

1
00:00:08,019 --> 00:00:12,440
hello everybody and welcome to our

2
00:00:10,308 --> 00:00:14,329
latest Hubble hang out my name is Tony

3
00:00:12,439 --> 00:00:16,670
Darnell I work heavy Space Telescope

4
00:00:14,330 --> 00:00:18,260
Science Institute and today we've got a

5
00:00:16,670 --> 00:00:20,420
great hangout plan for you we're going

6
00:00:18,260 --> 00:00:23,150
to be talking about water vapor plumes

7
00:00:20,420 --> 00:00:24,470
seen on Europa but before I get started

8
00:00:23,149 --> 00:00:27,528
I want to make a quick little

9
00:00:24,469 --> 00:00:29,329
programming announcement tonight we have

10
00:00:27,528 --> 00:00:32,060
a special Hubble public lecture series

11
00:00:29,329 --> 00:00:33,829
which is going to be from a renowned

12
00:00:32,060 --> 00:00:37,879
astrophysicist and an award-winning

13
00:00:33,829 --> 00:00:40,308
writer dr. ray jayawardana and he's

14
00:00:37,878 --> 00:00:42,890
going to be talking about neutrinos in

15
00:00:40,308 --> 00:00:44,959
the title is neutrino hunters chasing a

16
00:00:42,890 --> 00:00:46,909
ghostly particle to unlock cosmic

17
00:00:44,960 --> 00:00:49,460
secrets he's going to give us a look

18
00:00:46,909 --> 00:00:51,589
into the shadowy world of neutrinos and

19
00:00:49,460 --> 00:00:54,500
the colorful lives those who seek them

20
00:00:51,590 --> 00:00:58,670
so that's tonight at eight pm eastern uh

21
00:00:54,500 --> 00:01:00,829
I believe that's midnight in the

22
00:00:58,670 --> 00:01:02,899
universal time so hopefully you guys can

23
00:01:00,829 --> 00:01:06,109
catch alive you can also watch it at

24
00:01:02,899 --> 00:01:07,579
webcast I ftse I edu so I wanted to give

25
00:01:06,109 --> 00:01:11,530
that little programming note out there

26
00:01:07,579 --> 00:01:14,239
before we get too far into it um today

27
00:01:11,530 --> 00:01:17,599
we as i mentioned we're going to be

28
00:01:14,239 --> 00:01:19,579
talking about neutrinos and no or not no

29

00:01:17,599 --> 00:01:21,349
or not what about water vapor pick you

30
00:01:19,579 --> 00:01:24,349
can talk about neutrinos the weighted

31
00:01:21,349 --> 00:01:26,089
robot yeah we're out Europa and water

32
00:01:24,349 --> 00:01:27,799
vapor plumes that we've seen there and

33
00:01:26,090 --> 00:01:30,380
with me to help just help me with this

34
00:01:27,799 --> 00:01:31,789
discussion as they just did dr. carol

35
00:01:30,379 --> 00:01:33,049
christian she's the Hubble outreach

36
00:01:31,790 --> 00:01:35,660
scientist for the Space Telescope

37
00:01:33,049 --> 00:01:38,179
Science Institute and got Louis from

38
00:01:35,659 --> 00:01:41,359
know the cosmos calm and the internet

39
00:01:38,180 --> 00:01:43,640
driver extraordinary welcome guys it's

40
00:01:41,359 --> 00:01:45,829
good to see you again Ellen yeah so

41
00:01:43,640 --> 00:01:49,060
what's going with those neutrinos Tony

42
00:01:45,829 --> 00:01:52,519
okay I've got a tuna tonight okay okay

43
00:01:49,060 --> 00:01:54,429

that's the deal sorry I got all too too

44

00:01:52,519 --> 00:01:57,590
many things cooking

45

00:01:54,429 --> 00:02:00,228
so with me to discuss this ABS these

46

00:01:57,590 --> 00:02:06,170
observations that have just that have

47

00:02:00,228 --> 00:02:08,360
just recently is dr. rents room what dr.

48

00:02:06,170 --> 00:02:11,810
Lorenz let me slow down from these

49

00:02:08,360 --> 00:02:14,860
Research Institute I dr. Kurt rather 40

50

00:02:11,810 --> 00:02:18,500
from us the southwest research institute

51

00:02:14,860 --> 00:02:20,810
and dr. yo Joaquin star from the

52

00:02:18,500 --> 00:02:25,219
University of Cologne and Germany so

53

00:02:20,810 --> 00:02:28,819
welcome guys yeah thank you hello thank

54

00:02:25,219 --> 00:02:30,289
you Anchorage uh so let's go so let's go

55

00:02:28,818 --> 00:02:32,419
ahead and get started i'll be talking

56

00:02:30,289 --> 00:02:34,699
about others let's let's get everyone

57

00:02:32,419 --> 00:02:37,458
knowing on how they can ah thank you

58
00:02:34,699 --> 00:02:40,098
yeah internets let me drive you for a

59
00:02:37,459 --> 00:02:44,150
moment if you have any questions or

60
00:02:40,098 --> 00:02:46,729
comments for our panel you can tweet at

61
00:02:44,150 --> 00:02:49,069
us using the hashtag hubble hang out we

62
00:02:46,729 --> 00:02:51,199
also have the Q&A app installed right

63
00:02:49,068 --> 00:02:54,289
now so whether you're on youtube or on

64
00:02:51,199 --> 00:02:56,030
Google+ you can open that up there leave

65
00:02:54,289 --> 00:02:57,858
questions in there and we will be able

66
00:02:56,030 --> 00:02:59,599
to choose that during the show and we'll

67
00:02:57,859 --> 00:03:01,370
still be checking comments on YouTube

68
00:02:59,599 --> 00:03:03,620
and the Google+ event page there's many

69
00:03:01,370 --> 00:03:05,599
different ways that you can get in touch

70
00:03:03,620 --> 00:03:07,789
with us and we'll be monitoring them

71
00:03:05,599 --> 00:03:12,829
throughout the show great thank you

72
00:03:07,789 --> 00:03:14,959
Scott so this these observations as let

73
00:03:12,829 --> 00:03:17,450
me get a little background here Europa

74
00:03:14,959 --> 00:03:20,120
as many of you hopefully know is a moon

75
00:03:17,449 --> 00:03:22,098
that is in orbit around Jupiter one of

76
00:03:20,120 --> 00:03:24,650
the largest planet in our solar system

77
00:03:22,098 --> 00:03:27,138
and we've long known or at least I think

78
00:03:24,650 --> 00:03:32,090
observations have strongly suggested

79
00:03:27,139 --> 00:03:34,040
that there is water uh around the on the

80
00:03:32,090 --> 00:03:39,079
surface of or underneath the frozen

81
00:03:34,039 --> 00:03:41,629
surface of the moon but Hubble was that

82
00:03:39,079 --> 00:03:43,219
was able to detect some water vapor

83
00:03:41,629 --> 00:03:45,500
plumes what you think with some water

84
00:03:43,219 --> 00:03:46,969
water vapor plumes and so Lorenz let me

85
00:03:45,500 --> 00:03:49,370
start with you can use can you give us

86

00:03:46,969 --> 00:03:51,530
some idea of what you observed and and

87
00:03:49,370 --> 00:03:55,819
with the Hubble when you first pointed

88
00:03:51,530 --> 00:03:58,098
it at Europa so and we observe for your

89
00:03:55,818 --> 00:04:01,339
surface auroral emissions so we observe

90
00:03:58,098 --> 00:04:04,068
the neutral gas in the environment of

91
00:04:01,340 --> 00:04:06,020
Europa this is excited by charged

92
00:04:04,068 --> 00:04:08,629
particles by M

93
00:04:06,020 --> 00:04:11,150
runs in this case and in the particular

94
00:04:08,629 --> 00:04:13,609
case of the observations that led to the

95
00:04:11,150 --> 00:04:16,360
discovery of the water vapor we observed

96
00:04:13,610 --> 00:04:19,310
emissions from hydrogen and oxygen and

97
00:04:16,360 --> 00:04:21,139
these emissions kind of point to the

98
00:04:19,310 --> 00:04:25,189
existence of these water with Weber

99
00:04:21,139 --> 00:04:28,669
booms at Europa and when did you did you

100
00:04:25,189 --> 00:04:32,269

do this and the detection we have like

101

00:04:28,670 --> 00:04:34,069

one set of observations where we see the

102

00:04:32,269 --> 00:04:38,509

water vapor plumes and these were taken

103

00:04:34,069 --> 00:04:43,430

in December 2012 so um yeah not quite

104

00:04:38,509 --> 00:04:46,039

two years ago yes and then n the and so

105

00:04:43,430 --> 00:04:47,689

these were not as you point out these

106

00:04:46,040 --> 00:04:51,890

were not images right that you took

107

00:04:47,689 --> 00:04:55,069

these were yet it said the Methodist

108

00:04:51,889 --> 00:04:57,050

imaging spectroscopy so and we use the

109

00:04:55,069 --> 00:04:59,420

Disqus camera the space telescope

110

00:04:57,050 --> 00:05:02,480

imaging spectrograph on hubble and the

111

00:04:59,420 --> 00:05:04,939

two arcsecond white slid and the moons

112

00:05:02,480 --> 00:05:08,180

of jupiter they fit into this to our

113

00:05:04,939 --> 00:05:12,560

second wide slate so we can em we have

114

00:05:08,180 --> 00:05:18,079

the entire moon within the slit and then

115
00:05:12,560 --> 00:05:20,689
we spectrally disperse the signal from

116
00:05:18,079 --> 00:05:23,750
the moon and so we have both spatial

117
00:05:20,689 --> 00:05:26,060
information and also the spectral

118
00:05:23,750 --> 00:05:29,000
information so we have a spectrum of

119
00:05:26,060 --> 00:05:30,079
images so to say okay so yeah I wondered

120
00:05:29,000 --> 00:05:32,839
if I wanted to make that point because

121
00:05:30,079 --> 00:05:34,729
these are according to what I've read

122
00:05:32,839 --> 00:05:37,279
about the research this is a pretty

123
00:05:34,730 --> 00:05:40,580
these are pretty faint plumes right they

124
00:05:37,279 --> 00:05:44,359
may not even be visible to in visual or

125
00:05:40,579 --> 00:05:47,300
in visible light right yeah always I

126
00:05:44,360 --> 00:05:50,480
mean it's a matter of definition of a

127
00:05:47,300 --> 00:05:58,879
faint and here but I'm sorry it's my

128
00:05:50,480 --> 00:06:01,970
phone and and they are they can be like

129
00:05:58,879 --> 00:06:04,189
invisible light almost yeah undetectable

130
00:06:01,970 --> 00:06:07,100
and but we observed in the in the

131
00:06:04,189 --> 00:06:11,180
ultraviolet and a two distinct

132
00:06:07,100 --> 00:06:13,310
wavelength here and and I mean it's the

133
00:06:11,180 --> 00:06:16,430
emissions are relatively feigned so we

134
00:06:13,310 --> 00:06:18,829
need more exposure time to really

135
00:06:16,430 --> 00:06:21,329
observe them but

136
00:06:18,829 --> 00:06:23,158
alright lutely you can hard to say if

137
00:06:21,329 --> 00:06:25,528
they they are faint I mean always a

138
00:06:23,158 --> 00:06:27,329
matter of what you compare compare it to

139
00:06:25,528 --> 00:06:28,620
yeah I want to remind people that a lot

140
00:06:27,329 --> 00:06:31,528
of people associate Hubble observations

141
00:06:28,620 --> 00:06:33,509
with deep space stuff you know very

142
00:06:31,528 --> 00:06:35,879
distant galaxies and that sort of thing

143

00:06:33,509 --> 00:06:37,770
but who actually does do quite a bit of

144
00:06:35,879 --> 00:06:40,849
observing within our own solar system I

145
00:06:37,769 --> 00:06:45,269
mean just recently we've looked at the

146
00:06:40,848 --> 00:06:47,158
at comet ISON last year and we also I

147
00:06:45,269 --> 00:06:49,829
think Carol don't we have plans for a

148
00:06:47,158 --> 00:06:51,449
hangout on some more common observations

149
00:06:49,829 --> 00:06:53,998
may be a little bit difference months so

150
00:06:51,449 --> 00:06:56,278
how's actually be within the solar

151
00:06:53,999 --> 00:06:58,469
system and and what are the advantages

152
00:06:56,278 --> 00:07:01,860
when you use Hubble what does Hubble will

153
00:06:58,468 --> 00:07:03,509
give you when you look at these it will

154
00:07:01,860 --> 00:07:05,098
at Europa for example or for anything

155
00:07:03,509 --> 00:07:07,020
that might be within the solar system

156
00:07:05,098 --> 00:07:09,838
that you wouldn't or necessarily get

157
00:07:07,019 --> 00:07:11,060

from a ground-based telescope kurt is

158

00:07:09,838 --> 00:07:14,819

that something you can answer for us

159

00:07:11,060 --> 00:07:17,879

yeah sure our group our thoughts bar

160

00:07:14,819 --> 00:07:21,028

tonight did are feasting on some

161

00:07:17,879 --> 00:07:27,629

observations of i owed volcanic inside

162

00:07:21,028 --> 00:07:29,519

your absorbent and very similar of the

163

00:07:27,629 --> 00:07:31,588

related space from volcanic instead of

164

00:07:29,519 --> 00:07:33,688

going off on i'll light of it

165

00:07:31,588 --> 00:07:38,129

ultraviolet wavelengths a community

166

00:07:33,689 --> 00:07:41,088

functions and some other things on

167

00:07:38,129 --> 00:07:42,930

Jupiter's Roura but give spectacular

168

00:07:41,088 --> 00:07:45,778

okay we're starting to lose a little

169

00:07:42,930 --> 00:07:48,060

above your sound I think um I was just a

170

00:07:45,778 --> 00:07:50,759

really powerful tool for magic sorry

171

00:07:48,060 --> 00:07:56,098

that's what oh okay okay so yeah so uh

172
00:07:50,759 --> 00:07:59,249
oh the so the lorenz was telling us that

173
00:07:56,098 --> 00:08:01,560
the you looked at the Europa for quite a

174
00:07:59,249 --> 00:08:03,180
while any sense of how long what what

175
00:08:01,560 --> 00:08:04,528
the exposure times are honey how many

176
00:08:03,180 --> 00:08:08,459
orbits did you use to make these

177
00:08:04,528 --> 00:08:09,899
observations and so the visit or this

178
00:08:08,459 --> 00:08:12,749
set of observations with the detection

179
00:08:09,899 --> 00:08:14,848
had five double orbits so it was like

180
00:08:12,749 --> 00:08:17,459
five times more or less 40 minutes of

181
00:08:14,848 --> 00:08:20,240
exposure time and that gave us the

182
00:08:17,459 --> 00:08:24,180
signal we needed to do to take the poems

183
00:08:20,240 --> 00:08:25,709
okay i don't like Scott I don't know if

184
00:08:24,180 --> 00:08:27,360
you have it handy but from the press

185
00:08:25,709 --> 00:08:29,098
release that we did on this which by the

186
00:08:27,360 --> 00:08:31,830
way is in the link to that is in the

187
00:08:29,098 --> 00:08:34,439
Google+ event there is

188
00:08:31,829 --> 00:08:36,840
there's an image that shows your oppa

189
00:08:34,440 --> 00:08:39,330
with overlaid on top of it it's an

190
00:08:36,840 --> 00:08:40,950
illustration with overlaid on top of it

191
00:08:39,330 --> 00:08:42,660
with the locations of where these plumes

192
00:08:40,950 --> 00:08:45,720
were do you happen to have that image

193
00:08:42,659 --> 00:08:47,909
handy let me pull it up here if not it I

194
00:08:45,720 --> 00:08:49,680
I added it to the Google+ event page

195
00:08:47,909 --> 00:08:51,269
itself and I can see and I can share the

196
00:08:49,679 --> 00:08:52,739
screen we had some technical

197
00:08:51,269 --> 00:08:54,539
difficulties before we started I was

198
00:08:52,740 --> 00:08:56,490
going to have Elena have that handy but

199
00:08:54,539 --> 00:09:00,449
I didn't get a chance to ask her on that

200

00:08:56,490 --> 00:09:02,100
but it's well while Scott's looking for

201
00:09:00,450 --> 00:09:05,430
that um can you give us some sense of

202
00:09:02,100 --> 00:09:11,070
how where these were on Europa where did

203
00:09:05,429 --> 00:09:16,649
you find them are you asking oh sorry

204
00:09:11,070 --> 00:09:19,200
I'm space in spicy snack yeah there's no

205
00:09:16,649 --> 00:09:20,970
utterance oh yeah well okay yaki let me

206
00:09:19,200 --> 00:09:23,190
get you into this uh what do you have

207
00:09:20,970 --> 00:09:27,149
where were these things on on Europa

208
00:09:23,190 --> 00:09:30,630
they were located around the South Pole

209
00:09:27,149 --> 00:09:33,600
of Europa and thought of that was very

210
00:09:30,629 --> 00:09:36,980
similar to plumes recently discovered

211
00:09:33,600 --> 00:09:39,600
with the Cassini spacecraft at Enceladus

212
00:09:36,980 --> 00:09:41,580
so originally I mean they were always

213
00:09:39,600 --> 00:09:45,840
taught around that Europa could have

214
00:09:41,580 --> 00:09:48,629

plumes and then after similar blooms

215

00:09:45,840 --> 00:09:51,120

head teen have been seen on Enceladus it

216

00:09:48,629 --> 00:09:53,669

really sort of fell into place that we

217

00:09:51,120 --> 00:09:57,000

saw something similar on a body like

218

00:09:53,669 --> 00:09:58,319

with Alta has an icy surface and Scott

219

00:09:57,000 --> 00:10:00,960

has it up now I just wanted to say that

220

00:09:58,320 --> 00:10:07,560

real quick so Elena would know so yet so

221

00:10:00,960 --> 00:10:09,389

here so here we see we we see the sort

222

00:10:07,559 --> 00:10:14,429

of blue areas down and down at the

223

00:10:09,389 --> 00:10:16,919

bottom so what you can can I say

224

00:10:14,429 --> 00:10:19,049

something about it yeah go ahead I made

225

00:10:16,919 --> 00:10:21,240

it's just yeah it's it's like that the

226

00:10:19,049 --> 00:10:24,299

Hubble data and the blue thing is to

227

00:10:21,240 --> 00:10:27,360

double and double daters of smooth then

228

00:10:24,299 --> 00:10:29,759

the pixel spin together and they just

229
00:10:27,360 --> 00:10:33,240
laid on top of a image taken by Galileo

230
00:10:29,759 --> 00:10:35,279
and of Europa or mosaic of images of

231
00:10:33,240 --> 00:10:38,100
that the surface we actually or the

232
00:10:35,279 --> 00:10:40,019
hemisphere we actually observe and the

233
00:10:38,100 --> 00:10:42,750
structure of the thing is not really

234
00:10:40,019 --> 00:10:45,299
it's not a real structure or physical

235
00:10:42,750 --> 00:10:47,879
structure in a sense and more shows like

236
00:10:45,299 --> 00:10:50,189
the statistic variability and the signal

237
00:10:47,879 --> 00:10:52,289
is rather low we see so we the kind of

238
00:10:50,190 --> 00:10:55,080
structure is is created to through

239
00:10:52,289 --> 00:10:58,949
statistics of after detector count as a

240
00:10:55,080 --> 00:11:00,959
telescope and I only like cut out this

241
00:10:58,950 --> 00:11:02,430
signal from the South Pole or we see the

242
00:11:00,958 --> 00:11:04,169
plumes and put it on top and all the

243
00:11:02,429 --> 00:11:06,689
rest is it's not in this image here so

244
00:11:04,169 --> 00:11:08,219
so if you seen anything anywhere else or

245
00:11:06,690 --> 00:11:09,660
is it all pretty much been I guess it

246
00:11:08,220 --> 00:11:11,459
with these observations it's only in the

247
00:11:09,659 --> 00:11:14,458
south but you do think there might be

248
00:11:11,458 --> 00:11:17,099
some plumes that might appear elsewhere

249
00:11:14,458 --> 00:11:18,659
on Europa or is this a is there

250
00:11:17,100 --> 00:11:19,920
something about Europa that makes them

251
00:11:18,659 --> 00:11:22,588
appear mostly here do you have any

252
00:11:19,919 --> 00:11:24,809
conjecture or thoughts on that on where

253
00:11:22,589 --> 00:11:29,550
they might be Kurt maybe I'll ask you

254
00:11:24,809 --> 00:11:31,259
that yeah sure wherever you see a linear

255
00:11:29,549 --> 00:11:32,729
feature one of these small cracks that

256
00:11:31,259 --> 00:11:34,860
you can see running across the surface

257

00:11:32,730 --> 00:11:36,360
of Europa that's those dark lines that

258
00:11:34,860 --> 00:11:38,459
you see you across those dark lines yeah

259
00:11:36,360 --> 00:11:40,379
the question is how deep do those go

260
00:11:38,458 --> 00:11:41,669
that's something that we just really

261
00:11:40,379 --> 00:11:44,730
don't know after the Galileo mission

262
00:11:41,669 --> 00:11:47,458
took all these great imageries and but

263
00:11:44,730 --> 00:11:50,339
we do know that Europa is totally forced

264
00:11:47,458 --> 00:11:52,919
by Jupiter very very strong gravity and

265
00:11:50,339 --> 00:11:54,720
it's your boat orbits around its ice

266
00:11:52,919 --> 00:11:56,759
shell gets compressed stretched and

267
00:11:54,720 --> 00:11:58,589
pulled and twisted in all sorts of

268
00:11:56,759 --> 00:12:00,958
different ways and there are all sorts

269
00:11:58,589 --> 00:12:03,420
of geophysical geophysical models out

270
00:12:00,958 --> 00:12:06,989
there that can try to sort of estimate

271
00:12:03,419 --> 00:12:08,789

where along these a linear features the

272

00:12:06,990 --> 00:12:13,100
tensile stresses would add up to

273

00:12:08,789 --> 00:12:17,189
possibly given enough energy to let some

274

00:12:13,100 --> 00:12:19,230
auto paper out into space and we're

275

00:12:17,190 --> 00:12:21,120
probably seeing you know just one of the

276

00:12:19,230 --> 00:12:23,129
biggest plumes that are on Europa

277

00:12:21,120 --> 00:12:24,899
whether there are smaller ones that I'm

278

00:12:23,129 --> 00:12:26,700
about two kilometers and said 200

279

00:12:24,899 --> 00:12:28,198
commerce and I is really an open

280

00:12:26,700 --> 00:12:30,390
question that we can only speculate

281

00:12:28,198 --> 00:12:32,099
about right now but if possible I'm glad

282

00:12:30,389 --> 00:12:34,370
you brought that up at the title the

283

00:12:32,100 --> 00:12:38,220
tidal forces that are acting on this so

284

00:12:34,370 --> 00:12:41,429
but the the surface I look at this

285

00:12:38,220 --> 00:12:42,660
picture of Europa what the we're looking

286
00:12:41,429 --> 00:12:46,649
at here and correct me if I'm wrong

287
00:12:42,659 --> 00:12:48,990
anybody uh the this is an ice-covered

288
00:12:46,649 --> 00:12:51,500
world correct this is all ice we're

289
00:12:48,990 --> 00:12:54,120
looking at on the surface right and

290
00:12:51,500 --> 00:12:55,589
these little cracks and stuff are these

291
00:12:54,120 --> 00:12:58,440
those dark lines that you were talking

292
00:12:55,589 --> 00:12:59,070
about give us those are those are faults

293
00:12:58,440 --> 00:13:01,830
or some

294
00:12:59,070 --> 00:13:05,190
sort of imperfections in the indie in

295
00:13:01,830 --> 00:13:08,280
the surface what is Europa's orbit like

296
00:13:05,190 --> 00:13:10,020
income in relation to into relation to

297
00:13:08,279 --> 00:13:12,629
do better is it highly elliptical is a

298
00:13:10,019 --> 00:13:17,490
more or less circular y'all keep I'll

299
00:13:12,629 --> 00:13:21,029
ask you that oh yeah it's it's it's only

300
00:13:17,490 --> 00:13:23,190
a little bit and non circular but that's

301
00:13:21,029 --> 00:13:28,769
already sufficient does somebody know

302
00:13:23,190 --> 00:13:32,220
the eccentricity by heart um go ahead

303
00:13:28,769 --> 00:13:35,759
yeah I don't know what the point 0 0 3

304
00:13:32,220 --> 00:13:38,160
okay so it's a stupid kind of deviation

305
00:13:35,759 --> 00:13:40,110
from being circular but that's already

306
00:13:38,159 --> 00:13:43,139
sufficient because it's so close to that

307
00:13:40,110 --> 00:13:45,659
very massive planet that it still

308
00:13:43,139 --> 00:13:46,980
experienced heights on the surface okay

309
00:13:45,659 --> 00:13:49,289
that's the point I was trying to get to

310
00:13:46,980 --> 00:13:51,659
so there's got to be there's a there's a

311
00:13:49,289 --> 00:13:53,490
point in its orbit around Jupiter where

312
00:13:51,659 --> 00:13:59,309
their forces are stronger than it others

313
00:13:53,490 --> 00:14:03,389
correct okay so correct okay so so given

314

00:13:59,309 --> 00:14:04,619
that I are that one would expect at

315
00:14:03,389 --> 00:14:06,960
certain times of the orbit that there

316
00:14:04,620 --> 00:14:08,639
are these plumes would be present and

317
00:14:06,960 --> 00:14:09,990
one spot and maybe they'd be President

318
00:14:08,639 --> 00:14:12,019
and other depending on the forces acting

319
00:14:09,990 --> 00:14:15,750
on their boat is there ever a time when

320
00:14:12,019 --> 00:14:17,340
you know they might be more active than

321
00:14:15,750 --> 00:14:19,409
not is there any speculation on that

322
00:14:17,340 --> 00:14:22,710
make Lorenz do you have any any thoughts

323
00:14:19,409 --> 00:14:26,069
on that yeah that was we had a kind of

324
00:14:22,710 --> 00:14:27,900
suggestion after like the first three

325
00:14:26,070 --> 00:14:30,120
setups of observations we had we had

326
00:14:27,899 --> 00:14:32,279
this one detection and like i said from

327
00:14:30,120 --> 00:14:35,340
december two thousand twelve then we had

328
00:14:32,279 --> 00:14:36,899

the same kind of observations just from

329

00:14:35,340 --> 00:14:40,259

one month earlier in november two

330

00:14:36,899 --> 00:14:42,029

thousand twelve and we had very similar

331

00:14:40,259 --> 00:14:45,659

observations are also the same and from

332

00:14:42,029 --> 00:14:48,149

october 99s over 13 years ago and and

333

00:14:45,659 --> 00:14:51,149

the other two sets of observations and

334

00:14:48,149 --> 00:14:53,610

for taking mini ROK bar was closed

335

00:14:51,149 --> 00:14:55,379

Jupiter whereas in december two thousand

336

00:14:53,610 --> 00:14:58,169

twelve where the detection was made

337

00:14:55,379 --> 00:15:01,080

europa was further away from Jupiter so

338

00:14:58,169 --> 00:15:03,149

we had this idea that did the relative

339

00:15:01,080 --> 00:15:05,930

distance or the position of European its

340

00:15:03,149 --> 00:15:08,850

elliptical orbit and is connected to the

341

00:15:05,929 --> 00:15:11,729

m2 these two the existence or to the

342

00:15:08,850 --> 00:15:12,570

activity of the plumes based on these

343
00:15:11,730 --> 00:15:14,550
three

344
00:15:12,570 --> 00:15:18,450
observations that's not a good statistic

345
00:15:14,549 --> 00:15:21,599
with three data points but another clue

346
00:15:18,450 --> 00:15:23,640
was that the plumes of this saturn's

347
00:15:21,600 --> 00:15:27,060
moon enceladus you haven't mentioned

348
00:15:23,639 --> 00:15:28,980
earlier and there and we have seen so

349
00:15:27,059 --> 00:15:30,479
Cassini has taken a lot of images and we

350
00:15:28,980 --> 00:15:32,970
know that there is this connection that

351
00:15:30,480 --> 00:15:35,430
when telus is further away from say turn

352
00:15:32,970 --> 00:15:38,580
the plumes are more active and when it's

353
00:15:35,429 --> 00:15:40,349
closer to say turn and then they are

354
00:15:38,580 --> 00:15:42,570
less active so we had the idea that the

355
00:15:40,350 --> 00:15:44,909
same thing is happening it at Europa

356
00:15:42,570 --> 00:15:48,060
there and what we don't have any proof

357
00:15:44,909 --> 00:15:51,539
and for the AdSense and we only had two

358
00:15:48,059 --> 00:15:54,509
three data points okay you are kima how

359
00:15:51,539 --> 00:15:59,789
how did you know when you took this data

360
00:15:54,509 --> 00:16:03,559
that you were looking at water vapor the

361
00:15:59,789 --> 00:16:06,599
like we saw oxygen lines and we saw

362
00:16:03,559 --> 00:16:10,229
hydrogen line to the hype one the

363
00:16:06,600 --> 00:16:13,680
lyman-alpha of hydrogen and the emission

364
00:16:10,230 --> 00:16:17,550
was in a race you such as that electron

365
00:16:13,679 --> 00:16:21,169
break water molecules apart and because

366
00:16:17,549 --> 00:16:24,000
the service anyway consists out of water

367
00:16:21,169 --> 00:16:27,839
so what is the primary molecule that's

368
00:16:24,000 --> 00:16:30,240
around and and because we only saw it as

369
00:16:27,840 --> 00:16:32,070
a Pecha the South Pole needed to be blue

370
00:16:30,240 --> 00:16:35,549
but the ratio of the hydrogen and the

371

00:16:32,070 --> 00:16:38,760
oxygen emission lines that told us it

372
00:16:35,549 --> 00:16:42,569
needs to be watered it and broken up can

373
00:16:38,759 --> 00:16:44,610
you tell us how in in particular

374
00:16:42,570 --> 00:16:46,950
observations and you can pick you know

375
00:16:44,610 --> 00:16:51,659
whether December or the other the other

376
00:16:46,950 --> 00:16:55,980
time how high are these things how big

377
00:16:51,659 --> 00:16:58,769
were they it it's based on our

378
00:16:55,980 --> 00:17:01,110
calculation day of roughly 200 they rise

379
00:16:58,769 --> 00:17:05,819
up 200 kilometers above the surface oh

380
00:17:01,110 --> 00:17:08,519
wow ah nice uh well that's not so

381
00:17:05,819 --> 00:17:10,500
surprising it Europa because because

382
00:17:08,519 --> 00:17:12,660
gravity is much smaller stand up guys

383
00:17:10,500 --> 00:17:14,670
here on the earth doesn't make it 200

384
00:17:12,660 --> 00:17:17,070
kilometers because gravity on the earth

385
00:17:14,670 --> 00:17:19,439

is much stronger than gravity on Europa

386

00:17:17,069 --> 00:17:21,480
and I'm sure the tidal forces with

387

00:17:19,439 --> 00:17:24,390
Jupiter they're much stronger on that

388

00:17:21,480 --> 00:17:25,439
less massive planetary body too so that

389

00:17:24,390 --> 00:17:28,110
I would have a

390

00:17:25,439 --> 00:17:30,240
larger effect on it right yes that's to

391

00:17:28,109 --> 00:17:32,278
end anyway the moon is so much closer to

392

00:17:30,240 --> 00:17:34,769
Jupiter there and like for example like

393

00:17:32,278 --> 00:17:36,538
the earth-moon that creates the the

394

00:17:34,769 --> 00:17:39,120
tidal forces on the earth is even like

395

00:17:36,538 --> 00:17:41,548
the distance and the mazes are so much

396

00:17:39,119 --> 00:17:46,079
more in favor of being strong at Europa

397

00:17:41,548 --> 00:17:47,609
and the and I i was reading the press

398

00:17:46,079 --> 00:17:49,678
release earlier and i was and it was

399

00:17:47,609 --> 00:17:54,319
being compared to the plumes around

400
00:17:49,679 --> 00:17:56,909
Saturn's moon Enceladus do you are they

401
00:17:54,319 --> 00:18:00,138
are they roughly the same the roughly

402
00:17:56,909 --> 00:18:02,929
the same size and characteristics as

403
00:18:00,138 --> 00:18:09,209
what was seen in as what was seen on

404
00:18:02,929 --> 00:18:10,590
Enceladus yep into to some extent yeah

405
00:18:09,210 --> 00:18:12,210
roughly they are roughly the same size

406
00:18:10,589 --> 00:18:14,788
that's correct but there's a key

407
00:18:12,210 --> 00:18:17,370
difference intelligence is even less

408
00:18:14,788 --> 00:18:20,009
messy than you Europa so so the glooms

409
00:18:17,369 --> 00:18:22,288
actually at Enceladus are not really

410
00:18:20,009 --> 00:18:25,378
stopped by the gravity so they just keep

411
00:18:22,288 --> 00:18:27,179
going and they they leave a lot of the

412
00:18:25,378 --> 00:18:29,369
mayors of Enceladus just leaves

413
00:18:27,179 --> 00:18:32,460
intelligence because gravity cannot hold

414
00:18:29,369 --> 00:18:35,069
it well on Europa that's more massive

415
00:18:32,460 --> 00:18:41,730
body so the border plumes the stock

416
00:18:35,069 --> 00:18:44,189
falls back on Europa okay uh Kurt when

417
00:18:41,730 --> 00:18:46,470
you first saw this come on now this had

418
00:18:44,190 --> 00:18:47,548
to be in a big deal I mean I i I've when

419
00:18:46,470 --> 00:18:49,470
I first read about the press release

420
00:18:47,548 --> 00:18:53,429
earlier the earlier I guess is late last

421
00:18:49,470 --> 00:18:55,048
year the thought this was huge new so

422
00:18:53,429 --> 00:18:58,200
what did you think when you saw these

423
00:18:55,048 --> 00:19:00,179
planes coming up well we had hints of

424
00:18:58,200 --> 00:19:03,120
something interesting going on and some

425
00:19:00,179 --> 00:19:05,370
data that document published using a

426
00:19:03,119 --> 00:19:07,709
different instrument on Ebola called the

427
00:19:05,369 --> 00:19:09,658
ACS and solely enhance camera for

428

00:19:07,710 --> 00:19:12,139
surveys the fans camper service yes and

429
00:19:09,659 --> 00:19:15,028
we use the other ultraviolet wavelengths

430
00:19:12,138 --> 00:19:16,740
again to look for oxygen emissions and

431
00:19:15,028 --> 00:19:17,849
we thought we saw a little bump a hint

432
00:19:16,740 --> 00:19:20,788
or something that wasn't really well

433
00:19:17,849 --> 00:19:23,759
explained by I things on but so we

434
00:19:20,788 --> 00:19:25,109
really did dedicate a observing proposal

435
00:19:23,759 --> 00:19:27,808
to hobble to look for something

436
00:19:25,109 --> 00:19:30,418
specifically but we thought we'd see the

437
00:19:27,808 --> 00:19:33,839
plume maybe on the disk of Europa book

438
00:19:30,419 --> 00:19:36,419
when Lauren's show me the data that he

439
00:19:33,839 --> 00:19:39,419
published you know and there was this

440
00:19:36,419 --> 00:19:43,110
awful inhibition of this hydrogen

441
00:19:39,420 --> 00:19:44,700
Adam brightness it was just very bright

442
00:19:43,109 --> 00:19:46,829

compared to things that we've seen a tie

443

00:19:44,700 --> 00:19:50,069

on Ganymede before six hundred raley's

444

00:19:46,829 --> 00:19:52,169

versus of two hundred raleys or 100

445

00:19:50,069 --> 00:19:53,730

raleys of the oxygen show but that's

446

00:19:52,170 --> 00:19:55,620

just a science unit for brightness the

447

00:19:53,730 --> 00:19:57,990

higher the number the brighter so in

448

00:19:55,619 --> 00:19:59,549

your thin rate we had a good feel for

449

00:19:57,990 --> 00:20:04,109

what the brightness is told this in

450

00:19:59,549 --> 00:20:06,659

terms of a sort of how big this was and

451

00:20:04,109 --> 00:20:08,819

yeah that was a big deal and I sort of

452

00:20:06,660 --> 00:20:11,160

blinked twice and said boy yeah Lawrence

453

00:20:08,819 --> 00:20:12,839

we gotta sit down jackman really work

454

00:20:11,160 --> 00:20:14,460

out the statistics on this make sure

455

00:20:12,839 --> 00:20:18,359

this is right because this really would

456

00:20:14,460 --> 00:20:19,920

have big implications and turn off every

457
00:20:18,359 --> 00:20:21,869
explanation that we came up with in our

458
00:20:19,920 --> 00:20:23,250
own mind for how this data worked kept

459
00:20:21,869 --> 00:20:26,489
pointing back to plumes made the best

460
00:20:23,250 --> 00:20:29,670
explanation so I did have a question um

461
00:20:26,490 --> 00:20:32,039
I wanted to eat you to clarify exactly

462
00:20:29,670 --> 00:20:35,910
how the observation was taken so how

463
00:20:32,039 --> 00:20:40,079
much of the disk did you get in a single

464
00:20:35,910 --> 00:20:42,029
observation okay so Lawrence briefly

465
00:20:40,079 --> 00:20:43,919
described how we use a long slit

466
00:20:42,029 --> 00:20:46,279
spectrograph right to attend

467
00:20:43,920 --> 00:20:48,450
observations in Europa's disk filled up

468
00:20:46,279 --> 00:20:51,149
half of that slip with so we basically

469
00:20:48,450 --> 00:20:53,370
had to Europa radii from the center of

470
00:20:51,150 --> 00:20:55,350
that slit great event that you saw on

471
00:20:53,369 --> 00:20:56,969
the website maybe can bring it up again

472
00:20:55,349 --> 00:20:59,490
what you see is pretty much what we got

473
00:20:56,970 --> 00:21:00,839
or we have other slides too and all the

474
00:20:59,490 --> 00:21:02,849
pixels that you see on these images

475
00:21:00,839 --> 00:21:05,129
showed with the full extent of what

476
00:21:02,849 --> 00:21:06,389
we're looking at um that's pretty much

477
00:21:05,130 --> 00:21:08,850
the view that Hubble had right there

478
00:21:06,390 --> 00:21:10,470
that width across Europe okay so we

479
00:21:08,849 --> 00:21:14,789
didn't have to scan across it anything

480
00:21:10,470 --> 00:21:17,880
like that we got it all in one view we

481
00:21:14,789 --> 00:21:21,359
had to to do five hub orbits in a row to

482
00:21:17,880 --> 00:21:26,700
build up our signals noise but uh yeah

483
00:21:21,359 --> 00:21:28,439
we do have that same time so I see some

484
00:21:26,700 --> 00:21:31,470
other data up here maybe Lawrence wants

485

00:21:28,440 --> 00:21:35,210
to talk us through this one at a time

486
00:21:31,470 --> 00:21:37,319
when you go one slide or back to the

487
00:21:35,210 --> 00:21:43,559
spectral image it's a couple of flights

488
00:21:37,319 --> 00:21:46,289
earlier and Sonia it even one more yeah

489
00:21:43,559 --> 00:21:49,519
this one so that's if you probably need

490
00:21:46,289 --> 00:21:53,369
to zoom in here that's you can see like

491
00:21:49,519 --> 00:21:56,369
it's an image of Europa and in these

492
00:21:53,369 --> 00:21:59,219
yellow boxes here and we do get an image

493
00:21:56,369 --> 00:22:01,889
at the hydrogen lyman-alpha line that's

494
00:21:59,220 --> 00:22:03,600
the leftmost box here and at a sign at

495
00:22:01,890 --> 00:22:06,900
the same time we do get an image to

496
00:22:03,599 --> 00:22:09,359
oxygen lines to different wavelengths

497
00:22:06,900 --> 00:22:11,640
and so we have three images taken at the

498
00:22:09,359 --> 00:22:13,859
same time and then we compared the

499
00:22:11,640 --> 00:22:16,140

brightness and did this spatial

500

00:22:13,859 --> 00:22:19,079

distribution of the emissions in these

501

00:22:16,140 --> 00:22:23,130

images and what we did see is that the

502

00:22:19,079 --> 00:22:25,980

same location emissions showed up in the

503

00:22:23,130 --> 00:22:27,390

hydrogen image and in the one of one of

504

00:22:25,980 --> 00:22:29,700

the oxygen images but not in the other

505

00:22:27,390 --> 00:22:32,940

one and this is this particular ratio

506

00:22:29,700 --> 00:22:35,539

and it's kind of an indication for and

507

00:22:32,940 --> 00:22:38,970

that water isn't involved in the process

508

00:22:35,539 --> 00:22:42,750

so the way the spectrum works for an

509

00:22:38,970 --> 00:22:46,710

imaging spectrograph is if the object in

510

00:22:42,750 --> 00:22:49,650

Europa in this case was emitting sort of

511

00:22:46,710 --> 00:22:52,140

uniformly or in a continuous manner you

512

00:22:49,650 --> 00:22:55,200

would just see a smear like you do off

513

00:22:52,140 --> 00:22:58,710

to the right of the blue band but

514
00:22:55,200 --> 00:23:01,110
because it's specifically emitting or

515
00:22:58,710 --> 00:23:04,590
oxygen and hydrogen are then you get a

516
00:23:01,109 --> 00:23:07,049
brighter disk and so that is the picture

517
00:23:04,589 --> 00:23:09,808
if you will of Europa and hydrogen and

518
00:23:07,049 --> 00:23:12,509
then in oxygen and then the other smooth

519
00:23:09,808 --> 00:23:18,230
emission that it has as it shines

520
00:23:12,509 --> 00:23:18,230
reflected light right expect

521
00:23:22,710 --> 00:23:29,759
in my back can you hear me yes I'm

522
00:23:26,220 --> 00:23:31,829
really sorry folks I am having isp

523
00:23:29,759 --> 00:23:34,140
problems I can't apologize enough I

524
00:23:31,829 --> 00:23:36,148
really I'm a dropout I don't I can't

525
00:23:34,140 --> 00:23:37,770
understand what the stability issues of

526
00:23:36,148 --> 00:23:41,819
are here but they're not great so my

527
00:23:37,769 --> 00:23:43,440
apologies so I'm not quite sure I saw

528
00:23:41,819 --> 00:23:45,720
the spectra there and I guess I was that

529
00:23:43,440 --> 00:23:47,100
was explaining a little bit about how

530
00:23:45,720 --> 00:23:53,130
you do what you were looking at was

531
00:23:47,099 --> 00:23:55,408
water vapor and it was the water is are

532
00:23:53,130 --> 00:23:58,980
we sure that there is water underneath

533
00:23:55,409 --> 00:24:01,020
the crust anybody anybody have any I

534
00:23:58,980 --> 00:24:03,089
mean how sure are we that there are

535
00:24:01,019 --> 00:24:05,538
there there's water vapor or water

536
00:24:03,089 --> 00:24:11,339
liquid water underneath the cross there

537
00:24:05,538 --> 00:24:13,230
Kurt well I'm no expert on the internal

538
00:24:11,339 --> 00:24:14,490
geophysics of things but the Galileo

539
00:24:13,230 --> 00:24:18,120
mission really did give us a lot of

540
00:24:14,490 --> 00:24:20,609
insights into both the inner workings of

541
00:24:18,119 --> 00:24:23,308
the satellite and also surface features

542

00:24:20,609 --> 00:24:25,288
that hinted to his previous activity

543
00:24:23,308 --> 00:24:26,908
whether its current activity or not just

544
00:24:25,288 --> 00:24:29,278
the way the terrain looks like it just

545
00:24:26,909 --> 00:24:31,620
one features stood out from other

546
00:24:29,278 --> 00:24:33,720
features and having sort of a liquid a

547
00:24:31,619 --> 00:24:35,759
sort of process underneath I shall

548
00:24:33,720 --> 00:24:39,960
provide a good explanations for that and

549
00:24:35,759 --> 00:24:42,808
so I think everyone had really good

550
00:24:39,960 --> 00:24:44,278
circumstantial evidence for a subsurface

551
00:24:42,808 --> 00:24:47,220
ocean there was also a magnetometer

552
00:24:44,278 --> 00:24:50,849
experiment that saw the induced field

553
00:24:47,220 --> 00:24:53,819
change around Europa based on internal

554
00:24:50,849 --> 00:24:57,119
currents of salty water as magnetic

555
00:24:53,819 --> 00:24:58,859
field around Jupiter around so lots of

556
00:24:57,119 --> 00:25:01,558

things that working director to get into

557

00:24:58,859 --> 00:25:03,449

the subsurface but these plumes I think

558

00:25:01,558 --> 00:25:06,379

really excited everybody and maybe

559

00:25:03,450 --> 00:25:09,330

crystallized this idea of subsurface of

560

00:25:06,380 --> 00:25:11,610

liquid regions on Europa people's minds

561

00:25:09,329 --> 00:25:13,019

and you know if and when these plumes

562

00:25:11,609 --> 00:25:16,648

are confirmed by subsequent observations

563

00:25:13,019 --> 00:25:20,190

I think that'll be a real confirming

564

00:25:16,648 --> 00:25:21,439

aspect of global ocean ideas now whether

565

00:25:20,190 --> 00:25:23,429

the water we're seeing is actually

566

00:25:21,440 --> 00:25:25,320

connected all the way down to some

567

00:25:23,429 --> 00:25:27,809

subsurface ocean kilometers down or

568

00:25:25,319 --> 00:25:29,609

maybe just in a little subsurface lake

569

00:25:27,808 --> 00:25:31,589

trapped within an ice layer a little

570

00:25:29,609 --> 00:25:33,808

build lens within the ice shell or not

571
00:25:31,589 --> 00:25:36,449
something that will really only get to

572
00:25:33,808 --> 00:25:38,490
know what's future mission well what

573
00:25:36,450 --> 00:25:41,910
are there any are there any plans to

574
00:25:38,490 --> 00:25:44,640
send something out to to look at this to

575
00:25:41,910 --> 00:25:47,580
investigate this closer yes there are

576
00:25:44,640 --> 00:25:49,800
one mission called chuse the jupiter icy

577
00:25:47,579 --> 00:25:52,289
moon Explorer mission is being led by

578
00:25:49,799 --> 00:25:54,299
isa its alternate destiny is order on

579
00:25:52,289 --> 00:25:56,490
Ganymede but it will do to fly by

580
00:25:54,299 --> 00:25:58,859
around Europa and try to address some of

581
00:25:56,490 --> 00:26:01,440
these goals but just very recently if

582
00:25:58,859 --> 00:26:03,839
winds not going to happen uh it's going

583
00:26:01,440 --> 00:26:06,450
to launch in 2020 you know won't really

584
00:26:03,839 --> 00:26:10,049
get till to Jupiter until 2030 so this

585
00:26:06,450 --> 00:26:12,059
is a long-duration mission a long time

586
00:26:10,049 --> 00:26:16,440
delayed gratification type of process

587
00:26:12,059 --> 00:26:18,059
here thank you son but also some of this

588
00:26:16,440 --> 00:26:21,330
excitement about the plume discovery we

589
00:26:18,059 --> 00:26:24,720
have has helped take an idea to put a

590
00:26:21,329 --> 00:26:28,049
real fluid mission for NASA back on to

591
00:26:24,720 --> 00:26:30,450
the budget books and we've had de kado

592
00:26:28,049 --> 00:26:32,039
survey after taquito survey I they make

593
00:26:30,450 --> 00:26:33,720
this meal for science go study these

594
00:26:32,039 --> 00:26:37,799
questions about the or propulsion work

595
00:26:33,720 --> 00:26:39,210
or not and it's just seemed to be enough

596
00:26:37,799 --> 00:26:40,889
money in the budget make it happen right

597
00:26:39,210 --> 00:26:44,009
now there's an instrument called but the

598
00:26:40,890 --> 00:26:45,150
poles is out to do group of payload

599

00:26:44,009 --> 00:26:49,440
instruments to go and address the

600
00:26:45,150 --> 00:26:51,630
science goals that we are really unravel

601
00:26:49,440 --> 00:26:53,970
all these questions about Europa that we

602
00:26:51,630 --> 00:26:55,320
have now and vault really rolling on

603
00:26:53,970 --> 00:26:58,500
this NASA mission out so we're all

604
00:26:55,319 --> 00:27:02,609
really excited oh that's great so are

605
00:26:58,500 --> 00:27:04,140
you guys planning on looking at yo Keem

606
00:27:02,609 --> 00:27:05,519
Alaska's to you are you planning on

607
00:27:04,140 --> 00:27:08,759
looking at Europa any more in the future

608
00:27:05,519 --> 00:27:11,670
oh maybe you should give that to

609
00:27:08,759 --> 00:27:14,700
Lawrence like the reason sorry I was the

610
00:27:11,670 --> 00:27:16,920
p.i on the first two campaigns that to

611
00:27:14,700 --> 00:27:20,509
up to it now Lauren's took over it now

612
00:27:16,920 --> 00:27:23,220
Lawrence's is the p.i on the next huge

613
00:27:20,509 --> 00:27:25,259

campaign that we're looking at all so he

614

00:27:23,220 --> 00:27:29,549

can told you you know that okay so

615

00:27:25,259 --> 00:27:33,000

Lawrence yes so we and we already had

616

00:27:29,549 --> 00:27:35,569

like em follow-up observations after the

617

00:27:33,000 --> 00:27:39,420

initial detection early this year and

618

00:27:35,569 --> 00:27:41,490

but they could not confirm the initial

619

00:27:39,420 --> 00:27:44,759

detection basically I mean it's it's

620

00:27:41,490 --> 00:27:46,799

it's it's never really said that like

621

00:27:44,759 --> 00:27:49,019

Kurt said before that there's no plumes

622

00:27:46,799 --> 00:27:49,980

it's just we don't see you don't haven't

623

00:27:49,019 --> 00:27:52,190

seen them

624

00:27:49,980 --> 00:27:54,150

these follow-up observations so to

625

00:27:52,190 --> 00:27:58,200

follow observation didn't bring

626

00:27:54,150 --> 00:28:00,570

confirmation and but on the other way

627

00:27:58,200 --> 00:28:04,620

they they also do not exclude it all

628
00:28:00,569 --> 00:28:06,750
that there's plumes and um so we're

629
00:28:04,619 --> 00:28:09,209
still looking for confirmation of these

630
00:28:06,750 --> 00:28:12,419
booms and in a possible way and I think

631
00:28:09,210 --> 00:28:14,250
other people are too and so we will also

632
00:28:12,419 --> 00:28:16,710
have observations with the same

633
00:28:14,250 --> 00:28:18,690
technique basically we just detected two

634
00:28:16,710 --> 00:28:21,419
blooms in the next Hubble cycle so

635
00:28:18,690 --> 00:28:25,080
starting this fall and then going on and

636
00:28:21,419 --> 00:28:27,750
until early next next year and we'll try

637
00:28:25,079 --> 00:28:29,689
a couple of times again and the same

638
00:28:27,750 --> 00:28:33,240
technique to see the plums again oh

639
00:28:29,690 --> 00:28:35,009
great so the so we've got more

640
00:28:33,240 --> 00:28:36,599
observations coming up there are other

641
00:28:35,009 --> 00:28:39,839
people are confirming once you've got

642
00:28:36,599 --> 00:28:45,509
let's talk a little bit about whether or

643
00:28:39,839 --> 00:28:48,779
not the this does this do you gives us

644
00:28:45,509 --> 00:28:50,460
more motivation to not only back and

645
00:28:48,779 --> 00:28:51,899
look for for water there but what are

646
00:28:50,460 --> 00:28:54,960
the implications do you think Lauren's

647
00:28:51,900 --> 00:28:56,940
analysis you three for the chance of

648
00:28:54,960 --> 00:28:59,370
life in the solar system now I know this

649
00:28:56,940 --> 00:29:00,480
is a that's a speculative thing but but

650
00:28:59,369 --> 00:29:02,069
you know what are your you have an

651
00:29:00,480 --> 00:29:04,980
opinion on what this might mean for that

652
00:29:02,069 --> 00:29:09,839
i mean i would i would say it doesn't

653
00:29:04,980 --> 00:29:11,970
have any implications for for life on

654
00:29:09,839 --> 00:29:13,439
Europa just the existence of blooms

655
00:29:11,970 --> 00:29:16,710
doesn't have any implications because

656

00:29:13,440 --> 00:29:20,100
they're not I mean it's just they

657
00:29:16,710 --> 00:29:22,500
potentially give us a way and to probe

658
00:29:20,099 --> 00:29:25,019
the subsurface an environment of

659
00:29:22,500 --> 00:29:27,720
Europa's subsurface ocean subsurface

660
00:29:25,019 --> 00:29:29,668
lakes because if they are and connected

661
00:29:27,720 --> 00:29:31,650
to a subsurface lake you could think of

662
00:29:29,669 --> 00:29:34,700
a spacecraft flying through the plume

663
00:29:31,650 --> 00:29:37,620
measuring particles or just orbiting and

664
00:29:34,700 --> 00:29:39,390
euro per and observing to come from

665
00:29:37,619 --> 00:29:42,058
nearby and getting an idea of the

666
00:29:39,390 --> 00:29:44,820
composition and off the clothes and

667
00:29:42,058 --> 00:29:47,579
thereby after the subsurface and since

668
00:29:44,819 --> 00:29:49,980
like this the subsurface liquid

669
00:29:47,579 --> 00:29:53,129
environment and might be habitable so

670
00:29:49,980 --> 00:29:56,400

might Harbor life cannot exclude this

671

00:29:53,130 --> 00:29:58,049

and the plumes might allow us to check

672

00:29:56,400 --> 00:30:01,110

this and much easier than we thought

673

00:29:58,048 --> 00:30:02,849

before Scott had a comment up but I

674

00:30:01,109 --> 00:30:03,869

don't know if it got shown but it's from

675

00:30:02,849 --> 00:30:06,539

YouTube thank you for doing that

676

00:30:03,869 --> 00:30:08,609

god it's auto raag 134 from youtube goes

677

00:30:06,539 --> 00:30:12,629

if there is liquid water there is life

678

00:30:08,609 --> 00:30:15,209

well period okay it should be our

679

00:30:12,630 --> 00:30:16,860

highest priority mission and then he

680

00:30:15,210 --> 00:30:18,029

also goes on the state to a I think it

681

00:30:16,859 --> 00:30:20,639

got cut off in there because it why

682

00:30:18,029 --> 00:30:22,230

don't we fly a crap through a plume and

683

00:30:20,640 --> 00:30:25,680

look for life so you kind of touched on

684

00:30:22,230 --> 00:30:27,420

line already but is there any plans for

685
00:30:25,680 --> 00:30:29,640
that and what would what would they be

686
00:30:27,420 --> 00:30:32,460
looking for if they are if we're flying

687
00:30:29,640 --> 00:30:33,960
a spacecraft through a plume what sort

688
00:30:32,460 --> 00:30:35,730
of instruments but we have to have on

689
00:30:33,960 --> 00:30:40,640
there to be looking for these signs of

690
00:30:35,730 --> 00:30:42,720
life I'll answer that we have a

691
00:30:40,640 --> 00:30:45,360
instruments called the mass

692
00:30:42,720 --> 00:30:48,360
spectrometers that can take an atom or

693
00:30:45,359 --> 00:30:50,490
molecule into a chamber and measure it

694
00:30:48,359 --> 00:30:53,009
Friday different ways to understand by

695
00:30:50,490 --> 00:30:54,660
to mass mostly which constituent looking

696
00:30:53,009 --> 00:30:57,240
at if you look at a periodic table of

697
00:30:54,660 --> 00:30:59,640
elements just know by the mass this

698
00:30:57,240 --> 00:31:02,759
community what species you're looking at

699
00:30:59,640 --> 00:31:04,620
then measured abundances that way and so

700
00:31:02,759 --> 00:31:06,990
water vapor is going to be the main

701
00:31:04,619 --> 00:31:09,959
thing coming out at at assess we fly

702
00:31:06,990 --> 00:31:12,750
through these poon but uh as we found on

703
00:31:09,960 --> 00:31:14,900
Enceladus 108 here in Southwest Research

704
00:31:12,750 --> 00:31:17,369
pneus to Lisa's experiment actually

705
00:31:14,900 --> 00:31:20,550
there are other species of interest like

706
00:31:17,369 --> 00:31:23,159
ammonia carbon monoxide and other types

707
00:31:20,549 --> 00:31:25,139
of hydrocarbons to already known to be a

708
00:31:23,160 --> 00:31:27,450
solid plan so that's the kind of thing

709
00:31:25,140 --> 00:31:29,429
that we look at coming out of Europa as

710
00:31:27,450 --> 00:31:30,690
well but the composition might be a

711
00:31:29,429 --> 00:31:32,670
little different just based on the

712
00:31:30,690 --> 00:31:35,308
chemistry of Europa's ocean compared to

713

00:31:32,670 --> 00:31:38,220
that of the solidus justice last year

714
00:31:35,308 --> 00:31:40,970
and solidus was known to have a really

715
00:31:38,220 --> 00:31:44,850
extended subjects oceans well that's a

716
00:31:40,970 --> 00:31:47,759
good so Tom Snyder Q&A app is asking

717
00:31:44,849 --> 00:31:52,369
does the water vapor remain in the Rose

718
00:31:47,759 --> 00:31:52,369
orbit or is it lost into space any idea

719
00:31:52,609 --> 00:32:00,740
Lorenz in the am yeah so that's that's

720
00:31:56,940 --> 00:32:03,779
to do with it gravitation at Europa and

721
00:32:00,740 --> 00:32:06,019
also like the altitude we we kind of

722
00:32:03,779 --> 00:32:08,940
estimate for the plumes and and

723
00:32:06,019 --> 00:32:10,799
particles need a speed of about two

724
00:32:08,940 --> 00:32:14,190
kilometers per second to leave the

725
00:32:10,799 --> 00:32:17,009
gravity field of Europa and then from

726
00:32:14,190 --> 00:32:17,370
what we see we think that particles as a

727
00:32:17,009 --> 00:32:19,259

low

728

00:32:17,369 --> 00:32:22,019
or speed so they cannot leave the

729

00:32:19,259 --> 00:32:23,279
gravity field of Europa or most of them

730

00:32:22,019 --> 00:32:26,970
like probably more than ninety percent

731

00:32:23,279 --> 00:32:28,740
will fall back to the surface and as the

732

00:32:26,970 --> 00:32:34,500
surface temperatures are allowed about

733

00:32:28,740 --> 00:32:36,710
like 100 m 130 kelvin so clearly below

734

00:32:34,500 --> 00:32:39,990
freezing these these water molecules

735

00:32:36,710 --> 00:32:44,279
will freeze immediately and stick to the

736

00:32:39,990 --> 00:32:46,859
surface so and yeah okay alright so i

737

00:32:44,279 --> 00:32:50,639
can imagine depending on the the tidal

738

00:32:46,859 --> 00:32:52,709
forces that Europa is under one could

739

00:32:50,640 --> 00:32:55,880
imagine that i don't know i imagine that

740

00:32:52,710 --> 00:32:58,829
the source of energy for that keeps this

741

00:32:55,880 --> 00:33:01,080
if the keeps the water liquid would be

742
00:32:58,829 --> 00:33:05,779
from this this tidal heat correct or am

743
00:33:01,079 --> 00:33:08,460
I am I completely not understanding the

744
00:33:05,779 --> 00:33:11,279
characteristics of Europa wouldn't it

745
00:33:08,460 --> 00:33:15,000
need this sort of this tidal friction to

746
00:33:11,279 --> 00:33:18,420
keep the water liquid yes that's correct

747
00:33:15,000 --> 00:33:21,299
okay so if that's true then it's

748
00:33:18,420 --> 00:33:22,740
possible that it could be pockets of

749
00:33:21,299 --> 00:33:25,649
water here and there and not necessarily

750
00:33:22,740 --> 00:33:27,480
uniform all the way around the plan or

751
00:33:25,650 --> 00:33:30,450
around the moon so we might have just

752
00:33:27,480 --> 00:33:32,819
small areas where water might be but

753
00:33:30,450 --> 00:33:37,319
other areas where you know it's still

754
00:33:32,819 --> 00:33:39,928
ice all the way down correct only for

755
00:33:37,319 --> 00:33:42,659
the part that connects to space I think

756
00:33:39,929 --> 00:33:44,340
consensus is is that the the global I

757
00:33:42,660 --> 00:33:46,140
mean the subsurface ocean would be a

758
00:33:44,339 --> 00:33:48,720
global one just based on the dynamics of

759
00:33:46,140 --> 00:33:51,210
the data that was sent back from Galileo

760
00:33:48,720 --> 00:33:52,769
now from would you agree to that yeah

761
00:33:51,210 --> 00:33:54,509
yeah exactly i think that needs to be

762
00:33:52,769 --> 00:33:57,450
separated there's very strong evidence

763
00:33:54,509 --> 00:34:00,990
that there is this global subsurface

764
00:33:57,450 --> 00:34:03,900
ocean okay we've already and that comes

765
00:34:00,990 --> 00:34:06,058
from the geology of the surface that can

766
00:34:03,900 --> 00:34:08,190
only be reasonably explained like if

767
00:34:06,058 --> 00:34:11,909
there is an ocean because if there's an

768
00:34:08,190 --> 00:34:15,119
ocean the tides are much stronger and so

769
00:34:11,909 --> 00:34:17,760
that allows to give to make the cracks

770

00:34:15,119 --> 00:34:19,949
on the surface and at the same time the

771
00:34:17,760 --> 00:34:22,350
magnetometer has measured magnetic field

772
00:34:19,949 --> 00:34:26,009
anomalies which only really can be

773
00:34:22,349 --> 00:34:29,429
explained with the global ocean I say

774
00:34:26,010 --> 00:34:30,710
okay so the I I want to point out real

775
00:34:29,429 --> 00:34:33,619
quick that Judy Schmidt is common

776
00:34:30,710 --> 00:34:35,898
on the Q&A app in celle des is much

777
00:34:33,619 --> 00:34:37,940
smaller than Europa and there is a great

778
00:34:35,898 --> 00:34:40,128
a pod astronomy picture of the day

779
00:34:37,940 --> 00:34:42,050
coming up to show this tomorrow so thank

780
00:34:40,128 --> 00:34:44,329
you Judy oh I will think so keep on look

781
00:34:42,050 --> 00:34:45,589
at that's it that's the Astronomy

782
00:34:44,329 --> 00:34:46,639
Picture of the Day it's a great thing if

783
00:34:45,588 --> 00:34:47,750
you haven't subscribed to it and checked

784
00:34:46,639 --> 00:34:51,079

it out every day it's a wonderful thing

785

00:34:47,750 --> 00:34:54,769

to do to look at I I have a question

786

00:34:51,079 --> 00:34:59,139

haha so my question is when you look at

787

00:34:54,769 --> 00:35:01,670

the images that we have from Galileo of

788

00:34:59,139 --> 00:35:04,579

Enceladus and you see some of these very

789

00:35:01,670 --> 00:35:06,680

dark deep what appeared to be you would

790

00:35:04,579 --> 00:35:10,549

might interpret as deep or very long

791

00:35:06,679 --> 00:35:14,539

cracks do we actually have imagery of

792

00:35:10,550 --> 00:35:17,390

the place where you saw the plume do you

793

00:35:14,539 --> 00:35:21,369

know if that's a big crack or what is

794

00:35:17,389 --> 00:35:25,779

actually there since it was so far south

795

00:35:21,369 --> 00:35:28,640

and we do have like to a certain extent

796

00:35:25,780 --> 00:35:31,790

image material of Europa surface and

797

00:35:28,639 --> 00:35:33,920

it's it's covering pretty like the

798

00:35:31,789 --> 00:35:37,519

majority of the surface but at a

799

00:35:33,920 --> 00:35:39,200
different resolutions and so far in

800

00:35:37,519 --> 00:35:42,440
these images from Galileo we have not

801

00:35:39,199 --> 00:35:45,289
put not like correlate a certain and

802

00:35:42,440 --> 00:35:48,349
surface fracture to the plumeria because

803

00:35:45,289 --> 00:35:49,880
one reason is that the the limited

804

00:35:48,349 --> 00:35:53,030
resolution of the Hubble images do not

805

00:35:49,880 --> 00:35:54,829
allow to exactly and locate the club so

806

00:35:53,030 --> 00:35:57,519
we cannot say that like a year at this

807

00:35:54,829 --> 00:36:00,769
longitude and latitude of a surface and

808

00:35:57,519 --> 00:36:03,139
the other thing is that the resolution

809

00:36:00,769 --> 00:36:05,449
of the Galileo images gets worse towards

810

00:36:03,139 --> 00:36:07,219
the poles like the pole yeah we don't

811

00:36:05,449 --> 00:36:09,139
have good resolution in some areas at

812

00:36:07,219 --> 00:36:14,149
the South Pole and that makes it even

813
00:36:09,139 --> 00:36:17,319
more difficult and okay I suspected that

814
00:36:14,150 --> 00:36:19,670
was the case but you know this is a

815
00:36:17,320 --> 00:36:22,338
contrast to acknowledge from solidus

816
00:36:19,670 --> 00:36:24,320
we're with the Cassini mission at Saturn

817
00:36:22,338 --> 00:36:25,670
system they have flown by the South Pole

818
00:36:24,320 --> 00:36:27,140
of Enceladus and taken really

819
00:36:25,670 --> 00:36:30,079
spectacular images of these tiger

820
00:36:27,139 --> 00:36:32,779
stripes someone now it is features to

821
00:36:30,079 --> 00:36:35,170
what we see on Europa perhaps and there

822
00:36:32,780 --> 00:36:40,970
you can really pinpoint where these Jets

823
00:36:35,170 --> 00:36:43,889
favorite filter now ok so I gotta have a

824
00:36:40,969 --> 00:36:45,808
common hear from Joe Beneke from YouTube

825
00:36:43,889 --> 00:36:47,219
who is saying who's asking why is there

826
00:36:45,809 --> 00:36:50,130
so much more talk surrounding Europa

827

00:36:47,219 --> 00:36:53,038
than Enceladus the answer to that is

828
00:36:50,130 --> 00:36:54,838
this this particular hangout is on some

829
00:36:53,039 --> 00:36:57,778
findings of water vapor plumes found

830
00:36:54,838 --> 00:36:59,880
over Europa and that's how we're talking

831
00:36:57,778 --> 00:37:02,159
about it here in this particular one

832
00:36:59,880 --> 00:37:04,619
although we have compared Europa with

833
00:37:02,159 --> 00:37:07,798
the plumes in on Enceladus as well so

834
00:37:04,619 --> 00:37:10,200
that's why we're talking about it i can

835
00:37:07,798 --> 00:37:13,048
add something there only okay if you

836
00:37:10,199 --> 00:37:15,480
think of Enceladus its radius is about

837
00:37:13,048 --> 00:37:17,429
250 kilometers the plumes are seeing are

838
00:37:15,480 --> 00:37:19,940
about 200 kilometers and scale Europe is

839
00:37:17,429 --> 00:37:22,230
just a much much bigger world and as

840
00:37:19,940 --> 00:37:24,480
probably as much water under its

841
00:37:22,230 --> 00:37:26,579

subsurface ice shell as we have here on

842

00:37:24,480 --> 00:37:29,278

earth and so a lot of scientists a lot

843

00:37:26,579 --> 00:37:31,289

of astrobiologists speculate that Europe

844

00:37:29,278 --> 00:37:33,659

is just a more likely place for life to

845

00:37:31,289 --> 00:37:36,119

evolve and has more energy resources for

846

00:37:33,659 --> 00:37:38,250

it to you sort of feed through the

847

00:37:36,119 --> 00:37:40,289

habitable environment and that's not to

848

00:37:38,250 --> 00:37:43,018

say that solidus is an amazing itself I

849

00:37:40,289 --> 00:37:47,069

mean it's a skies are shooting on

850

00:37:43,018 --> 00:37:49,169

several a satellite radii away I think

851

00:37:47,068 --> 00:37:51,900

the bullets really distinct bones but I

852

00:37:49,170 --> 00:37:53,880

think Romeo Third Earth easier to

853

00:37:51,900 --> 00:37:58,710

explore future missions to some extent

854

00:37:53,880 --> 00:38:00,269

and that's what we focus on right so

855

00:37:58,710 --> 00:38:03,480

thank you that was good that was great

856
00:38:00,268 --> 00:38:05,669
so uh I would try and pronounce this

857
00:38:03,480 --> 00:38:08,068
name but I would mess it up so i won't i

858
00:38:05,670 --> 00:38:10,889
won't do that but the this is from

859
00:38:08,068 --> 00:38:12,538
youtube he goes hi all i'm 25 and i

860
00:38:10,889 --> 00:38:16,018
wonder if there's a chance for me to

861
00:38:12,539 --> 00:38:17,400
witness landing probe on Europa i don't

862
00:38:16,018 --> 00:38:19,518
think there's you didn't mention

863
00:38:17,400 --> 00:38:22,380
anything about landing on Europa did you

864
00:38:19,518 --> 00:38:27,268
as far as the future future missions

865
00:38:22,380 --> 00:38:30,240
there was a study recently we're both a

866
00:38:27,268 --> 00:38:33,298
lander an orbiter and a flyby mission

867
00:38:30,239 --> 00:38:35,129
more like a la hora senior they orbit

868
00:38:33,298 --> 00:38:37,230
around Jupiter Saturn but just fly by

869
00:38:35,130 --> 00:38:39,028
the salads and these were all studied

870
00:38:37,230 --> 00:38:41,940
and the lander was determined to be the

871
00:38:39,028 --> 00:38:44,579
hardest one once the three to achieve in

872
00:38:41,940 --> 00:38:46,019
the next decade or so so a lot of what

873
00:38:44,579 --> 00:38:49,109
we want to do with our our next mission

874
00:38:46,018 --> 00:38:51,588
to Europa is to scout out landing sites

875
00:38:49,108 --> 00:38:55,380
for that Lander that would do great song

876
00:38:51,588 --> 00:38:57,358
he's safe to finance a blank spot all

877
00:38:55,380 --> 00:38:59,160
right anybody who ever saw the movie too

878
00:38:57,358 --> 00:39:05,389
he 10 knows that we were warned to stay

879
00:38:59,159 --> 00:39:11,940
away from there so just so you know okay

880
00:39:05,389 --> 00:39:13,558
here I come on up it's maybe all the one

881
00:39:11,940 --> 00:39:15,568
of the reason why there is more talk

882
00:39:13,559 --> 00:39:20,400
about Europa because there's a science

883
00:39:15,568 --> 00:39:24,679
fiction literature on what you know and

884

00:39:20,400 --> 00:39:27,210
then there is your mother report how and

885
00:39:24,679 --> 00:39:29,548
when you get people's imaginations doing

886
00:39:27,210 --> 00:39:31,019
it you tend to be able to get more at

887
00:39:29,548 --> 00:39:33,809
least public's way and people will talk

888
00:39:31,018 --> 00:39:37,768
that's right yes so thank you arthur c

889
00:39:33,809 --> 00:39:39,390
clarke adam synergy from the QA app is

890
00:39:37,768 --> 00:39:41,129
asking am i right to think that the

891
00:39:39,389 --> 00:39:43,108
amount of water in these plumes will

892
00:39:41,130 --> 00:39:45,028
change over time according to the

893
00:39:43,108 --> 00:39:46,710
varying strengths of tidal interactions

894
00:39:45,028 --> 00:39:47,849
with jupiter we touch down that a little

895
00:39:46,710 --> 00:39:51,179
bit but you guys want to comment on that

896
00:39:47,849 --> 00:39:55,890
one more time let's let's go to rents

897
00:39:51,179 --> 00:39:58,108
okay and yes that is that is likely i

898
00:39:55,889 --> 00:40:00,509

mean that's what we think and because we

899

00:39:58,108 --> 00:40:04,619

have not seen the plumes in in all

900

00:40:00,509 --> 00:40:06,838

observations and but we do not know

901

00:40:04,619 --> 00:40:08,548

exactly i mean we just we've seen them

902

00:40:06,838 --> 00:40:12,088

once we have not seen them four times

903

00:40:08,548 --> 00:40:15,088

now and we see a similar phenomenon and

904

00:40:12,088 --> 00:40:17,429

Enceladus and that is variable so it is

905

00:40:15,088 --> 00:40:20,608

very likely that these films are very

906

00:40:17,429 --> 00:40:23,940

over time and another reason is that

907

00:40:20,608 --> 00:40:25,949

they are and a lot of mass is checked it

908

00:40:23,940 --> 00:40:28,440

here and if they were going on for like

909

00:40:25,949 --> 00:40:29,998

decades and hundreds of years and you

910

00:40:28,440 --> 00:40:32,159

would probably see something on the

911

00:40:29,998 --> 00:40:33,988

surface you would see a bright feature

912

00:40:32,159 --> 00:40:37,318

on the surface and we don't we don't see

913
00:40:33,989 --> 00:40:40,528
that so and it's very likely that their

914
00:40:37,318 --> 00:40:44,369
time variable and maybe even going on

915
00:40:40,528 --> 00:40:46,588
and off okay the parts let's also talk

916
00:40:44,369 --> 00:40:48,900
about some things we have and for the

917
00:40:46,588 --> 00:40:50,639
next set puzzle observations and you

918
00:40:48,900 --> 00:40:52,798
know we thought well what if the plumes

919
00:40:50,639 --> 00:40:54,808
on Europa more like balloons on eyewear

920
00:40:52,798 --> 00:40:56,818
the book tunes on earth the volcanoes on

921
00:40:54,809 --> 00:40:58,528
Earth where they turn on and then

922
00:40:56,818 --> 00:41:00,630
they're dormant for a couple years maybe

923
00:40:58,528 --> 00:41:03,028
they just come go with us for a de clé

924
00:41:00,630 --> 00:41:05,039
then then we saw it and solidus got

925
00:41:03,028 --> 00:41:07,199
excited about original so the next set

926
00:41:05,039 --> 00:41:08,940
of observations we had five before one

927
00:41:07,199 --> 00:41:10,649
of which showed something we have about

928
00:41:08,940 --> 00:41:11,250
twenty eight twenty three different

929
00:41:10,650 --> 00:41:14,610
visits

930
00:41:11,250 --> 00:41:17,039
58 different orbits spread across next

931
00:41:14,610 --> 00:41:19,860
even though and we're really going to

932
00:41:17,039 --> 00:41:21,150
try to more robustly search for this

933
00:41:19,860 --> 00:41:23,039
type of variability and get to the

934
00:41:21,150 --> 00:41:25,740
bottom of running through beautiful or

935
00:41:23,039 --> 00:41:27,029
whether it's much Braddock that'll be

936
00:41:25,739 --> 00:41:30,539
great that'll be great information to

937
00:41:27,030 --> 00:41:33,810
have so Jim Jim tier is asking also on

938
00:41:30,539 --> 00:41:35,730
the Q&A app it might be possible that if

939
00:41:33,809 --> 00:41:38,219
there are microorganisms they get shot

940
00:41:35,730 --> 00:41:40,110
into Europa's atmosphere via the plumes

941

00:41:38,219 --> 00:41:41,549
and he's nasty I guess it's a comment

942
00:41:40,110 --> 00:41:44,610
one of the question but like that sort

943
00:41:41,550 --> 00:41:46,890
of alludes to this idea of a little bit

944
00:41:44,610 --> 00:41:49,050
i think on panspermia right i mean one

945
00:41:46,889 --> 00:41:51,210
of the things that these microorganisms

946
00:41:49,050 --> 00:41:53,280
are simple cell life or whatever you

947
00:41:51,210 --> 00:41:55,110
want to call it it might be one way in

948
00:41:53,280 --> 00:41:57,269
which things travel from one planet to

949
00:41:55,110 --> 00:42:01,440
another do you any of you have a comment

950
00:41:57,269 --> 00:42:04,110
on that I think that's pretty far out to

951
00:42:01,440 --> 00:42:06,170
think of that actor oh yeah I want some

952
00:42:04,110 --> 00:42:10,860
europen tardigrades that'd be awesome

953
00:42:06,170 --> 00:42:13,230
don't think that's the case but hey

954
00:42:10,860 --> 00:42:15,599
although you're saying that its water

955
00:42:13,230 --> 00:42:19,260

there water plumes what is the

956

00:42:15,599 --> 00:42:21,750

temperature of this water so they'll

957

00:42:19,260 --> 00:42:24,780

have to like if there is that there they

958

00:42:21,750 --> 00:42:26,460

would have to be extreme of files and I

959

00:42:24,780 --> 00:42:30,060

mean we know that we have extreme the

960

00:42:26,460 --> 00:42:33,420

files that can exist in space like like

961

00:42:30,059 --> 00:42:35,579

tardigrade but like I'm Scott Lewis like

962

00:42:33,420 --> 00:42:38,400

a Scott yell I am pretty extreme to the

963

00:42:35,579 --> 00:42:43,199

max all the time 120 degrees in

964

00:42:38,400 --> 00:42:45,329

September in LA but um yeah I think with

965

00:42:43,199 --> 00:42:47,609

that it would have to be an extreme

966

00:42:45,329 --> 00:42:48,960

about be at least from what we know of

967

00:42:47,610 --> 00:42:51,720

life to exist because we can only

968

00:42:48,960 --> 00:42:53,550

observe life in the place that we see it

969

00:42:51,719 --> 00:42:55,829

which is only here on this planet so far

970
00:42:53,550 --> 00:42:57,060
and it would have to compare to that and

971
00:42:55,829 --> 00:42:58,949
I think that's the biggest thing with

972
00:42:57,059 --> 00:43:01,349
all the astrobiologist I've spoken with

973
00:42:58,949 --> 00:43:03,569
is they're looking base up the only data

974
00:43:01,349 --> 00:43:07,529
set they have which is on this tiny

975
00:43:03,570 --> 00:43:10,769
little planet around a mediocre star in

976
00:43:07,530 --> 00:43:13,230
our galaxy and so what Carol just ask is

977
00:43:10,769 --> 00:43:14,699
related to Ronald inches or comment here

978
00:43:13,230 --> 00:43:15,900
who's going who's asking what kind of

979
00:43:14,699 --> 00:43:20,309
temperatures are involved in these

980
00:43:15,900 --> 00:43:22,440
plumes and atmospheric pressure so what

981
00:43:20,309 --> 00:43:23,820
do you have a sense of that I mean it

982
00:43:22,440 --> 00:43:25,880
would be are you able to find that out

983
00:43:23,820 --> 00:43:28,140
from these up

984

00:43:25,880 --> 00:43:30,030
things like a bastard pressure and

985

00:43:28,139 --> 00:43:31,559
temperature yeah Lawrence you work those

986

00:43:30,030 --> 00:43:34,019
numbers just based on the height that

987

00:43:31,559 --> 00:43:35,940
this water was ejected we knew what its

988

00:43:34,019 --> 00:43:38,940
velocity was and we confer temperature

989

00:43:35,940 --> 00:43:42,750
of what the water was at the event there

990

00:43:38,940 --> 00:43:44,400
knew it was more like 260 Kelvin maybe

991

00:43:42,750 --> 00:43:47,909
10 degrees your freakin comfort

992

00:43:44,400 --> 00:43:50,940
principle to make water and evaporate

993

00:43:47,909 --> 00:43:53,129
you need I mean that in order to be at

994

00:43:50,940 --> 00:43:56,369
least it's a triple point and so you

995

00:43:53,130 --> 00:43:59,990
need temperatures of 270 Kelvin or more

996

00:43:56,369 --> 00:44:03,030
and to get water into the vapor phase

997

00:43:59,989 --> 00:44:06,269
but we can yeah mostly only speculate

998

00:44:03,030 --> 00:44:08,369
what's going on and exactly and what

999
00:44:06,269 --> 00:44:10,318
temperatures so it's it's better

1000
00:44:08,369 --> 00:44:13,349
definitely not going to be really hot

1001
00:44:10,318 --> 00:44:15,739
there like a thousand degrees or

1002
00:44:13,349 --> 00:44:19,519
something and would we just above the

1003
00:44:15,739 --> 00:44:22,108
treble point probably and just enough

1004
00:44:19,519 --> 00:44:24,929
temperature to to get it into the wiper

1005
00:44:22,108 --> 00:44:26,369
face awesome good question in brothers

1006
00:44:24,929 --> 00:44:28,618
they don't know their watch what do you

1007
00:44:26,369 --> 00:44:30,809
mean by the triple point right that's at

1008
00:44:28,619 --> 00:44:34,170
the point that combination of

1009
00:44:30,809 --> 00:44:36,779
temperature and pressure where water can

1010
00:44:34,170 --> 00:44:41,220
exist in all three states that it can be

1011
00:44:36,780 --> 00:44:43,950
liquid solid or in the gas phase and by

1012
00:44:41,219 --> 00:44:46,019

like infinite infinitely small changes

1013

00:44:43,949 --> 00:44:49,739

of the temperature or pressure you can

1014

00:44:46,019 --> 00:44:51,980

change between the three states and yeah

1015

00:44:49,739 --> 00:44:55,618

that's basically it's a triple point

1016

00:44:51,980 --> 00:44:58,980

okay so where is big oh sorry go ahead

1017

00:44:55,619 --> 00:45:01,710

no go bow it with respect to life life

1018

00:44:58,980 --> 00:45:03,389

is altered earth-like found at places

1019

00:45:01,710 --> 00:45:04,920

where people originally didn't think

1020

00:45:03,389 --> 00:45:07,679

they would find life I mean there's like

1021

00:45:04,920 --> 00:45:09,930

like bacteria live in the deep sea like

1022

00:45:07,679 --> 00:45:11,190

completely separated from from the Sun

1023

00:45:09,929 --> 00:45:15,289

and death and life so called a

1024

00:45:11,190 --> 00:45:17,880

speculation that there is life like

1025

00:45:15,289 --> 00:45:19,769

bacterial microbes like India and what

1026

00:45:17,880 --> 00:45:22,530

what's called Lake Vostok which is the

1027
00:45:19,769 --> 00:45:25,289
sea like under the Antarctica just like

1028
00:45:22,530 --> 00:45:27,720
like three kilometres below the sea ice

1029
00:45:25,289 --> 00:45:31,440
shield off antarctica I said 250

1030
00:45:27,719 --> 00:45:33,419
kilometres long see that sort of similar

1031
00:45:31,440 --> 00:45:35,240
what we expected Europa and these are

1032
00:45:33,420 --> 00:45:37,800
plated like Lake Vostok it's not

1033
00:45:35,239 --> 00:45:38,519
improvement but there are so many places

1034
00:45:37,800 --> 00:45:40,019
at earth

1035
00:45:38,519 --> 00:45:41,759
people I garage we didn't think that

1036
00:45:40,019 --> 00:45:44,309
it's a possibility for life but they

1037
00:45:41,760 --> 00:45:47,100
find it on life on these very extreme

1038
00:45:44,309 --> 00:45:48,420
conditions also on earth yeah now sort

1039
00:45:47,099 --> 00:45:49,650
of her lewd to what Scott was talking

1040
00:45:48,420 --> 00:45:51,570
about with extreme of files you know

1041
00:45:49,650 --> 00:45:54,380
they for we find these weasel these life

1042
00:45:51,570 --> 00:45:58,230
forms and very inhospitable places so

1043
00:45:54,380 --> 00:46:01,410
who knows Andrew planet offer from the

1044
00:45:58,230 --> 00:46:03,750
QA app is making a comment and a

1045
00:46:01,409 --> 00:46:05,969
question does the throwaway society we

1046
00:46:03,750 --> 00:46:08,369
live in produce throwaway spacecraft

1047
00:46:05,969 --> 00:46:11,069
could we make them last much longer by

1048
00:46:08,369 --> 00:46:12,960
refueling or replenishing late into

1049
00:46:11,070 --> 00:46:15,960
their missions with whatever they run

1050
00:46:12,960 --> 00:46:20,070
out of I know that sounds like kind of a

1051
00:46:15,960 --> 00:46:24,539
Carol question made a big announcement

1052
00:46:20,070 --> 00:46:25,980
yesterday yeah so i guess i would say if

1053
00:46:24,539 --> 00:46:27,989
i if i had to comment on that i would

1054
00:46:25,980 --> 00:46:30,389
say you know that it depends on on the

1055

00:46:27,989 --> 00:46:32,549
mission practicalities and and sometimes

1056
00:46:30,389 --> 00:46:35,009
throw away spacecraft are the best way

1057
00:46:32,550 --> 00:46:37,380
to go they really are wow yeah i mean

1058
00:46:35,010 --> 00:46:39,570
let's look for example we were talking

1059
00:46:37,380 --> 00:46:41,190
about lander so we have the Mars rovers

1060
00:46:39,570 --> 00:46:43,380
they were designed for a certain period

1061
00:46:41,190 --> 00:46:45,090
of performance and they actually lasted

1062
00:46:43,380 --> 00:46:48,450
much longer and in that case you use

1063
00:46:45,090 --> 00:46:50,220
solar panels you know how much light is

1064
00:46:48,449 --> 00:46:52,679
going to come from the Sun throughout

1065
00:46:50,219 --> 00:46:55,769
the seasons in Mars and you try to

1066
00:46:52,679 --> 00:46:59,009
generate enough energy for the rover to

1067
00:46:55,769 --> 00:47:02,480
be operable orbiting satellites tend to

1068
00:46:59,010 --> 00:47:06,300
last longer and you know as we know

1069
00:47:02,480 --> 00:47:08,659

Voyager like way out there and it's so

1070

00:47:06,300 --> 00:47:12,480
feebly sending us little signal so

1071

00:47:08,659 --> 00:47:15,599
sometimes a small probe can be very

1072

00:47:12,480 --> 00:47:19,110
effective another strategy is to do

1073

00:47:15,599 --> 00:47:20,969
multiple targets so go from one place to

1074

00:47:19,110 --> 00:47:23,340
another so there have been satellites

1075

00:47:20,969 --> 00:47:25,019
that have done that on from here to here

1076

00:47:23,340 --> 00:47:26,700
to here and then make sometimes there's

1077

00:47:25,019 --> 00:47:29,400
an extended mission that if you

1078

00:47:26,699 --> 00:47:32,730
accomplish these two goals then you can

1079

00:47:29,400 --> 00:47:35,340
do the next one Raleigh God as had two

1080

00:47:32,730 --> 00:47:37,050
places to go to it had best in series so

1081

00:47:35,340 --> 00:47:38,400
that they were able to use their ion

1082

00:47:37,050 --> 00:47:41,789
propulsion to go to two different

1083

00:47:38,400 --> 00:47:43,590
objects and I think with that what

1084
00:47:41,789 --> 00:47:46,590
you're talking is completely on point

1085
00:47:43,590 --> 00:47:49,019
Landers if you're trying to get your

1086
00:47:46,590 --> 00:47:50,460
Lander to another surface that means

1087
00:47:49,019 --> 00:47:51,349
you're going to have to send all the

1088
00:47:50,460 --> 00:47:55,070
fuel to

1089
00:47:51,349 --> 00:47:56,360
to achieve escape velocity somehow to be

1090
00:47:55,070 --> 00:47:58,580
able to do that to get to another place

1091
00:47:56,360 --> 00:48:00,710
and that's just not practical right and

1092
00:47:58,579 --> 00:48:03,170
with with things like SpaceX which i

1093
00:48:00,710 --> 00:48:05,139
think is at least going in some

1094
00:48:03,170 --> 00:48:09,050
direction where they're trying to find

1095
00:48:05,139 --> 00:48:10,730
reusable rockets that you know the

1096
00:48:09,050 --> 00:48:13,370
primary and secondary stages can be

1097
00:48:10,730 --> 00:48:14,980
reused but what we're sending out there

1098
00:48:13,369 --> 00:48:17,239
I don't think it's really practical

1099
00:48:14,980 --> 00:48:19,400
economics as far just thinking about the

1100
00:48:17,239 --> 00:48:22,429
resources to do that would be far away

1101
00:48:19,400 --> 00:48:24,440
then the cash market is not to be

1102
00:48:22,429 --> 00:48:26,269
underestimated but he focuses although

1103
00:48:24,440 --> 00:48:29,179
hang out Hubble is the best example of

1104
00:48:26,269 --> 00:48:31,610
let's go up replenish it exactly that is

1105
00:48:29,179 --> 00:48:33,559
right but it's also just above our heads

1106
00:48:31,610 --> 00:48:35,570
if we had something out on Europa for

1107
00:48:33,559 --> 00:48:37,849
example sending something out to refuel

1108
00:48:35,570 --> 00:48:40,309
it I'd like Scott said you know they

1109
00:48:37,849 --> 00:48:42,349
take all the fuel that we would I would

1110
00:48:40,309 --> 00:48:43,849
send a new one yeah if we're gonna send

1111
00:48:42,349 --> 00:48:46,159
something out there about the same as

1112

00:48:43,849 --> 00:48:47,809
you send a new one yeah everything

1113
00:48:46,159 --> 00:48:52,190
problems tend to be much smaller than

1114
00:48:47,809 --> 00:48:54,170
the Hubble mirror so um yeah so there is

1115
00:48:52,190 --> 00:48:56,059
cost benefit in that how far out you

1116
00:48:54,170 --> 00:48:58,430
have to go in a few a service it you

1117
00:48:56,059 --> 00:49:00,710
might in a couple years say oh forget

1118
00:48:58,429 --> 00:49:02,509
that you know I need new technology

1119
00:49:00,710 --> 00:49:05,420
because the new tip there are going to

1120
00:49:02,510 --> 00:49:07,670
be new technologies we are not using you

1121
00:49:05,420 --> 00:49:09,440
know old technologies for these

1122
00:49:07,670 --> 00:49:11,420
satellites and so you want to

1123
00:49:09,440 --> 00:49:13,519
investigate in the best possible way and

1124
00:49:11,420 --> 00:49:15,380
that's cost-effective now what would be

1125
00:49:13,519 --> 00:49:18,739
nice is if we could figure out how we

1126
00:49:15,380 --> 00:49:22,670

can fuel in syd you so somehow harm

1127

00:49:18,739 --> 00:49:25,519

harvest materials out there that would

1128

00:49:22,670 --> 00:49:27,590

provide whatever energy or something but

1129

00:49:25,519 --> 00:49:32,449

we're not there yet yeah done another

1130

00:49:27,590 --> 00:49:33,950

utilize the Stargate and no you're

1131

00:49:32,449 --> 00:49:36,819

supposed to be throwing that out there

1132

00:49:33,949 --> 00:49:39,409

yet late yeah no there's no Stargate

1133

00:49:36,820 --> 00:49:40,640

nevermind anyway it was a good comment I

1134

00:49:39,409 --> 00:49:42,529

don't know and roofie if you should

1135

00:49:40,639 --> 00:49:45,170

think about those a throwaway spacecraft

1136

00:49:42,530 --> 00:49:49,460

that it's just a sing I mean single use

1137

00:49:45,170 --> 00:49:52,760

some if it it's not like you know that

1138

00:49:49,460 --> 00:49:55,730

we're trying to conserve plastic bottles

1139

00:49:52,760 --> 00:49:57,980

or something these really do need to it

1140

00:49:55,730 --> 00:50:00,139

would take a lot more resources to make

1141
00:49:57,980 --> 00:50:02,119
it refuel able and reusable probably i

1142
00:50:00,139 --> 00:50:04,489
would think anyway so that's my thought

1143
00:50:02,119 --> 00:50:05,210
on that Carol I have one thing I like to

1144
00:50:04,489 --> 00:50:06,619
that

1145
00:50:05,210 --> 00:50:09,260
this was a good one for you too but

1146
00:50:06,619 --> 00:50:11,630
Michael jobin and as asking does the

1147
00:50:09,260 --> 00:50:14,960
Hubble Space Telescope wobble from

1148
00:50:11,630 --> 00:50:18,920
Earth's varying gravity as it orbits or

1149
00:50:14,960 --> 00:50:20,780
say the moon tugging on it and and is

1150
00:50:18,920 --> 00:50:23,389
that why the Pluto pics are not so good

1151
00:50:20,780 --> 00:50:29,150
I'm not so sure no I don't like that

1152
00:50:23,389 --> 00:50:31,339
laughter awesome fantastic I know go

1153
00:50:29,150 --> 00:50:34,010
around the from the position of the

1154
00:50:31,340 --> 00:50:36,350
earth Hubble Space lost tape has taken

1155
00:50:34,010 --> 00:50:38,960
exquisite pictures and well it's just

1156
00:50:36,349 --> 00:50:42,190
the size of the of the mirror it has

1157
00:50:38,960 --> 00:50:44,510
nothing to do it wobbling her around I'm

1158
00:50:42,190 --> 00:50:46,789
sure they're a slight variation OTT so

1159
00:50:44,510 --> 00:50:50,210
much to the moon but the earth but the

1160
00:50:46,789 --> 00:50:54,289
way that we use the telescope is that we

1161
00:50:50,210 --> 00:50:56,659
use guidance both there's they're all

1162
00:50:54,289 --> 00:50:59,929
kinds of guidance system on the Hubble

1163
00:50:56,659 --> 00:51:02,359
to keep it on point on the target now

1164
00:50:59,929 --> 00:51:05,469
things like solar system objects are a

1165
00:51:02,360 --> 00:51:09,349
little more challenging because we

1166
00:51:05,469 --> 00:51:12,109
though the telescope is built to look at

1167
00:51:09,349 --> 00:51:14,269
distant stars distant objects and so the

1168
00:51:12,110 --> 00:51:16,610
whole system responds to that but we

1169

00:51:14,269 --> 00:51:18,739
still can make adjustments so that we

1170
00:51:16,610 --> 00:51:23,630
can track along and look at the solar

1171
00:51:18,739 --> 00:51:26,269
system objects but I object to the Pluto

1172
00:51:23,630 --> 00:51:29,119
images are not good enough they're

1173
00:51:26,269 --> 00:51:31,639
spectacular for the size of that mirror

1174
00:51:29,119 --> 00:51:33,289
and that is the limiting factor in space

1175
00:51:31,639 --> 00:51:35,210
that you'll get something different

1176
00:51:33,289 --> 00:51:37,400
that's just a matter of optical

1177
00:51:35,210 --> 00:51:38,869
resolution that's right so it's have

1178
00:51:37,400 --> 00:51:40,579
drawn this year's hubble still has some

1179
00:51:38,869 --> 00:51:42,889
of the best reaction with big fly wheels

1180
00:51:40,579 --> 00:51:48,170
for doing for the accurate pointing oh

1181
00:51:42,889 --> 00:51:54,759
it was rising yeah right so uh so that

1182
00:51:48,170 --> 00:51:56,960
would be our opinion on that Andrew so

1183
00:51:54,760 --> 00:51:59,720

Craig Landon's going don't forget

1184

00:51:56,960 --> 00:52:03,099
cassini-huygens we can accomplish

1185

00:51:59,719 --> 00:52:05,869
whatever we need without sci-fi good

1186

00:52:03,099 --> 00:52:08,719
although although sci-fi is nice to kind

1187

00:52:05,869 --> 00:52:11,210
of moat you know open our minds get us

1188

00:52:08,719 --> 00:52:13,609
motivated but I don't want to point out

1189

00:52:11,210 --> 00:52:17,210
that we just can't randomly send you

1190

00:52:13,610 --> 00:52:17,930
know or satellites out there I will also

1191

00:52:17,210 --> 00:52:20,269
point out that

1192

00:52:17,929 --> 00:52:23,960
Space Telescope help look for landing

1193

00:52:20,269 --> 00:52:26,300
sites on Mars so we need ground-based

1194

00:52:23,960 --> 00:52:28,190
and space-based telescopes to

1195

00:52:26,300 --> 00:52:30,380
investigate these phenomenon like the

1196

00:52:28,190 --> 00:52:32,690
water flows and really thoroughly

1197

00:52:30,380 --> 00:52:34,730
understand the phenomenon before we just

1198
00:52:32,690 --> 00:52:36,380
start sending stuff out there and hoping

1199
00:52:34,730 --> 00:52:38,510
we go through a plume now that would be

1200
00:52:36,380 --> 00:52:41,358
a throwaway mission I mean we've got to

1201
00:52:38,510 --> 00:52:44,089
know what we're going to do and so these

1202
00:52:41,358 --> 00:52:45,949
telescopes and orbiting the Earth and

1203
00:52:44,088 --> 00:52:48,440
especially Hubble and some ground-based

1204
00:52:45,949 --> 00:52:50,118
telescopes are used because we're very

1205
00:52:48,440 --> 00:52:52,400
judicious about how we do the

1206
00:52:50,119 --> 00:52:54,500
investigations before we just start

1207
00:52:52,400 --> 00:52:58,608
slinging stuff out there and hoping we

1208
00:52:54,500 --> 00:53:00,800
need discover something yeah so um auto

1209
00:52:58,608 --> 00:53:03,409
raag one two three four again on youtube

1210
00:53:00,800 --> 00:53:04,700
is commenting that actually it's kind of

1211
00:53:03,409 --> 00:53:08,088
an interesting comment what we may think

1212
00:53:04,699 --> 00:53:11,750
of as extreme for life may not may be

1213
00:53:08,088 --> 00:53:14,239
the most common form as an interesting

1214
00:53:11,750 --> 00:53:17,179
thought because what for all we know if

1215
00:53:14,239 --> 00:53:19,068
life is common in the universe and we

1216
00:53:17,179 --> 00:53:21,318
don't know the answer to that yet then

1217
00:53:19,068 --> 00:53:22,759
it may be that the most common form of

1218
00:53:21,318 --> 00:53:24,500
it is in the form of what Scott was

1219
00:53:22,760 --> 00:53:28,460
calling extremophiles these these these

1220
00:53:24,500 --> 00:53:32,659
very simple life forms that are they can

1221
00:53:28,460 --> 00:53:34,670
exist in the outer reaches of space so

1222
00:53:32,659 --> 00:53:37,250
that's a good point that's a good

1223
00:53:34,670 --> 00:53:39,530
comment anything else got that I'm am I

1224
00:53:37,250 --> 00:53:42,019
missing anything am i you you saw

1225
00:53:39,530 --> 00:53:43,579
everything that I want to talk about is

1226

00:53:42,019 --> 00:53:46,730
anybody tweeting I haven't had a chance

1227
00:53:43,579 --> 00:53:48,589
to look at my bubble hash tag in this

1228
00:53:46,730 --> 00:53:50,869
war look at almost tweets and there's a

1229
00:53:48,588 --> 00:53:53,690
lot of retweets so that's good oh good

1230
00:53:50,869 --> 00:53:55,519
yep Oh awesome yeah Scott's owning a

1231
00:53:53,690 --> 00:53:59,329
Hubble hang out hashtag thank you for

1232
00:53:55,519 --> 00:54:02,329
taking on Twitter it's cool so I

1233
00:53:59,329 --> 00:54:04,609
actually had a question about the Jovian

1234
00:54:02,329 --> 00:54:07,160
system since not all of us know

1235
00:54:04,608 --> 00:54:09,348
everything about this 60 moons or

1236
00:54:07,159 --> 00:54:13,759
whatever are there any other of the

1237
00:54:09,349 --> 00:54:16,940
moons around jupiter that might have a

1238
00:54:13,760 --> 00:54:19,730
similar situation we talked about and

1239
00:54:16,940 --> 00:54:21,829
sell it is around Saturn but are there

1240
00:54:19,730 --> 00:54:30,400

any other moons that might be

1241
00:54:21,829 --> 00:54:32,890
interesting in this regard kirkham beta

1242
00:54:30,400 --> 00:54:35,920
okay what's the answer we think that

1243
00:54:32,889 --> 00:54:39,159
ganymede uh also has a subsurface ocean

1244
00:54:35,920 --> 00:54:41,019
just much further down and well you know

1245
00:54:39,159 --> 00:54:43,750
less likely that it would communicate to

1246
00:54:41,019 --> 00:54:45,608
the surface and have offense but maybe

1247
00:54:43,750 --> 00:54:47,349
not all the question was some sort of

1248
00:54:45,608 --> 00:54:50,019
subsurface lake or that sort of thing to

1249
00:54:47,349 --> 00:54:52,329
so something that we're look talking

1250
00:54:50,019 --> 00:54:54,130
about on Jews project the mission is

1251
00:54:52,329 --> 00:54:56,099
going to orbit around again I'll be

1252
00:54:54,130 --> 00:54:59,858
looking for that hard they're

1253
00:54:56,099 --> 00:55:04,180
interesting okay I mean and mr. tail oh

1254
00:54:59,858 --> 00:55:06,460
all moons have seen atmospheres aeo has

1255
00:55:04,179 --> 00:55:08,618
the walkin ISM you wrote for any way in

1256
00:55:06,460 --> 00:55:10,210
addition to the blooms it has an oxygen

1257
00:55:08,619 --> 00:55:12,490
atmosphere that's also being discovered

1258
00:55:10,210 --> 00:55:16,150
with hubble hubble space telescope in

1259
00:55:12,489 --> 00:55:18,399
the 90s and that name it has also an

1260
00:55:16,150 --> 00:55:20,588
oxygen atmosphere thin oxygen atmosphere

1261
00:55:18,400 --> 00:55:23,650
also discovered with her book and their

1262
00:55:20,588 --> 00:55:26,230
color salon x1 has a CO 2 atmosphere and

1263
00:55:23,650 --> 00:55:28,000
like a yacht and oxygen atmosphere and

1264
00:55:26,230 --> 00:55:31,028
they are also speculation that all the

1265
00:55:28,000 --> 00:55:32,798
other two like can evade and Callisto

1266
00:55:31,028 --> 00:55:34,389
but that's also spake only speculation

1267
00:55:32,798 --> 00:55:37,269
that they may be also have flumes

1268
00:55:34,389 --> 00:55:40,868
because my god subject to these to these

1269
00:55:37,269 --> 00:55:42,730
tidal forces but it's only speculation

1270
00:55:40,869 --> 00:55:44,740
that theory in the paper stays no

1271
00:55:42,730 --> 00:55:47,318
observational evidence for perfumes

1272
00:55:44,739 --> 00:55:49,868
economy but because the titles are

1273
00:55:47,318 --> 00:55:54,278
strong so it's an idea that could that

1274
00:55:49,869 --> 00:55:56,019
they could be there Wow interesting very

1275
00:55:54,278 --> 00:55:57,460
much so I know folks on the Pluto

1276
00:55:56,019 --> 00:56:00,190
mission new horizons are excited by the

1277
00:55:57,460 --> 00:56:01,960
potential for seeing not water vapor

1278
00:56:00,190 --> 00:56:04,568
pros but other types of plumes like we

1279
00:56:01,960 --> 00:56:07,599
saw with Voyager on Triton Neptune's

1280
00:56:04,568 --> 00:56:10,000
moon Triton different gases coming out

1281
00:56:07,599 --> 00:56:14,769
of the surface there other processes but

1282
00:56:10,000 --> 00:56:16,480
uh so exhibition is fiction enter the

1283

00:56:14,769 --> 00:56:19,389
inner solar system moons aren't so

1284
00:56:16,480 --> 00:56:21,548
interesting all the movies Jupiter out

1285
00:56:19,389 --> 00:56:25,868
words are pretty interesting it turns

1286
00:56:21,548 --> 00:56:30,759
out solar systems pretty gassy lot of

1287
00:56:25,869 --> 00:56:32,048
gassing going on here I do all right ok

1288
00:56:30,760 --> 00:56:34,960
folks well I guess that's it for this

1289
00:56:32,048 --> 00:56:38,139
week I thank you guys for for for

1290
00:56:34,960 --> 00:56:39,789
watching I want to thank you dr. want to

1291
00:56:38,139 --> 00:56:41,379
thank dr. you walking sore from

1292
00:56:39,789 --> 00:56:43,640
University of Cologne dr. Kerr

1293
00:56:41,380 --> 00:56:44,660
Rutherford dr. Lorenz Roth for

1294
00:56:43,639 --> 00:56:46,549
telling us about these great

1295
00:56:44,659 --> 00:56:47,599
observations and we look forward to

1296
00:56:46,550 --> 00:56:50,570
hearing more from you in the future

1297
00:56:47,599 --> 00:56:51,949

thank you guys very much for hanging out

1298

00:56:50,570 --> 00:56:55,640

with us and telling us about all this

1299

00:56:51,949 --> 00:56:58,339

yeah yeah they're saying thanks so much

1300

00:56:55,639 --> 00:56:59,569

yeah hey Carolyn's got thank you this

1301

00:56:58,340 --> 00:57:01,390

has been awesome thank you very much for

1302

00:56:59,570 --> 00:57:07,070

your help for when I was temporarily

1303

00:57:01,389 --> 00:57:08,809

engaged otherwise and and don't forget

1304

00:57:07,070 --> 00:57:11,809

this the tonight folks we got a special

1305

00:57:08,809 --> 00:57:14,929

Hubble public lecture on neutrinos and

1306

00:57:11,809 --> 00:57:18,309

also next week Carol Scott and I will be

1307

00:57:14,929 --> 00:57:23,419

talking about 3d printing in outer space

1308

00:57:18,309 --> 00:57:25,039

yes and and in other areas too but will

1309

00:57:23,420 --> 00:57:27,260

be so that will be next week and we look

1310

00:57:25,039 --> 00:57:29,570

forward to seeing you then thank you all

1311

00:57:27,260 --> 00:57:33,670

for watching and as always keep looking

1312

00:57:29,570 --> 00:57:33,670

up everyone