479
00:55:02,470 --> 00:55:01,040
impression that um

1480
00:55:05,030 --> 00:55:02,480
that there's a lot of particulate

1481
00:55:07,910 --> 00:55:05,040
precipitation so does that tend to bury

1482
00:55:10,549 --> 00:55:07,920
everything or it gets washed away so uh

1483
00:55:13,750 --> 00:55:10,559
for instance the huygens probe has

1484
00:55:15,270 --> 00:55:13,760
measured this when it came down um it it

1485
00:55:16,950 --> 00:55:15,280
the penetrometer went through some

1486
00:55:19,190 --> 00:55:16,960
material and it was estimated to be

1487
00:55:20,710 --> 00:55:19,200
about seven millimeters thick so there

1488
00:55:22,150 --> 00:55:20,720

was a coating at the hogan's landing

1489
00:55:23,670 --> 00:55:22,160
site seven millimeters thick and that's

1490
00:55:26,549 --> 00:55:23,680
one of the reasons we have a drill that

1491
00:55:28,549 --> 00:55:26,559
will get us down six uh centimeters so

1492
00:55:31,270 --> 00:55:28,559
we'll be able to get through uh any

1493
00:55:33,430 --> 00:55:31,280
surface mantling it seems that you know

1494
00:55:35,190 --> 00:55:33,440
either rainfall or aeolian processes are

1495
00:55:37,829 --> 00:55:35,200
keeping it cleaner so we don't have

1496
00:55:39,270 --> 00:55:37,839
meters of this stuff building up um and

1497
00:55:41,349 --> 00:55:39,280
we have the the drill to be able to get

1498
00:55:43,750 --> 00:55:41,359
us through uh what we think is a

1499
00:55:45,109 --> 00:55:43,760
pretty thick but not impenetrable veneer

1500
00:55:46,710 --> 00:55:45,119
of material that's falling out of the

1501
00:55:50,789 --> 00:55:46,720
atmosphere

1502
00:55:53,190 --> 00:55:50,799
yeah and and it really is a relatively

1503
00:55:55,430 --> 00:55:53,200
uh over kind of longer term time scale

1504
00:55:58,069 --> 00:55:55,440
it's a relatively active environment

1505
00:56:00,150 --> 00:55:58,079
with aeolian processes you know moving

1506
00:56:01,349 --> 00:56:00,160
materials around and clearing some areas

1507
00:56:04,630 --> 00:56:01,359
and and

1508
00:56:06,470 --> 00:56:04,640
rainfall as well so uh we expect there

1509
00:56:08,470 --> 00:56:06,480
there there clearly isn't from we know

1510
00:56:10,870 --> 00:56:08,480
from the the data from cassini and from

1511
00:56:12,710 --> 00:56:10,880
huygens that there isn't just a uniform

1512
00:56:14,150 --> 00:56:12,720
layer that's that's built up there's a

1513
00:56:17,510 --> 00:56:14,160

there are a lot of places where that's

1514
00:56:19,910 --> 00:56:17,520
been moved and modified too

1515
00:56:22,150 --> 00:56:19,920
all right you get the honor of the last

1516
00:56:23,910 --> 00:56:22,160
question oh wow wonderful

1517
00:56:25,990 --> 00:56:23,920
and this last question will be a very

1518
00:56:28,950 --> 00:56:26,000
analytical chemistry question so

1519
00:56:31,270 --> 00:56:28,960
apologies in advance but um i'm curious

1520
00:56:33,109 --> 00:56:31,280
about the capacity of the mass

1521
00:56:35,270 --> 00:56:33,119
spectrometer to really identify

1522
00:56:37,750 --> 00:56:35,280
molecular compositions so you were

1523
00:56:39,510 --> 00:56:37,760
talking about an interest in nucleobases

1524
00:56:41,750 --> 00:56:39,520
and i'm sure as you're well aware you

1525
00:56:43,670 --> 00:56:41,760
know with compounds of that nature there

1526
00:56:46,230 --> 00:56:43,680
are many possible compositions you could

1527
00:56:47,270 --> 00:56:46,240
have for a given mass number and so i'm

1528
00:56:49,030 --> 00:56:47,280
curious

1529
00:56:51,510 --> 00:56:49,040
will the instruments be able to resolve

1530
00:56:53,829 --> 00:56:51,520
like isotopic windows or be able to do

1531
00:56:56,390 --> 00:56:53,839
fragmentation to be able to try to go

1532
00:56:57,990 --> 00:56:56,400
beyond just mass number and get more

1533
00:57:00,710 --> 00:56:58,000
detailed information about molecular

1534
00:57:00,720 --> 00:57:06,240
uh yes

1535
00:57:06,250 --> 00:57:10,829
[Music]

1536
00:57:16,710 --> 00:57:14,549
um you want to come up here oh okay

1537
00:57:18,069 --> 00:57:16,720
sorry okay

1538
00:57:20,870 --> 00:57:18,079

so

1539
00:57:23,349 --> 00:57:20,880
um when we're operating the laser

1540
00:57:25,349 --> 00:57:23,359
desorption mode we definitely plan to do

1541
00:57:28,150 --> 00:57:25,359
msms so the idea is that we have the

1542
00:57:30,789 --> 00:57:28,160
capability to isolate the mass window

1543
00:57:32,870 --> 00:57:30,799
and and then do fragmentation to look at

1544
00:57:34,630 --> 00:57:32,880
right the components of

1545
00:57:36,789 --> 00:57:34,640
uh the molecules that that were

1546
00:57:38,150 --> 00:57:36,799
isolating so that's one of the ways that

1547
00:57:39,750 --> 00:57:38,160
we'll be doing that kind of

1548
00:57:41,829 --> 00:57:39,760
deconvolution like you said moving kind

1549
00:57:43,430 --> 00:57:41,839
of beyond a single mass unit and then of

1550
00:57:47,030 --> 00:57:43,440
course one of the reasons as well that

1551
00:57:48,789 --> 00:57:47,040
we carry the the gc and the gcms mode is

1552
00:57:51,109 --> 00:57:48,799
that enables a different type of

1553
00:57:53,990 --> 00:57:51,119
separation step by looking at retention

1554
00:57:56,150 --> 00:57:54,000
times and uh healthy and separating them

1555
00:57:57,990 --> 00:57:56,160
out and and how things that loot and

1556
00:57:59,829 --> 00:57:58,000
then the spectral that we see there and

1557
00:58:01,270 --> 00:57:59,839
how they respond to jervization if

1558
00:58:03,750 --> 00:58:01,280
that's what we're doing then we'll use

1559
00:58:07,430 --> 00:58:03,760
that also as a way to identify

1560
00:58:11,910 --> 00:58:10,309
sorry we can't okay okay absorption can

1561
00:58:14,230 --> 00:58:11,920
do ms ms

1562
00:58:16,230 --> 00:58:14,240
is that right um can you say that again

1563
00:58:18,390 --> 00:58:16,240

i couldn't hear the g so the gc can do

1564
00:58:20,870 --> 00:58:18,400
gt ms and the laser desorption can do

1565
00:58:24,789 --> 00:58:20,880
msms is that that's right so that's

1566
00:58:26,950 --> 00:58:24,799
that's the primary primary plan yes

1567
00:58:28,630 --> 00:58:26,960
awesome well thank you guys so much for

1568
00:58:30,390 --> 00:58:28,640
joining us the discussion doesn't have

1569
00:58:32,309 --> 00:58:30,400
to end here because we're going to be

1570
00:58:34,870 --> 00:58:32,319
all around all the rest of today and

1571
00:58:37,030 --> 00:58:34,880
some of us around even tomorrow um and

1572
00:58:39,109 --> 00:58:37,040
uh we hope to uh continue this

1573
00:58:41,270 --> 00:58:39,119
discussion throughout the year um i want

1574
00:58:43,270 --> 00:58:41,280
to thank all of our panelists including

1575
00:58:45,430 --> 00:58:43,280
uh the

1576
00:58:47,670 --> 00:58:45,440
fantastic ken hibbard who has called in

1577
00:58:50,710 --> 00:58:47,680
all the way from maryland um and of

1578
00:58:52,470 --> 00:58:50,720
course our rpi zombie turtle and wdpi's

1579
00:58:55,349 --> 00:58:52,480
jason barnes and melissa traynor as well

1580
00:58:57,589 --> 00:58:55,359
as the other dragonfly team in the room

1581
00:59:00,870 --> 00:58:57,599
thanks to all of you we are really

1582
00:59:02,150 --> 00:59:00,880
excited to start taking data and making

1583
00:59:04,140 --> 00:59:02,160
some cool discoveries with you in the