
Google+

1
00:00:03,990 --> 00:00:01,910
today about the weird and wonderful

2
00:00:06,550 --> 00:00:04,000
things that nasa's cassini spacecraft

3
00:00:09,110 --> 00:00:06,560
has been sending back about saturn

4
00:00:11,509 --> 00:00:09,120
i'm your moderator jari cook i'm the

5
00:00:13,509 --> 00:00:11,519
cassini media rep based here at nasa's

6
00:00:14,870 --> 00:00:13,519
jet propulsion laboratory in pasadena

7
00:00:16,710 --> 00:00:14,880
california

8
00:00:17,830 --> 00:00:16,720
jpl is where cassini's mission is

9
00:00:20,230 --> 00:00:17,840
managed

10
00:00:22,390 --> 00:00:20,240
but we have some great speakers for you

11
00:00:24,710 --> 00:00:22,400
today from across the country

12
00:00:27,189 --> 00:00:24,720
so our hangout today is provocatively

13
00:00:28,630 --> 00:00:27,199

titled weird and wonderful saturn but

14
00:00:30,230 --> 00:00:28,640
we'll have some scientists here to tell

15
00:00:31,669 --> 00:00:30,240
you why some of the things that might

16
00:00:33,990 --> 00:00:31,679
seem weird on the surface aren't

17
00:00:36,470 --> 00:00:34,000
actually all that weird um so our

18
00:00:39,030 --> 00:00:36,480
hangout is going to happen in three acts

19
00:00:41,750 --> 00:00:39,040
our first act is going to be

20
00:00:44,310 --> 00:00:41,760
brought to you by kunio sayanagi he's a

21
00:00:46,709 --> 00:00:44,320
cassini imaging team associate based at

22
00:00:48,229 --> 00:00:46,719
hampton university in virginia he's

23
00:00:51,430 --> 00:00:48,239
going to be telling you about this

24
00:00:52,950 --> 00:00:51,440
really unique six-sided jet stream

25
00:00:55,430 --> 00:00:52,960
around the north pole of saturn that we

26
00:00:57,590 --> 00:00:55,440
call the hexagon

27
00:00:59,590 --> 00:00:57,600
we've actually just released some new

28
00:01:03,590 --> 00:00:59,600
images and video of the hexagon which

29
00:01:08,950 --> 00:01:03,600
you can see on our websites at nasa.gov

30
00:01:13,190 --> 00:01:11,030
he's going to be showing you our new

31
00:01:15,910 --> 00:01:13,200
views of the hexagon and telling you a

32
00:01:17,670 --> 00:01:15,920
little bit about you know

33
00:01:20,469 --> 00:01:17,680
how it works

34
00:01:23,749 --> 00:01:20,479
our second act is going to be uh carolyn

35
00:01:25,670 --> 00:01:23,759
porco she's our imaging team lead she's

36
00:01:26,870 --> 00:01:25,680
based at the space science institute in

37
00:01:28,390 --> 00:01:26,880
colorado

38
00:01:31,910 --> 00:01:28,400

she's going to be talking about this

39
00:01:34,069 --> 00:01:31,920
really gorgeous multi-image mosaic that

40
00:01:36,950 --> 00:01:34,079
cassini has been able to put together of

41
00:01:38,469 --> 00:01:36,960
the saturn system it shows saturn its

42
00:01:40,950 --> 00:01:38,479
rings

43
00:01:43,350 --> 00:01:40,960
a lot of moons and then also

44
00:01:44,710 --> 00:01:43,360
our inner planets of our solar system

45
00:01:46,630 --> 00:01:44,720
she's going to give you a tour through

46
00:01:47,749 --> 00:01:46,640
the image and then tell you how it came

47
00:01:49,910 --> 00:01:47,759
to be

48
00:01:52,870 --> 00:01:49,920
our third act is going to involve linda

49
00:01:55,670 --> 00:01:52,880
spilker and earl mays

50
00:01:57,990 --> 00:01:55,680
linda is our cassini project scientist

51
00:02:00,469 --> 00:01:58,000
and earl is our cassini program manager

52
00:02:03,190 --> 00:02:00,479
and they are based here at jpl as well

53
00:02:05,510 --> 00:02:03,200
um cassini linda is going to tell you

54
00:02:07,190 --> 00:02:05,520
what's up uh what's coming up next for

55
00:02:08,469 --> 00:02:07,200
cassini science

56
00:02:10,389 --> 00:02:08,479
all the exciting things that we're going

57
00:02:12,550 --> 00:02:10,399
to do in the next couple years and then

58
00:02:14,390 --> 00:02:12,560
earl is going to tell you how does our

59
00:02:16,390 --> 00:02:14,400
spacecraft do all the acrobatics it

60
00:02:17,430 --> 00:02:16,400
needs to do in order to get that great

61
00:02:20,830 --> 00:02:17,440
science

62
00:02:24,229 --> 00:02:20,840
so we're going to start off with cunio

63
00:02:26,150 --> 00:02:24,239

hi so i will be talking about this

64
00:02:29,270 --> 00:02:26,160
i will be talking about the images we

65
00:02:30,630 --> 00:02:29,280
are releasing today um saturn's hexagon

66
00:02:32,949 --> 00:02:30,640
and that

67
00:02:35,350 --> 00:02:32,959
so we are imaging we are looking at

68
00:02:37,430 --> 00:02:35,360
saturn from cassini

69
00:02:39,509 --> 00:02:37,440
vantage point which is an orbit around

70
00:02:41,030 --> 00:02:39,519
saturn since 2004.

71
00:02:42,869 --> 00:02:41,040
so i have been studying this feature

72
00:02:45,750 --> 00:02:42,879
called the hexagon around north pole of

73
00:02:47,990 --> 00:02:45,760
saturn um the feature is not new just to

74
00:02:51,910 --> 00:02:48,000
be sure we've known that it existed

75
00:02:54,710 --> 00:02:51,920
since at least since 81

76
00:02:57,350 --> 00:02:54,720
and um we confirmed that as soon as

77
00:02:59,750 --> 00:02:57,360
cassini went into orbit around saturn um

78
00:03:02,309 --> 00:02:59,760
it is still um it was still active in

79
00:03:05,350 --> 00:03:02,319
2004 i think we're still waiting for the

80
00:03:07,830 --> 00:03:05,360
image so we are in orbit around saturn

81
00:03:10,070 --> 00:03:07,840
um the images we're releasing today

82
00:03:12,790 --> 00:03:10,080
let's see the image just that just

83
00:03:14,710 --> 00:03:12,800
showed up is how saturn's north polar

84
00:03:16,470 --> 00:03:14,720
area looks like from

85
00:03:18,869 --> 00:03:16,480
orbit of saturn

86
00:03:21,110 --> 00:03:18,879
so right in the middle is um

87
00:03:23,509 --> 00:03:21,120
north pole of saturn the darker spot and

88
00:03:25,270 --> 00:03:23,519

then you can see the clear

89
00:03:28,710 --> 00:03:25,280
geometric hexagon

90
00:03:30,149 --> 00:03:28,720
geometric shape um which has six sides

91
00:03:32,789 --> 00:03:30,159
and corners that's why we've been

92
00:03:35,750 --> 00:03:32,799
calling it the hexagon

93
00:03:36,710 --> 00:03:35,760
so this is the view we have

94
00:03:41,270 --> 00:03:36,720
from

95
00:03:43,030 --> 00:03:41,280
and let's see so what's new about what

96
00:03:44,710 --> 00:03:43,040
we're going to talk about today is the

97
00:03:47,509 --> 00:03:44,720
view we have

98
00:03:49,830 --> 00:03:47,519
saturn was in um saturn's north pole was

99
00:03:52,869 --> 00:03:49,840
in winter darkness when we were when we

100
00:03:54,710 --> 00:03:52,879
entered orbit around saturn in 2004 and

101
00:03:56,390 --> 00:03:54,720
sunlight has been slowly starting to

102
00:03:58,630 --> 00:03:56,400
shine on north pole during the earlier

103
00:04:01,589 --> 00:03:58,640
part of the mission and then that that

104
00:04:03,990 --> 00:04:01,599
brings us to the next image that we we

105
00:04:07,030 --> 00:04:04,000
released in 2009

106
00:04:10,309 --> 00:04:07,040
so this is the hat we had in 2008 and

107
00:04:12,229 --> 00:04:10,319
released in 2009 so we still had a hole

108
00:04:15,190 --> 00:04:12,239
around north pole this is the best image

109
00:04:17,270 --> 00:04:15,200
we had previously today

110
00:04:19,110 --> 00:04:17,280
before today so you can still see the

111
00:04:21,509 --> 00:04:19,120
hexagonal pattern you can see the wavy

112
00:04:22,950 --> 00:04:21,519
patterns really radiating off the

113
00:04:25,350 --> 00:04:22,960

corners

114
00:04:27,990 --> 00:04:25,360
so this is what we started seeing around

115
00:04:32,390 --> 00:04:28,000
2008 and then

116
00:04:37,830 --> 00:04:34,870
cassini has been in orbit around saturn

117
00:04:39,990 --> 00:04:37,840
since 2004 and we change orbit once in a

118
00:04:43,030 --> 00:04:40,000
while so that we can have a better view

119
00:04:45,510 --> 00:04:43,040
of different parts of the planet so um

120
00:04:47,590 --> 00:04:45,520
saturn went through an equinox earlier a

121
00:04:49,830 --> 00:04:47,600
few years ago and we just changed

122
00:04:51,830 --> 00:04:49,840
saturn's i'm sorry cassini's orbit so

123
00:04:53,909 --> 00:04:51,840
that we can have better views of north

124
00:04:56,629 --> 00:04:53,919
pole so that we can have movies like

125
00:04:59,510 --> 00:04:56,639
this so this is a this is a view we had

126
00:05:01,990 --> 00:04:59,520
about a year ago and then um it takes us

127
00:05:04,469 --> 00:05:02,000
a bit of time to put together uh makeup

128
00:05:07,029 --> 00:05:04,479
map we have to stitch together tons of

129
00:05:09,110 --> 00:05:07,039
images to put together this movie and

130
00:05:10,430 --> 00:05:09,120
this is the view we have today

131
00:05:13,350 --> 00:05:10,440
in the middle you can see the

132
00:05:15,830 --> 00:05:13,360
counterclockwise spinning fast vortex we

133
00:05:19,430 --> 00:05:15,840
have been calling it the polar hurricane

134
00:05:20,390 --> 00:05:19,440
and then you see around the um

135
00:05:22,390 --> 00:05:20,400
around

136
00:05:24,870 --> 00:05:22,400
five o'clock in the spot you can see a

137
00:05:27,110 --> 00:05:24,880
counter clockwise clockwise spinning

138
00:05:29,270 --> 00:05:27,120

vortex that's it that is another vortex

139
00:05:31,430 --> 00:05:29,280
and then you see of course the hexagonal

140
00:05:34,070 --> 00:05:31,440
pattern and outline

141
00:05:36,870 --> 00:05:34,080
so i hope you can see the clouds zipping

142
00:05:39,590 --> 00:05:36,880
through the hexagonal outline

143
00:05:43,110 --> 00:05:39,600
this shows that the hexagon is actually

144
00:05:45,749 --> 00:05:43,120
a feature geometric pattern born formed

145
00:05:48,710 --> 00:05:45,759
by the jet stream at that latitude

146
00:05:53,990 --> 00:05:51,189
the jet stream has a lot of effect on

147
00:05:56,230 --> 00:05:54,000
the cloud dynamics and we can in one

148
00:05:58,710 --> 00:05:56,240
another of the view we are releasing

149
00:06:00,550 --> 00:05:58,720
today we can actually tell the um a

150
00:06:03,510 --> 00:06:00,560
little bit more about the cloud

151
00:06:07,110 --> 00:06:03,520
properties of the clouds affected by

152
00:06:09,670 --> 00:06:07,120
digital stream which is coming up now

153
00:06:13,029 --> 00:06:09,680
so in this view i hope you can see the

154
00:06:16,309 --> 00:06:13,039
sharp color boundary between blue to

155
00:06:18,790 --> 00:06:16,319
darker darker color color and then green

156
00:06:23,270 --> 00:06:18,800
that is the color boundary formed by the

157
00:06:25,350 --> 00:06:23,280
jet stream so um a jet stream can act as

158
00:06:27,990 --> 00:06:25,360
a transport barrier let's see it can

159
00:06:30,150 --> 00:06:28,000
prevent materials from going across the

160
00:06:31,110 --> 00:06:30,160
jet stream because it's just blowing so

161
00:06:32,790 --> 00:06:31,120
fast

162
00:06:36,070 --> 00:06:32,800
you can kind of imagine that it's easy

163
00:06:38,870 --> 00:06:36,080

to move along the stream of the jet but

164
00:06:40,629 --> 00:06:38,880
it's really hard to cross that stream so

165
00:06:42,870 --> 00:06:40,639
when there's a strong jet stream blowing

166
00:06:45,590 --> 00:06:42,880
like this it tends to create

167
00:06:48,469 --> 00:06:45,600
create a wall like this and

168
00:06:50,710 --> 00:06:48,479
in this image this is a false color view

169
00:06:54,150 --> 00:06:50,720
red color is responding to large

170
00:06:56,309 --> 00:06:54,160
particles large droplets of clouds and

171
00:06:57,990 --> 00:06:56,319
then green channel is

172
00:07:01,189 --> 00:06:58,000
assigned to

173
00:07:04,550 --> 00:07:01,199
similar particles but at higher

174
00:07:07,749 --> 00:07:04,560
altitudes so red is deep big particles

175
00:07:10,629 --> 00:07:07,759
green is high large particles and then

176
00:07:13,510 --> 00:07:10,639
the blue channel is assigned to

177
00:07:15,189 --> 00:07:13,520
a wavelength that is responsive to

178
00:07:18,790 --> 00:07:15,199
tiny aerosols higher up in the

179
00:07:21,110 --> 00:07:18,800
atmosphere so this color composite is

180
00:07:22,950 --> 00:07:21,120
showing properties of clouds that exist

181
00:07:25,110 --> 00:07:22,960
in different areas and you can clearly

182
00:07:27,749 --> 00:07:25,120
see that there's a sharp boundary and

183
00:07:29,749 --> 00:07:27,759
the composition

184
00:07:31,510 --> 00:07:29,759
or makeup of the clouds that we see

185
00:07:34,230 --> 00:07:31,520
across the hexagon

186
00:07:36,469 --> 00:07:34,240
so i've been talking about um i said

187
00:07:40,309 --> 00:07:36,479
that this jet stream has a six-sided

188
00:07:44,230 --> 00:07:40,319

pattern it looks really well

189
00:07:46,790 --> 00:07:44,240
particular picky peculiar maybe

190
00:07:48,869 --> 00:07:46,800
and it looks it is the surprising thing

191
00:07:51,909 --> 00:07:48,879
is that it's really stable it has been

192
00:07:53,990 --> 00:07:51,919
there since at least 1981.

193
00:07:55,670 --> 00:07:54,000
um this is a really exciting

194
00:07:57,510 --> 00:07:55,680
thing we can see

195
00:07:59,029 --> 00:07:57,520
it looks you might sign

196
00:08:00,950 --> 00:07:59,039
you might think that it's really weird

197
00:08:02,790 --> 00:08:00,960
but similar thing actually happens on

198
00:08:05,430 --> 00:08:02,800
earth which is the next movie that we're

199
00:08:09,589 --> 00:08:06,390
earth

200
00:08:11,350 --> 00:08:09,599
has atmospheric jet streams um this is

201
00:08:13,909 --> 00:08:11,360
the this is the weather system this is

202
00:08:16,710 --> 00:08:13,919
the um this is the flow that moves the

203
00:08:19,350 --> 00:08:16,720
weather systems across the um

204
00:08:20,710 --> 00:08:19,360
north american continent for example

205
00:08:21,990 --> 00:08:20,720
across north

206
00:08:23,909 --> 00:08:22,000
north america

207
00:08:26,070 --> 00:08:23,919
you might notice that we see weather

208
00:08:28,230 --> 00:08:26,080
patterns moving from west to the east so

209
00:08:31,189 --> 00:08:28,240
west coast feels the weather in the

210
00:08:33,269 --> 00:08:31,199
storms before they reach east coast that

211
00:08:35,990 --> 00:08:33,279
is because there's this jet stream um

212
00:08:38,070 --> 00:08:36,000
flowing across high altitudes around

213
00:08:40,389 --> 00:08:38,080

earth so that actually totally wraps

214
00:08:43,350 --> 00:08:40,399
around the planet and you you can see

215
00:08:44,790 --> 00:08:43,360
that this path of this jet stream is

216
00:08:45,670 --> 00:08:44,800
actually meandering

217
00:08:46,710 --> 00:08:45,680
and

218
00:08:48,630 --> 00:08:46,720
um

219
00:08:51,030 --> 00:08:48,640
but the meandering shape is not stable

220
00:08:53,190 --> 00:08:51,040
on earth because on earth that jet

221
00:08:55,190 --> 00:08:53,200
stream has to blow over mountain ranges

222
00:08:57,670 --> 00:08:55,200
and it has to cross the boundary between

223
00:08:59,750 --> 00:08:57,680
the continents and oceans earth is

224
00:09:01,430 --> 00:08:59,760
basically really messy so the

225
00:09:02,949 --> 00:09:01,440
interaction between the hard ground and

226
00:09:05,509 --> 00:09:02,959
the jet stream is going to make an

227
00:09:06,389 --> 00:09:05,519
unstable pattern but of course saturn is

228
00:09:39,910 --> 00:09:06,399
a

229
00:09:41,829 --> 00:09:39,920
the outline of this ozone hole is

230
00:09:43,910 --> 00:09:41,839
actually maintained by another jet

231
00:09:44,949 --> 00:09:43,920
stream that's blowing around antarctic

232
00:09:47,750 --> 00:09:44,959
continent

233
00:09:50,470 --> 00:09:47,760
so this is another example of a wall

234
00:09:53,350 --> 00:09:50,480
that was imposed by a jet stream inside

235
00:09:55,910 --> 00:09:53,360
of inside the jet stream um the ozone is

236
00:09:58,470 --> 00:09:55,920
destroyed depleted by

237
00:10:00,389 --> 00:09:58,480
man-made cfcs and

238
00:10:02,069 --> 00:10:00,399

the ozone that was created outside

239
00:10:04,550 --> 00:10:02,079
cannot go inside of the jet stream

240
00:10:06,550 --> 00:10:04,560
that's why there's this hook um

241
00:10:09,269 --> 00:10:06,560
ozo that gets maintained

242
00:10:10,230 --> 00:10:09,279
during winter in antarctica

243
00:10:13,430 --> 00:10:10,240
so

244
00:10:15,910 --> 00:10:13,440
um i like to compare the atmospheric

245
00:10:18,470 --> 00:10:15,920
dynamics the weather systems of saturn

246
00:10:20,710 --> 00:10:18,480
and earth because well

247
00:10:22,550 --> 00:10:20,720
the goal here is to understand this

248
00:10:24,069 --> 00:10:22,560
thing called weather

249
00:10:26,069 --> 00:10:24,079
so

250
00:10:27,750 --> 00:10:26,079
um

251
00:10:29,829 --> 00:10:27,760
i'd like to talk about

252
00:10:33,750 --> 00:10:29,839
when i talk about why study other

253
00:10:36,230 --> 00:10:33,760
planets i like to say well

254
00:10:38,310 --> 00:10:36,240
bring up the topic of psychology you do

255
00:10:40,230 --> 00:10:38,320
not claim to understand psychology by

256
00:10:42,230 --> 00:10:40,240
just talking about one person

257
00:10:43,750 --> 00:10:42,240
not just by studying one

258
00:10:45,910 --> 00:10:43,760
one person's mind

259
00:10:47,910 --> 00:10:45,920
if you want to understand psychology you

260
00:10:49,829 --> 00:10:47,920
study many many persons

261
00:10:51,750 --> 00:10:49,839
so it's the same thing about whether

262
00:10:54,069 --> 00:10:51,760
when you want to understand whether you

263
00:10:55,430 --> 00:10:54,079

don't just focus on one planet just in

264
00:10:58,550 --> 00:10:55,440
our solar system we have a lot of

265
00:10:59,509 --> 00:10:58,560
atmospheres starting with venus earth

266
00:11:02,069 --> 00:10:59,519
mars

267
00:11:04,150 --> 00:11:02,079
jupiter saturn uranus neptune and then

268
00:11:06,069 --> 00:11:04,160
saturn's moon titan they all have

269
00:11:08,470 --> 00:11:06,079
interesting weather systems so

270
00:11:10,710 --> 00:11:08,480
it is really important to compare all

271
00:11:12,470 --> 00:11:10,720
these different weather systems and so

272
00:11:15,509 --> 00:11:12,480
that we develop a wider range of

273
00:11:17,430 --> 00:11:15,519
perspective on our understanding

274
00:11:20,630 --> 00:11:17,440
and that's what i have

275
00:11:22,870 --> 00:11:20,640
okay great kunio um thanks very much

276
00:11:24,389 --> 00:11:22,880
just for all of you guys out there uh

277
00:11:26,150 --> 00:11:24,399
participating in our hangout right now

278
00:11:28,870 --> 00:11:26,160
just wanted to let you guys know how you

279
00:11:30,710 --> 00:11:28,880
can ask questions we you can ask

280
00:11:33,350 --> 00:11:30,720
questions on the google hangout page

281
00:11:34,790 --> 00:11:33,360
itself you can ask them in the chat box

282
00:11:37,870 --> 00:11:34,800
on ustream

283
00:11:40,550 --> 00:11:37,880
you can also ask them on twitter via

284
00:11:42,470 --> 00:11:40,560
askcassini and you can also do it by

285
00:11:46,389 --> 00:11:42,480
email if you want it the slightly more

286
00:11:49,509 --> 00:11:46,399
old-fashioned way email v mcgregor at

287
00:11:52,310 --> 00:11:50,550
so

288
00:11:53,670 --> 00:11:52,320

we'll be taking those throughout and

289
00:11:55,590 --> 00:11:53,680
we're going to

290
00:11:58,470 --> 00:11:55,600
break up each speaker session with some

291
00:12:00,150 --> 00:11:58,480
questions at the end so uh well for

292
00:12:01,509 --> 00:12:00,160
kunio um

293
00:12:03,829 --> 00:12:01,519
let me just ask you my first question

294
00:12:05,269 --> 00:12:03,839
which is how excited were you to see

295
00:12:07,269 --> 00:12:05,279
these images i mean you know the false

296
00:12:09,430 --> 00:12:07,279
color one it's pretty psychedelic and to

297
00:12:11,670 --> 00:12:09,440
see a complete view i mean how exciting

298
00:12:13,350 --> 00:12:11,680
was it to actually see these things come

299
00:12:15,430 --> 00:12:13,360
down

300
00:12:17,269 --> 00:12:15,440
i actually remember the evening i first

301
00:12:20,150 --> 00:12:17,279
processed those images those images came

302
00:12:22,310 --> 00:12:20,160
down and then i got to see the images so

303
00:12:23,910 --> 00:12:22,320
the first thing i do when i get these

304
00:12:24,870 --> 00:12:23,920
images is to

305
00:12:28,069 --> 00:12:24,880
map

306
00:12:30,310 --> 00:12:28,079
i showed you the very first image that

307
00:12:31,750 --> 00:12:30,320
was in perspective view from saturn it's

308
00:12:33,509 --> 00:12:31,760
actually really hard to tell where

309
00:12:35,829 --> 00:12:33,519
exactly on the planet those cloud

310
00:12:37,350 --> 00:12:35,839
features are so the first thing i do

311
00:12:40,069 --> 00:12:37,360
is to

312
00:12:42,550 --> 00:12:40,079
project it on a known coordinate system

313
00:12:44,150 --> 00:12:42,560

and then when i do that um when i do

314
00:12:46,230 --> 00:12:44,160
that i can start tracking things and

315
00:12:47,269 --> 00:12:46,240
then i can start stitching together the

316
00:12:48,550 --> 00:12:47,279
images

317
00:12:51,030 --> 00:12:48,560
so when i

318
00:12:53,110 --> 00:12:51,040
first started getting the images that

319
00:12:55,190 --> 00:12:53,120
cover the hexagon the images actually

320
00:12:57,670 --> 00:12:55,200
didn't show the entire hexagon but as i

321
00:12:59,750 --> 00:12:57,680
started stitching together the images i

322
00:13:01,829 --> 00:12:59,760
the full view of the hexagon actually in

323
00:13:03,269 --> 00:13:01,839
color as well came into view that

324
00:13:05,910 --> 00:13:03,279
evening i was actually just going to

325
00:13:08,069 --> 00:13:05,920
process just the very first frame i was

326
00:13:09,990 --> 00:13:08,079
pretty tired that i finished i was about

327
00:13:12,389 --> 00:13:10,000
to be done with the first image about

328
00:13:14,150 --> 00:13:12,399
1am i actually worked late at night and

329
00:13:15,910 --> 00:13:14,160
then i was going to go home but as soon

330
00:13:17,430 --> 00:13:15,920
as i saw the very first image i just

331
00:13:20,069 --> 00:13:17,440
couldn't stop right

332
00:13:22,150 --> 00:13:20,079
i i just processed the rest of it and

333
00:13:25,509 --> 00:13:22,160
and i just stayed up until 5am so yeah

334
00:13:28,150 --> 00:13:25,519
that was a really memorable evening

335
00:13:31,030 --> 00:13:28,160
well great um so then uh one question

336
00:13:33,430 --> 00:13:31,040
that came in via email is what's your

337
00:13:35,190 --> 00:13:33,440
favorite image of the mission um i mean

338
00:13:36,949 --> 00:13:35,200

is it this hexagon one or have you got

339
00:13:38,949 --> 00:13:36,959
some other ones that you know are dear

340
00:13:41,189 --> 00:13:38,959
to your heart as well

341
00:13:42,389 --> 00:13:41,199
well the hexagon is definitely

342
00:13:46,470 --> 00:13:42,399
um

343
00:13:48,550 --> 00:13:46,480
2008 view of the hexagon that was really

344
00:13:51,269 --> 00:13:48,560
exciting because that was the first very

345
00:13:53,350 --> 00:13:51,279
first complete view of the hexagon under

346
00:13:56,470 --> 00:13:53,360
under sunlight and then that was the

347
00:14:00,710 --> 00:13:56,480
highest resolution ever of this of the

348
00:14:05,509 --> 00:14:03,430
something that comes close are these um

349
00:14:08,310 --> 00:14:05,519
images of the storm that there was a

350
00:14:10,710 --> 00:14:08,320
storm that blew up in december 2010 and

351
00:14:12,870 --> 00:14:10,720
lasted for 200 days it was a single

352
00:14:15,590 --> 00:14:12,880
thunderstorm giant thunderstorm that

353
00:14:18,069 --> 00:14:15,600
kept going for 200 days

354
00:14:20,069 --> 00:14:18,079
and we had a lot of good images from

355
00:14:22,470 --> 00:14:20,079
that we got a lot of press press

356
00:14:25,430 --> 00:14:22,480
coverages out of the images and many of

357
00:14:27,509 --> 00:14:25,440
those um the turbulent wakes showing a

358
00:14:32,069 --> 00:14:27,519
lot of details in the storm dynamics

359
00:14:34,470 --> 00:14:32,079
those are those images are very well um

360
00:14:36,550 --> 00:14:34,480
i i don't think well those are different

361
00:14:39,110 --> 00:14:36,560
features i really like both both the

362
00:14:41,509 --> 00:14:39,120
hexagon and the big storm yeah those are

363
00:14:42,949 --> 00:14:41,519

the two big things that have happened

364
00:14:44,550 --> 00:14:42,959
during cassini

365
00:14:45,910 --> 00:14:44,560
so yeah

366
00:14:47,269 --> 00:14:45,920
okay well i know it's a little like

367
00:14:49,590 --> 00:14:47,279
choosing among your children and you

368
00:14:51,110 --> 00:14:49,600
can't really have a favorite

369
00:14:54,069 --> 00:14:51,120
but someone

370
00:14:55,910 --> 00:14:54,079
with um

371
00:14:57,670 --> 00:14:55,920
images and in fact the whole

372
00:14:59,509 --> 00:14:57,680
span of all the images that cassini has

373
00:15:01,189 --> 00:14:59,519
been sending back for the over nine

374
00:15:03,750 --> 00:15:01,199
years that we've been at saturn is

375
00:15:05,829 --> 00:15:03,760
carolyn porco so carolyn why don't you

376
00:15:08,550 --> 00:15:05,839
uh tell us a little bit about the big

377
00:15:11,110 --> 00:15:08,560
multi-image mosaic that cassini took on

378
00:15:13,750 --> 00:15:11,120
july 19th of this year

379
00:15:15,030 --> 00:15:13,760
okay well i have i think the best job of

380
00:15:16,550 --> 00:15:15,040
everybody here

381
00:15:19,750 --> 00:15:16,560
because i get to

382
00:15:20,870 --> 00:15:19,760
tell you about this fabulous and unusual

383
00:15:26,069 --> 00:15:20,880
event

384
00:15:28,470 --> 00:15:26,079
call the day the earth smiled on which

385
00:15:30,310 --> 00:15:28,480
we took the cassini cameras and turned

386
00:15:32,230 --> 00:15:30,320
them in the direction of saturn and the

387
00:15:33,030 --> 00:15:32,240
earth and took a big glorious mosaic

388
00:15:34,790 --> 00:15:33,040

like

389
00:15:38,230 --> 00:15:34,800
we just told you

390
00:15:40,230 --> 00:15:38,240
and my attachment to the idea of taking

391
00:15:42,150 --> 00:15:40,240
a picture of earth goes all the way back

392
00:15:44,150 --> 00:15:42,160
to voyager

393
00:15:46,790 --> 00:15:44,160
when i worked with carl sagan on what

394
00:15:47,670 --> 00:15:46,800
has now become the very famous pale blue

395
00:15:52,230 --> 00:15:47,680
dot

396
00:15:54,470 --> 00:15:52,240
i'm part of a mosaic of

397
00:15:56,949 --> 00:15:54,480
six planets in the inner solar system

398
00:15:59,110 --> 00:15:56,959
and i had had this idea i'd just been

399
00:16:00,870 --> 00:15:59,120
added to the voyager imaging team

400
00:16:03,829 --> 00:16:00,880
and i had this idea that it would be

401
00:16:04,629 --> 00:16:03,839
fabulous to show the world

402
00:16:06,550 --> 00:16:04,639
what

403
00:16:08,790 --> 00:16:06,560
our solar system looked like to the

404
00:16:09,990 --> 00:16:08,800
point of view of an alien making an

405
00:16:11,910 --> 00:16:10,000
approach

406
00:16:14,069 --> 00:16:11,920
from outside the solar system and

407
00:16:15,749 --> 00:16:14,079
approaching our star

408
00:16:17,910 --> 00:16:15,759
and um

409
00:16:19,590 --> 00:16:17,920
i had found after came up with this idea

410
00:16:21,829 --> 00:16:19,600
that carl sagan had come up with this

411
00:16:24,389 --> 00:16:21,839
idea two years before i did

412
00:16:26,790 --> 00:16:24,399
and in fact other people have also had

413
00:16:29,110 --> 00:16:26,800

also come up with this idea so i joined

414
00:16:31,910 --> 00:16:29,120
forces with carl

415
00:16:34,470 --> 00:16:31,920
and he and others planned and executed

416
00:16:36,629 --> 00:16:34,480
the pale blue dot image now

417
00:16:38,389 --> 00:16:36,639
if you recall the pale blue dot image

418
00:16:40,230 --> 00:16:38,399
and let's bring that up to show

419
00:16:43,269 --> 00:16:40,240
everybody remind them what it looked

420
00:16:45,350 --> 00:16:43,279
like the pale blue dot image

421
00:16:47,590 --> 00:16:45,360
was not a great image you kind of look

422
00:16:50,550 --> 00:16:47,600
at it and say what you call that an

423
00:16:52,389 --> 00:16:50,560
image it was just uh

424
00:16:54,870 --> 00:16:52,399
the dot of earth

425
00:16:59,030 --> 00:16:54,880
no stars forgot to add

426
00:17:01,509 --> 00:16:59,040
in car proposal to the voyager project

427
00:17:04,870 --> 00:17:01,519
he said the idea was to take a picture

428
00:17:06,549 --> 00:17:04,880
of the earth and i quote a wash in a sea

429
00:17:08,549 --> 00:17:06,559
of stars

430
00:17:11,909 --> 00:17:08,559
well you look at the pale blue dot image

431
00:17:13,189 --> 00:17:11,919
and you don't see any stars and you see

432
00:17:15,429 --> 00:17:13,199
the earth

433
00:17:18,069 --> 00:17:15,439
sitting on a beam of light that is in

434
00:17:19,750 --> 00:17:18,079
fact scattered in the optics of the of

435
00:17:22,230 --> 00:17:19,760
course none of this really mattered

436
00:17:24,949 --> 00:17:22,240
because it was what carl

437
00:17:27,110 --> 00:17:24,959
had to say about this image

438
00:17:28,630 --> 00:17:27,120

and the way he romanced it

439
00:17:31,029 --> 00:17:28,640
and

440
00:17:34,230 --> 00:17:31,039
turned it into an allegory of the human

441
00:17:37,190 --> 00:17:34,240
condition that made ever since has made

442
00:17:38,230 --> 00:17:37,200
the phrase pale blue dots synonymous

443
00:17:40,710 --> 00:17:38,240
with

444
00:17:43,029 --> 00:17:40,720
an inspirational call to protect the

445
00:17:44,950 --> 00:17:43,039
environment and a call to planetary

446
00:17:47,669 --> 00:17:44,960
brotherhood

447
00:17:49,750 --> 00:17:47,679
well ever since the beginning of my

448
00:17:52,070 --> 00:17:49,760
tenure as the leader

449
00:17:53,909 --> 00:17:52,080
of the imaging team on cassini i have

450
00:17:55,430 --> 00:17:53,919
wanted to do that picture over again

451
00:17:57,430 --> 00:17:55,440
only make it better

452
00:17:58,310 --> 00:17:57,440
and somewhere along the line it occurred

453
00:18:01,830 --> 00:17:58,320
to me

454
00:18:04,630 --> 00:18:01,840
wouldn't it be just absolutely fabulous

455
00:18:06,870 --> 00:18:04,640
if we could at the moment that

456
00:18:08,950 --> 00:18:06,880
if we could tell people in advance at

457
00:18:12,310 --> 00:18:08,960
this moment your picture is going to be

458
00:18:13,590 --> 00:18:12,320
taken from the orbit of saturn a billion

459
00:18:15,750 --> 00:18:13,600
miles away

460
00:18:18,070 --> 00:18:15,760
and invite them

461
00:18:19,110 --> 00:18:18,080
at that of the appropriate time to go

462
00:18:20,470 --> 00:18:19,120
out

463
00:18:21,350 --> 00:18:20,480

look up

464
00:18:24,470 --> 00:18:21,360
and

465
00:18:25,909 --> 00:18:24,480
with an acute sense of

466
00:18:29,270 --> 00:18:25,919
awareness

467
00:18:31,590 --> 00:18:29,280
contemplate their cosmic whereabouts

468
00:18:32,630 --> 00:18:31,600
think about the utter isolation of the

469
00:18:36,150 --> 00:18:32,640
earth

470
00:18:37,430 --> 00:18:36,160
in the never-ending blackness of space

471
00:18:38,150 --> 00:18:37,440
marvel

472
00:18:44,310 --> 00:18:38,160
the

473
00:18:45,909 --> 00:18:44,320
sun

474
00:18:47,669 --> 00:18:45,919
appreciate the

475
00:18:50,230 --> 00:18:47,679
lushness

476
00:18:52,549 --> 00:18:50,240
and the life on our planet and marvel at

477
00:18:56,710 --> 00:18:52,559
their own existence

478
00:18:59,350 --> 00:18:56,720
and also appreciate and contemplate the

479
00:19:01,669 --> 00:18:59,360
magnitude of the accomplishment the

480
00:19:03,190 --> 00:19:01,679
technological and scientific

481
00:19:04,070 --> 00:19:03,200
accomplishment

482
00:19:06,870 --> 00:19:04,080
that

483
00:19:10,789 --> 00:19:06,880
made this interplanetary

484
00:19:12,230 --> 00:19:10,799
salute between robot and maker possible

485
00:19:15,750 --> 00:19:12,240
and um

486
00:19:18,230 --> 00:19:15,760
and so uh that's in fact what happened

487
00:19:20,390 --> 00:19:18,240
on july 19th of this past year the

488
00:19:23,750 --> 00:19:20,400

cassini cameras were turned

489
00:19:25,350 --> 00:19:23,760
towards saturn while it eclipsed the sun

490
00:19:26,710 --> 00:19:25,360
and it took another

491
00:19:28,710 --> 00:19:26,720
pale blue dot

492
00:19:31,190 --> 00:19:28,720
the image of the earth and we sent out

493
00:19:33,510 --> 00:19:31,200
the word ahead of time get out there

494
00:19:35,909 --> 00:19:33,520
feel the cosmic love

495
00:19:38,390 --> 00:19:35,919
uh smile and celebration

496
00:19:40,630 --> 00:19:38,400
and to borrow a line with bob dylan

497
00:19:42,390 --> 00:19:40,640
dance beneath the diamond sky with one

498
00:19:44,789 --> 00:19:42,400
hand waving free

499
00:19:46,470 --> 00:19:44,799
uh and i have to say we had a lot of

500
00:19:48,470 --> 00:19:46,480
help in spreading the word an

501
00:19:49,590 --> 00:19:48,480
organization called astronomers without

502
00:19:51,750 --> 00:19:49,600
borders

503
00:19:54,950 --> 00:19:51,760
uh spread the word they organized events

504
00:19:56,870 --> 00:19:54,960
all over the globe uh and jpl did its

505
00:19:58,710 --> 00:19:56,880
own wave at saturn program which i'm

506
00:20:00,470 --> 00:19:58,720
sure you all know about and you're gonna

507
00:20:02,149 --> 00:20:00,480
hear about afterwards

508
00:20:04,070 --> 00:20:02,159
um

509
00:20:06,230 --> 00:20:04,080
but uh

510
00:20:08,710 --> 00:20:06,240
the whole thing out just went off

511
00:20:11,270 --> 00:20:08,720
tremendously well it was joyous people

512
00:20:14,310 --> 00:20:11,280
all over the world got involved and they

513
00:20:16,549 --> 00:20:14,320

responded exactly the way i had hoped we

514
00:20:18,470 --> 00:20:16,559
got a lot of comments uh some of the

515
00:20:20,149 --> 00:20:18,480
comments i got of course we got comments

516
00:20:21,830 --> 00:20:20,159
like i hope you saw me i'm the one

517
00:20:24,710 --> 00:20:21,840
wearing the funny hat

518
00:20:27,350 --> 00:20:24,720
uh but by and large we received many

519
00:20:29,909 --> 00:20:27,360
comments i want to read some to you

520
00:20:32,470 --> 00:20:29,919
because they're wonderful

521
00:20:34,789 --> 00:20:32,480
someone richard from pennsylvania wrote

522
00:20:37,590 --> 00:20:34,799
what a great way to feel connected to

523
00:20:40,470 --> 00:20:37,600
the universe the planet and every single

524
00:20:41,590 --> 00:20:40,480
person on it we are truly all in this

525
00:20:43,510 --> 00:20:41,600
together

526
00:20:44,789 --> 00:20:43,520
and tests from somewhere i don't know

527
00:20:46,789 --> 00:20:44,799
where said

528
00:20:49,190 --> 00:20:46,799
at the appropriate time

529
00:20:51,750 --> 00:20:49,200
i left the table at a restaurant and i

530
00:20:54,710 --> 00:20:51,760
went to the parking lot i turned my face

531
00:20:56,950 --> 00:20:54,720
to the sky and i spent a few minutes

532
00:20:58,310 --> 00:20:56,960
watching and listening to what life on

533
00:21:00,789 --> 00:20:58,320
earth was like

534
00:21:03,510 --> 00:21:00,799
right there right at that moment

535
00:21:06,310 --> 00:21:03,520
knowing that millions of miles away a

536
00:21:09,510 --> 00:21:06,320
spacecraft was turning its lands towards

537
00:21:12,070 --> 00:21:09,520
our amazing planet and taking photos

538
00:21:14,710 --> 00:21:12,080

what a feeling of connection and oneness

539
00:21:17,669 --> 00:21:14,720
with the miracle that is life on earth

540
00:21:21,029 --> 00:21:17,679
this experience was beyond meaningful it

541
00:21:24,390 --> 00:21:21,039
was transcendent what a beautiful thing

542
00:21:26,149 --> 00:21:24,400
and then finally from lake ontario

543
00:21:28,470 --> 00:21:26,159
i had been entranced

544
00:21:30,870 --> 00:21:28,480
by this project ever since i heard about

545
00:21:33,510 --> 00:21:30,880
it and was determined to join in the

546
00:21:35,270 --> 00:21:33,520
celebration i just never knew how

547
00:21:38,070 --> 00:21:35,280
emotional i would feel

548
00:21:41,029 --> 00:21:38,080
i stood on the edge of lake ontario and

549
00:21:44,390 --> 00:21:41,039
i spun in circles waving up the sky

550
00:21:46,789 --> 00:21:44,400
we may not be unique we may be transient

551
00:21:49,990 --> 00:21:46,799
we may be only flying along in a dust

552
00:21:52,950 --> 00:21:50,000
mode but darn it for 15 minutes we were

553
00:21:54,470 --> 00:21:52,960
there we were aware and we smiled

554
00:21:57,270 --> 00:21:54,480
and so the whole thing was a great

555
00:21:59,430 --> 00:21:57,280
success and here now

556
00:22:01,510 --> 00:21:59,440
is the image that was taken on the day

557
00:22:02,950 --> 00:22:01,520
the earth smile

558
00:22:04,630 --> 00:22:02,960
and if you really want to see the

559
00:22:06,310 --> 00:22:04,640
details in this image

560
00:22:07,830 --> 00:22:06,320
you you won't see them in pictures we

561
00:22:09,750 --> 00:22:07,840
could show you on a google hangout

562
00:22:11,750 --> 00:22:09,760
you'll have to go on the web there are

563
00:22:13,830 --> 00:22:11,760

many places as you probably know they're

564
00:22:16,070 --> 00:22:13,840
on the cyclops website they're on the

565
00:22:17,669 --> 00:22:16,080
jpl website they're on the nasa website

566
00:22:19,430 --> 00:22:17,679
and in fact the image has gone viral

567
00:22:20,870 --> 00:22:19,440
it's many places

568
00:22:22,870 --> 00:22:20,880
but you can see

569
00:22:25,669 --> 00:22:22,880
center stage you can see the globe of

570
00:22:28,870 --> 00:22:25,679
saturn it's eclipsing the sun so the sun

571
00:22:30,789 --> 00:22:28,880
is behind it uh the main rings they look

572
00:22:33,029 --> 00:22:30,799
like they're glowing the sunlight is

573
00:22:34,870 --> 00:22:33,039
actually diffusing through them

574
00:22:35,750 --> 00:22:34,880
uh you see

575
00:22:38,390 --> 00:22:35,760
um

576
00:22:41,430 --> 00:22:38,400
you see the narrow g ring but the big

577
00:22:44,390 --> 00:22:41,440
blue ring that you see the beautiful one

578
00:22:47,909 --> 00:22:44,400
uh is most prominent and that ring is

579
00:22:49,909 --> 00:22:47,919
created by a hundred geysers erupting

580
00:22:53,110 --> 00:22:49,919
from the south pole

581
00:22:56,390 --> 00:22:53,120
of enceladus i'll say more about that in

582
00:22:58,549 --> 00:22:56,400
a minute and also in this picture

583
00:22:59,909 --> 00:22:58,559
we captured um

584
00:23:01,190 --> 00:22:59,919
four planets

585
00:23:02,710 --> 00:23:01,200
we captured

586
00:23:06,310 --> 00:23:02,720
not only saturn

587
00:23:07,430 --> 00:23:06,320
uh venus and and mars and of course the

588
00:23:10,149 --> 00:23:07,440

earth

589
00:23:13,029 --> 00:23:10,159
so i think that this may be

590
00:23:15,830 --> 00:23:13,039
the only picture that's captured um that

591
00:23:17,750 --> 00:23:15,840
many planets since the day of pale blue

592
00:23:19,110 --> 00:23:17,760
dots since the day of voyager which

593
00:23:21,510 --> 00:23:19,120
captured six

594
00:23:22,549 --> 00:23:21,520
um and then the next picture

595
00:23:24,390 --> 00:23:22,559
is a

596
00:23:27,830 --> 00:23:24,400
close-up of enceladus i want to

597
00:23:30,230 --> 00:23:27,840
concentrate on enceladus because i feel

598
00:23:33,590 --> 00:23:30,240
this is our most profound discovery with

599
00:23:36,070 --> 00:23:33,600
cassini you see the plume of material

600
00:23:37,590 --> 00:23:36,080
issuing forth from the south southern

601
00:23:40,070 --> 00:23:37,600
half of the moon

602
00:23:42,470 --> 00:23:40,080
that is as i said it's a material

603
00:23:44,549 --> 00:23:42,480
erupting from 100 geysers

604
00:23:47,269 --> 00:23:44,559
and they come from

605
00:23:49,909 --> 00:23:47,279
what we believe is a habitable habitable

606
00:23:51,909 --> 00:23:49,919
zone within this small moon and because

607
00:23:52,789 --> 00:23:51,919
those geysers are connected

608
00:23:53,990 --> 00:23:52,799
to

609
00:23:56,470 --> 00:23:54,000
this

610
00:23:59,110 --> 00:23:56,480
reservoir of liquid water subfused with

611
00:24:00,230 --> 00:23:59,120
organic material inside this moon it

612
00:24:03,269 --> 00:24:00,240
makes

613
00:24:05,669 --> 00:24:03,279

enceladus the most accessible habitable

614
00:24:07,669 --> 00:24:05,679
zone in all the solar system

615
00:24:09,990 --> 00:24:07,679
you can fly through those geysers and

616
00:24:12,470 --> 00:24:10,000
scoop up material and it's not out of

617
00:24:15,110 --> 00:24:12,480
the question that it could be snowing

618
00:24:18,549 --> 00:24:15,120
microbes at the south pole of enceladus

619
00:24:20,070 --> 00:24:18,559
so this is just one of very many reasons

620
00:24:22,470 --> 00:24:20,080
why we

621
00:24:23,990 --> 00:24:22,480
really are desperate to make sure that

622
00:24:25,750 --> 00:24:24,000
we can continue

623
00:24:27,590 --> 00:24:25,760
through the rest of the cassini mission

624
00:24:30,630 --> 00:24:27,600
out to 2017

625
00:24:32,870 --> 00:24:30,640
because um enceladus is one of the prime

626
00:24:34,310 --> 00:24:32,880
targets that we wish to fill them

627
00:24:36,470 --> 00:24:34,320
and then of course

628
00:24:39,669 --> 00:24:36,480
this picture

629
00:24:44,070 --> 00:24:41,909
over the right shoulder as it were of

630
00:24:45,510 --> 00:24:44,080
saturn beneath the rings and you will

631
00:24:47,909 --> 00:24:45,520
see

632
00:24:49,909 --> 00:24:47,919
our planet earth

633
00:24:51,350 --> 00:24:49,919
right there that bright dot and again

634
00:24:53,350 --> 00:24:51,360
you may not be able to see it on the

635
00:24:54,310 --> 00:24:53,360
screen but if you go on the web you will

636
00:24:55,830 --> 00:24:54,320
see

637
00:24:58,870 --> 00:24:55,840
that it is

638
00:25:00,710 --> 00:24:58,880

a washing sea of stars and it is there a

639
00:25:02,470 --> 00:25:00,720
billion miles away and this image

640
00:25:04,950 --> 00:25:02,480
freezes in time

641
00:25:07,510 --> 00:25:04,960
a unique moment when people all around

642
00:25:08,789 --> 00:25:07,520
the globe at the instant this picture

643
00:25:12,390 --> 00:25:08,799
was taken

644
00:25:14,470 --> 00:25:12,400
were saluting cassini and thinking about

645
00:25:15,830 --> 00:25:14,480
the magnificence of what we have

646
00:25:18,149 --> 00:25:15,840
accomplished in

647
00:25:21,029 --> 00:25:18,159
exploring the solar system and i have to

648
00:25:23,830 --> 00:25:21,039
add that i can't help

649
00:25:26,470 --> 00:25:23,840
but when i look at this image think that

650
00:25:29,830 --> 00:25:26,480
it represents the very very best that

651
00:25:30,950 --> 00:25:29,840
humanity has to offer because we are no

652
00:25:34,470 --> 00:25:30,960
good

653
00:25:36,789 --> 00:25:34,480
the small and trolled and war-like

654
00:25:40,149 --> 00:25:36,799
inhabitants of one tiny little dot of a

655
00:25:41,269 --> 00:25:40,159
planet but it serves us well to always

656
00:25:43,590 --> 00:25:41,279
remember

657
00:25:46,230 --> 00:25:43,600
we are also the seekers

658
00:25:47,669 --> 00:25:46,240
and the thinkers and the explorers who

659
00:25:48,950 --> 00:25:47,679
took this picture

660
00:25:52,070 --> 00:25:48,960
one world

661
00:25:54,149 --> 00:25:52,080
clear across interplanetary space to it

662
00:25:57,350 --> 00:25:54,159
and to be that small

663
00:26:00,230 --> 00:25:57,360

and reach so far is in the end what

664
00:26:02,789 --> 00:26:00,240
makes us the extraordinary citizens of

665
00:26:03,669 --> 00:26:02,799
planet earth so if you're ever down and

666
00:26:06,390 --> 00:26:03,679
out

667
00:26:08,390 --> 00:26:06,400
and you you're listening to the news and

668
00:26:10,870 --> 00:26:08,400
you're nothing but one bad thing after

669
00:26:13,750 --> 00:26:10,880
another go look at our cassini picture

670
00:26:15,909 --> 00:26:13,760
of earth and be reminded of just exactly

671
00:26:17,029 --> 00:26:15,919
how far we have come and how great we

672
00:26:18,549 --> 00:26:17,039
really are

673
00:26:20,870 --> 00:26:18,559
thank you

674
00:26:22,470 --> 00:26:20,880
all right thanks carolyn um certainly a

675
00:26:24,549 --> 00:26:22,480
lot of the comments and feedback that we

676
00:26:25,909 --> 00:26:24,559
got from that picture about how

677
00:26:27,510 --> 00:26:25,919
looking at this picture really puts

678
00:26:30,070 --> 00:26:27,520
things in perspective and i think you

679
00:26:33,750 --> 00:26:30,080
really nicely encapsulated that so we

680
00:26:36,149 --> 00:26:33,760
have uh a question here from twitter at

681
00:26:39,669 --> 00:26:36,159
q8 fail ak

682
00:26:42,310 --> 00:26:39,679
um the rings are obviously a big feature

683
00:26:44,230 --> 00:26:42,320
in that new mosaic that we put out and

684
00:26:46,470 --> 00:26:44,240
uh this person wants to know what is the

685
00:26:48,230 --> 00:26:46,480
thickness of the rings

686
00:26:50,070 --> 00:26:48,240
oh well it depends which rings you're

687
00:26:51,350 --> 00:26:50,080
talking about but i presume he means the

688
00:26:55,110 --> 00:26:51,360

main rings

689
00:26:56,230 --> 00:26:55,120
uh and they are really very thin uh they

690
00:26:58,630 --> 00:26:56,240
are

691
00:27:01,110 --> 00:26:58,640
no bigger they're about 30 feet thick

692
00:27:04,549 --> 00:27:01,120
and that makes them no bigger than about

693
00:27:07,350 --> 00:27:04,559
two stories uh in a modern day building

694
00:27:09,669 --> 00:27:07,360
so they're very thin despite the fact

695
00:27:11,430 --> 00:27:09,679
that saturn's rings are across they're

696
00:27:13,510 --> 00:27:11,440
about one light second they're only

697
00:27:16,470 --> 00:27:13,520
they're about 280 000. this is only the

698
00:27:17,750 --> 00:27:16,480
main rings about 280 000 kilometers

699
00:27:19,430 --> 00:27:17,760
across

700
00:27:21,750 --> 00:27:19,440
and in fact i'd love to add this

701
00:27:23,909 --> 00:27:21,760
statistic because i think it's marvelous

702
00:27:24,789 --> 00:27:23,919
if you took all the mass and saturn's

703
00:27:28,149 --> 00:27:24,799
rings

704
00:27:30,389 --> 00:27:28,159
and recomposed it into a moon

705
00:27:32,149 --> 00:27:30,399
for of the proper density for the saturn

706
00:27:34,389 --> 00:27:32,159
system it would be no bigger than

707
00:27:36,950 --> 00:27:34,399
enceladus which is a moon that's no

708
00:27:39,269 --> 00:27:36,960
bigger across than great britain so it's

709
00:27:43,029 --> 00:27:39,279
tremendous visual spectacle for very

710
00:27:49,350 --> 00:27:45,590
okay well we have another question um

711
00:27:50,870 --> 00:27:49,360
from cali center grin on google plus

712
00:27:52,710 --> 00:27:50,880
if you were planning the next mission of

713
00:27:54,950 --> 00:27:52,720

saturn uh

714
00:27:57,350 --> 00:27:54,960
what would your cassini 2.0 look like

715
00:27:58,710 --> 00:27:57,360
what instruments would it have so maybe

716
00:28:00,870 --> 00:27:58,720
you can tell us a little bit about the

717
00:28:03,750 --> 00:28:00,880
cameras that cassini has right now and

718
00:28:05,110 --> 00:28:03,760
then you know if you had your wishes uh

719
00:28:06,789 --> 00:28:05,120
what kind of camera would you really

720
00:28:09,909 --> 00:28:06,799
like out there

721
00:28:11,269 --> 00:28:09,919
well i won't so much on uh well okay

722
00:28:12,549 --> 00:28:11,279
like the cameras let me describe the

723
00:28:15,510 --> 00:28:12,559
cassini cameras they're the most

724
00:28:17,029 --> 00:28:15,520
sophisticated cameras in fact

725
00:28:18,789 --> 00:28:17,039
cassini's payload is the most

726
00:28:21,510 --> 00:28:18,799
sophisticated payload that was ever

727
00:28:23,510 --> 00:28:21,520
taken into the outer solar system uh in

728
00:28:25,990 --> 00:28:23,520
our cameras we have two of them we call

729
00:28:28,310 --> 00:28:26,000
them cameras they're actually telescopes

730
00:28:31,830 --> 00:28:28,320
uh and outfitted with many spectral

731
00:28:33,590 --> 00:28:31,840
filters that's why cunio can look at the

732
00:28:35,830 --> 00:28:33,600
hexagon and all sorts of different

733
00:28:39,110 --> 00:28:35,840
spectral filters and they kind of slice

734
00:28:42,470 --> 00:28:39,120
the saturn atmosphere and give us a shot

735
00:28:44,710 --> 00:28:42,480
at different levels in the atmosphere

736
00:28:47,350 --> 00:28:44,720
other images like the one our mosaic is

737
00:28:49,990 --> 00:28:47,360
made of um this our this particular

738
00:28:52,870 --> 00:28:50,000

mosaic whereas our red green and blue we

739
00:28:55,029 --> 00:28:52,880
can use those to make not what

740
00:28:56,789 --> 00:28:55,039
you might call natural color

741
00:28:58,789 --> 00:28:56,799
um but they also have scientific

742
00:29:00,870 --> 00:28:58,799
purposes you look at

743
00:29:02,789 --> 00:29:00,880
surfaces of moons for example in

744
00:29:05,669 --> 00:29:02,799
different colors you might be able to

745
00:29:06,789 --> 00:29:05,679
pick out different types of ices and so

746
00:29:07,830 --> 00:29:06,799
on so

747
00:29:09,269 --> 00:29:07,840
um

748
00:29:11,110 --> 00:29:09,279
and then and then there's many other

749
00:29:13,110 --> 00:29:11,120
capabilities in the cameras i don't have

750
00:29:14,710 --> 00:29:13,120
to uh the time to go into but i will

751
00:29:16,389 --> 00:29:14,720
tell you

752
00:29:17,590 --> 00:29:16,399
first you need to know if you ask this

753
00:29:19,350 --> 00:29:17,600
picture

754
00:29:20,310 --> 00:29:19,360
uh this question

755
00:29:22,630 --> 00:29:20,320
of

756
00:29:24,789 --> 00:29:22,640
any planetary scientist you'd get a

757
00:29:26,870 --> 00:29:24,799
different answer probably from

758
00:29:28,389 --> 00:29:26,880
each one but my favorite

759
00:29:29,350 --> 00:29:28,399
thing to do

760
00:29:31,190 --> 00:29:29,360
with a

761
00:29:34,789 --> 00:29:31,200
mission that goes back to

762
00:29:37,350 --> 00:29:34,799
saturn is concentrate on enceladus

763
00:29:40,470 --> 00:29:37,360

because we need to know did biological

764
00:29:42,710 --> 00:29:40,480
processes ever get started on enceladus

765
00:29:45,510 --> 00:29:42,720
and so if we equipped

766
00:29:48,310 --> 00:29:45,520
a spacecraft returning to saturn with an

767
00:29:49,430 --> 00:29:48,320
instrument that could scoop up materials

768
00:29:51,590 --> 00:29:49,440
and do

769
00:29:54,149 --> 00:29:51,600
a more sophisticated job of chemical

770
00:29:55,830 --> 00:29:54,159
analysis than cassini is equipped to do

771
00:29:58,310 --> 00:29:55,840
we might actually be able to answer the

772
00:30:00,470 --> 00:29:58,320
question whether or not

773
00:30:03,029 --> 00:30:00,480
biotic processes have gotten started on

774
00:30:05,510 --> 00:30:03,039
enceladus and then my other favorite i

775
00:30:07,909 --> 00:30:05,520
would combine these into one mission my

776
00:30:10,389 --> 00:30:07,919
other favorite would be to study titan

777
00:30:12,630 --> 00:30:10,399
uh because titan is the only place in

778
00:30:15,110 --> 00:30:12,640
our solar system where we have liquid

779
00:30:17,350 --> 00:30:15,120
organics ponded on the surface and it

780
00:30:20,630 --> 00:30:17,360
has a thick atmosphere and in many

781
00:30:22,710 --> 00:30:20,640
regards it is very similar to our planet

782
00:30:24,389 --> 00:30:22,720
except that it has liquid organics so we

783
00:30:26,630 --> 00:30:24,399
could study

784
00:30:27,990 --> 00:30:26,640
organic in situ if

785
00:30:28,870 --> 00:30:28,000
if you please

786
00:30:30,789 --> 00:30:28,880
um

787
00:30:32,389 --> 00:30:30,799
in a way that we can't do it any longer

788
00:30:35,190 --> 00:30:32,399

on the earth because the earth has

789
00:30:37,590 --> 00:30:35,200
oxygen and free oxygen oxidizes and

790
00:30:38,630 --> 00:30:37,600
destroys organic materials so that's

791
00:30:41,430 --> 00:30:38,640
what i do

792
00:30:46,230 --> 00:30:41,440
with the mission after uh cassini and i

793
00:30:50,630 --> 00:30:48,870
um well that's a very passionate answer

794
00:30:52,310 --> 00:30:50,640
um

795
00:30:53,750 --> 00:30:52,320
one question that we got i'm gonna throw

796
00:30:56,310 --> 00:30:53,760
it back to cunyo for a minute because we

797
00:30:59,669 --> 00:30:56,320
had a question come in about the hexagon

798
00:31:02,230 --> 00:30:59,679
uh this is on twitter from jp major um

799
00:31:05,909 --> 00:31:02,240
is there or why isn't there a similar

800
00:31:09,029 --> 00:31:05,919
hexagon around saturn's south pole

801
00:31:12,070 --> 00:31:09,039
so and the meandering property of the

802
00:31:14,950 --> 00:31:12,080
these jets so i said that the hexagon or

803
00:31:16,789 --> 00:31:14,960
north pole of saturn is a meandering jet

804
00:31:18,870 --> 00:31:16,799
so

805
00:31:22,149 --> 00:31:18,880
the meandering property really depends

806
00:31:24,310 --> 00:31:22,159
on the details of the jet um so the the

807
00:31:27,430 --> 00:31:24,320
jet around north pole has the right

808
00:31:30,950 --> 00:31:27,440
speed and width to have

809
00:31:33,590 --> 00:31:30,960
to fit in a wave basically to fold into

810
00:31:35,830 --> 00:31:33,600
six-sided shape um saturn's south pole

811
00:31:38,389 --> 00:31:35,840
actually doesn't have a similar jet

812
00:31:39,669 --> 00:31:38,399
stream that's um that's wrapping around

813
00:31:42,310 --> 00:31:39,679

the north

814
00:31:44,310 --> 00:31:42,320
well it's well there's a jet but it's

815
00:31:46,630 --> 00:31:44,320
the property is actually very different

816
00:31:49,509 --> 00:31:46,640
from the around north pole

817
00:31:51,830 --> 00:31:49,519
there's a jet that does me under um it

818
00:31:54,070 --> 00:31:51,840
sometimes takes twelve-sided

819
00:31:57,269 --> 00:31:54,080
top side in shape it's not very stable

820
00:31:59,830 --> 00:31:57,279
um but it does develop a many sided

821
00:32:01,750 --> 00:31:59,840
pattern but it doesn't look as visually

822
00:32:03,190 --> 00:32:01,760
striking but it's a very similar

823
00:32:07,430 --> 00:32:03,200
dynamics that's happening around

824
00:32:11,190 --> 00:32:09,669
and then we um of course we have a lot

825
00:32:13,830 --> 00:32:11,200
of vortices and

826
00:32:16,710 --> 00:32:13,840
but what we do have around saturn style

827
00:32:18,470 --> 00:32:16,720
south pole is a hurricane-like structure

828
00:32:22,310 --> 00:32:18,480
that we do have in north pole so there

829
00:32:27,190 --> 00:32:24,870
also i mean it is a very special sort of

830
00:32:29,029 --> 00:32:27,200
a thing because uh it doesn't even

831
00:32:30,789 --> 00:32:29,039
appear at the other giant planets in our

832
00:32:33,430 --> 00:32:30,799
solar system does it

833
00:32:35,590 --> 00:32:33,440
no it does not so all giant planets

834
00:32:38,310 --> 00:32:35,600
actually most most planets in general

835
00:32:39,350 --> 00:32:38,320
have a strong vortex um around each of

836
00:32:41,990 --> 00:32:39,360
their poles

837
00:32:45,590 --> 00:32:42,000
um venus venus's poles have what the

838
00:32:47,029 --> 00:32:45,600

seas earth poles have jet streams or um

839
00:32:48,789 --> 00:32:47,039
just streams that's wrapping around the

840
00:32:49,590 --> 00:32:48,799
pole is basically a vortex

841
00:32:51,430 --> 00:32:49,600
um

842
00:32:54,149 --> 00:32:51,440
jupiter we've actually never seen

843
00:32:55,269 --> 00:32:54,159
jupiter um in reflected sunlight

844
00:32:57,190 --> 00:32:55,279
jupiter's

845
00:32:58,710 --> 00:32:57,200
polar regions of jupiter and reflected

846
00:33:00,470 --> 00:32:58,720
sunlight so that's actually another

847
00:33:02,230 --> 00:33:00,480
exploration

848
00:33:05,350 --> 00:33:02,240
um we're that's going to happen soon

849
00:33:08,630 --> 00:33:05,360
with the um nasa's juno spacecraft that

850
00:33:10,789 --> 00:33:08,640
will have a first view well um a first

851
00:33:13,190 --> 00:33:10,799
detailed views of the polar regions of

852
00:33:15,830 --> 00:33:13,200
saturn i mean of jupiter

853
00:33:18,389 --> 00:33:15,840
um and then uranus and neptune right we

854
00:33:22,230 --> 00:33:18,399
do not have polygonal structures but we

855
00:33:24,470 --> 00:33:22,240
um they too have void disease so yeah um

856
00:33:26,789 --> 00:33:24,480
right the question was about why no

857
00:33:28,470 --> 00:33:26,799
hexagon or polygon around other planets

858
00:33:31,990 --> 00:33:28,480
right we don't have polygons but all of

859
00:33:34,710 --> 00:33:32,000
them do have the streams flowing around

860
00:33:38,310 --> 00:33:34,720
great thanks cunyo uh we're gonna make a

861
00:33:40,549 --> 00:33:38,320
transition here um and i'm gonna uh uh

862
00:33:42,549 --> 00:33:40,559
introduce linda next she's gonna talk

863
00:33:44,470 --> 00:33:42,559

about uh some of the mysteries that we

864
00:33:46,389 --> 00:33:44,480
still have to solve around saturn and

865
00:33:48,710 --> 00:33:46,399
then after that earl we'll talk about

866
00:33:49,750 --> 00:33:48,720
how we're gonna do that

867
00:33:51,669 --> 00:33:49,760
linda

868
00:33:53,750 --> 00:33:51,679
well i think if someone asked me what is

869
00:33:56,070 --> 00:33:53,760
your favorite image i'd have to say that

870
00:33:58,470 --> 00:33:56,080
the saturn mosaic that just came back is

871
00:34:01,350 --> 00:33:58,480
one of my new very favorite images it's

872
00:34:03,509 --> 00:34:01,360
so beautiful it's almost heart-stopping

873
00:34:04,950 --> 00:34:03,519
to look at it and with that in mind let

874
00:34:07,669 --> 00:34:04,960
me go to the first side let's look at

875
00:34:09,190 --> 00:34:07,679
that image in a very different way

876
00:34:11,990 --> 00:34:09,200
and what you see when it comes up is

877
00:34:13,030 --> 00:34:12,000
this is a collage that includes 1600

878
00:34:15,109 --> 00:34:13,040
images

879
00:34:17,829 --> 00:34:15,119
that were sent by members of the public

880
00:34:19,349 --> 00:34:17,839
to us as part of cassini's wave at

881
00:34:20,950 --> 00:34:19,359
saturn campaign

882
00:34:22,629 --> 00:34:20,960
we asked people to go out in that

883
00:34:24,950 --> 00:34:22,639
20-minute window and we were taking

884
00:34:27,349 --> 00:34:24,960
pictures of the earth to raise their

885
00:34:30,149 --> 00:34:27,359
hand and wave at saturn take a picture

886
00:34:32,149 --> 00:34:30,159
of themselves a selfie and send it to us

887
00:34:34,550 --> 00:34:32,159
so those pictures are here

888
00:34:35,750 --> 00:34:34,560

in fact my husband tom and i also have

889
00:34:37,430 --> 00:34:35,760
our picture in there and it's kind of

890
00:34:39,990 --> 00:34:37,440
fun to try and hunt down and look for

891
00:34:41,109 --> 00:34:40,000
your friends and family in this giant

892
00:34:43,270 --> 00:34:41,119
collage

893
00:34:45,909 --> 00:34:43,280
and i'd just like to say a big thank you

894
00:34:48,550 --> 00:34:45,919
to everyone who participated in the wave

895
00:34:50,790 --> 00:34:48,560
at saturn smile at saturn campaigns you

896
00:34:52,869 --> 00:34:50,800
really helped us celebrate this very

897
00:34:54,869 --> 00:34:52,879
phenomenal event

898
00:34:57,109 --> 00:34:54,879
and with that like to move on to some of

899
00:34:58,870 --> 00:34:57,119
the mysteries that we might solve as we

900
00:35:00,069 --> 00:34:58,880
continue over the next few years with

901
00:35:03,270 --> 00:35:00,079
cassini

902
00:35:06,390 --> 00:35:03,280
and if we go to the next image clearly

903
00:35:08,470 --> 00:35:06,400
the seasons are changing at saturn

904
00:35:11,349 --> 00:35:08,480
this is a wide-angle view of saturn with

905
00:35:12,790 --> 00:35:11,359
titan crossing in front of it

906
00:35:15,430 --> 00:35:12,800
basically you can see it's sort of a

907
00:35:17,510 --> 00:35:15,440
bluish tint or hue if you go back 10

908
00:35:18,710 --> 00:35:17,520
years to when cassini first arrived at

909
00:35:20,870 --> 00:35:18,720
saturn

910
00:35:23,829 --> 00:35:20,880
the northern hemisphere was in winter

911
00:35:26,390 --> 00:35:23,839
and it had a bluish tint and now we see

912
00:35:28,150 --> 00:35:26,400
that that tint is slowly lightning in

913
00:35:30,390 --> 00:35:28,160

the northern hemisphere and is moving to

914
00:35:33,270 --> 00:35:30,400
the southern hemisphere the colors are

915
00:35:35,990 --> 00:35:33,280
reversing as we're approaching winter in

916
00:35:37,990 --> 00:35:36,000
the southern hemisphere of saturn

917
00:35:41,109 --> 00:35:38,000
in fact this is a unique opportunity to

918
00:35:44,550 --> 00:35:41,119
look at saturn and we're so close to

919
00:35:47,430 --> 00:35:44,560
solstice just a few years away from that

920
00:35:50,069 --> 00:35:47,440
summer solstice and no spacecraft has

921
00:35:51,829 --> 00:35:50,079
been this close to saturn anywhere near

922
00:35:54,870 --> 00:35:51,839
the summer solstice so it offers a

923
00:35:58,310 --> 00:35:54,880
unique opportunity to study saturn and

924
00:36:00,069 --> 00:35:58,320
titan and the moons in this new season

925
00:36:02,390 --> 00:36:00,079
in fact if you think about it it takes

926
00:36:03,750 --> 00:36:02,400
saturn 30 years to go around the sun a

927
00:36:06,630 --> 00:36:03,760
single time

928
00:36:09,349 --> 00:36:06,640
so three decades will pass

929
00:36:12,150 --> 00:36:09,359
before we have the opportunity to once

930
00:36:14,069 --> 00:36:12,160
again observe saturn and titan at the

931
00:36:16,630 --> 00:36:14,079
summer solstice

932
00:36:19,270 --> 00:36:16,640
and moving on to my next graphic in fact

933
00:36:21,510 --> 00:36:19,280
for titan the next few years will be

934
00:36:22,790 --> 00:36:21,520
some of the most exciting time for titan

935
00:36:25,030 --> 00:36:22,800
weather

936
00:36:27,349 --> 00:36:25,040
this image titan is huge it's about the

937
00:36:29,510 --> 00:36:27,359
size of the planet mercury it has a

938
00:36:30,470 --> 00:36:29,520

thick nitrogen atmosphere and as carolyn

939
00:36:32,150 --> 00:36:30,480
mentioned

940
00:36:35,510 --> 00:36:32,160
it's one of the only worlds besides the

941
00:36:37,829 --> 00:36:35,520
earth where liquids pool on the surface

942
00:36:39,589 --> 00:36:37,839
and at minus 290 degrees fahrenheit

943
00:36:41,589 --> 00:36:39,599
those liquids are methane and ethane and

944
00:36:43,589 --> 00:36:41,599
there are lots of organics

945
00:36:45,510 --> 00:36:43,599
on the surface of titan

946
00:36:47,270 --> 00:36:45,520
if you look at this image here this is a

947
00:36:49,750 --> 00:36:47,280
near-infrared image

948
00:36:51,109 --> 00:36:49,760
basically a false color image it turns

949
00:36:53,270 --> 00:36:51,119
out that if you look in the visible you

950
00:36:55,510 --> 00:36:53,280
can't see through the titan's surface

951
00:36:57,589 --> 00:36:55,520
but if you look in the near infrared you

952
00:36:59,349 --> 00:36:57,599
can then start to see those details and

953
00:37:01,750 --> 00:36:59,359
those black splotches

954
00:37:04,230 --> 00:37:01,760
up toward the top of the image are these

955
00:37:06,550 --> 00:37:04,240
lakes that we see on titan and it's just

956
00:37:09,349 --> 00:37:06,560
very intriguing to think about not only

957
00:37:11,990 --> 00:37:09,359
is titan a giant laboratory for

958
00:37:14,069 --> 00:37:12,000
how life might have started on the earth

959
00:37:16,550 --> 00:37:14,079
one also wonders could there possibly be

960
00:37:18,550 --> 00:37:16,560
some kind of methane based life that

961
00:37:21,109 --> 00:37:18,560
might be in the lakes and then of course

962
00:37:22,950 --> 00:37:21,119
titan has a liquid ocean and so perhaps

963
00:37:25,270 --> 00:37:22,960

in that liquid ocean similar to what we

964
00:37:28,550 --> 00:37:25,280
have with europa perhaps that's another

965
00:37:29,990 --> 00:37:28,560
habitat for life as well

966
00:37:32,230 --> 00:37:30,000
so let's look at one of those one of

967
00:37:33,750 --> 00:37:32,240
those c's up close if we go on to the

968
00:37:35,990 --> 00:37:33,760
next graphic

969
00:37:38,390 --> 00:37:36,000
this is like gmra it's the second

970
00:37:40,150 --> 00:37:38,400
largest sea on titan

971
00:37:42,150 --> 00:37:40,160
it's about the size of one of the great

972
00:37:43,430 --> 00:37:42,160
lakes that you see at the u.s canadian

973
00:37:45,510 --> 00:37:43,440
border

974
00:37:48,150 --> 00:37:45,520
this lake is filled with organics with

975
00:37:49,990 --> 00:37:48,160
methane and ethane and all of the lakes

976
00:37:51,670 --> 00:37:50,000
on titan seem to be congregated pretty

977
00:37:54,069 --> 00:37:51,680
much at the north pole with the

978
00:37:56,230 --> 00:37:54,079
exception of just a few lakes

979
00:37:58,470 --> 00:37:56,240
and this is a view at radar wavelengths

980
00:38:00,470 --> 00:37:58,480
so again we can see in the near infrared

981
00:38:02,550 --> 00:38:00,480
and radar wavelengths so we use all of

982
00:38:05,030 --> 00:38:02,560
the tools that we have on cassini

983
00:38:07,430 --> 00:38:05,040
including the cameras to help us reveal

984
00:38:09,750 --> 00:38:07,440
titan and its surface and over the next

985
00:38:11,829 --> 00:38:09,760
few years one of the mysteries we wonder

986
00:38:13,349 --> 00:38:11,839
what will happen with the lakes

987
00:38:14,550 --> 00:38:13,359
will the methane or methane start to

988
00:38:16,950 --> 00:38:14,560

evaporate

989
00:38:19,349 --> 00:38:16,960
when we see clouds of methane come over

990
00:38:21,990 --> 00:38:19,359
and fill what look like dry ancient lake

991
00:38:23,589 --> 00:38:22,000
beds at the north pole will there be

992
00:38:25,430 --> 00:38:23,599
winds that will be strong enough to

993
00:38:26,630 --> 00:38:25,440
create waves on the lakes that would be

994
00:38:29,270 --> 00:38:26,640
able to see

995
00:38:31,670 --> 00:38:29,280
with the radar data and maybe even tiny

996
00:38:33,670 --> 00:38:31,680
hurricanes depending on how strong the

997
00:38:36,069 --> 00:38:33,680
winds blow at the north pole

998
00:38:37,750 --> 00:38:36,079
so the seasons are changing and we're

999
00:38:39,109 --> 00:38:37,760
really anxious to see what will happen

1000
00:38:40,390 --> 00:38:39,119
when that sun

1001
00:38:42,550 --> 00:38:40,400
shines down

1002
00:38:44,150 --> 00:38:42,560
on the north pole of titan

1003
00:38:45,829 --> 00:38:44,160
and perhaps we'll answer some of the

1004
00:38:48,470 --> 00:38:45,839
mysteries about the lakes why they're

1005
00:38:50,310 --> 00:38:48,480
just so predominant at the north pole

1006
00:38:51,430 --> 00:38:50,320
and how they might evolve with the

1007
00:38:53,829 --> 00:38:51,440
seasons

1008
00:38:55,270 --> 00:38:53,839
i'm moving on to enceladus that's my

1009
00:38:57,750 --> 00:38:55,280
next slide

1010
00:38:58,870 --> 00:38:57,760
enceladus is one of the most intriguing

1011
00:39:00,470 --> 00:38:58,880
objects

1012
00:39:02,390 --> 00:39:00,480
in the solar system

1013
00:39:04,390 --> 00:39:02,400

it has a water ice surface and as

1014
00:39:07,510 --> 00:39:04,400
carolyn pointed out you have jets of

1015
00:39:09,750 --> 00:39:07,520
material coming out from the south pole

1016
00:39:11,990 --> 00:39:09,760
primarily liquid water a lot of it falls

1017
00:39:14,470 --> 00:39:12,000
back to the surface but we also have

1018
00:39:16,630 --> 00:39:14,480
carbon dioxide we have organics we have

1019
00:39:19,030 --> 00:39:16,640
nitrogen we basically have the

1020
00:39:21,990 --> 00:39:19,040
ingredients there for life possibly in

1021
00:39:25,190 --> 00:39:22,000
that liquid water reservoir beneath

1022
00:39:27,430 --> 00:39:25,200
titan's south pole and in fact the south

1023
00:39:29,589 --> 00:39:27,440
pole of titan or south pole of enceladus

1024
00:39:32,150 --> 00:39:29,599
is now dark and that's very interesting

1025
00:39:34,230 --> 00:39:32,160
because with it dark we can now measure

1026
00:39:36,630 --> 00:39:34,240
the heat coming out of the south pole

1027
00:39:38,950 --> 00:39:36,640
very accurately and that might help tell

1028
00:39:41,589 --> 00:39:38,960
us what's happening with enceladus and

1029
00:39:43,190 --> 00:39:41,599
why it is so very active

1030
00:39:45,510 --> 00:39:43,200
and now if we just zoom in on some of

1031
00:39:47,589 --> 00:39:45,520
those jets up close

1032
00:39:49,510 --> 00:39:47,599
we have three flybys coming up in the

1033
00:39:51,589 --> 00:39:49,520
end of 2015

1034
00:39:54,150 --> 00:39:51,599
one of those flybys is going to fly

1035
00:39:55,910 --> 00:39:54,160
right through those jets and it's going

1036
00:39:58,069 --> 00:39:55,920
to be it for the very first time at the

1037
00:39:59,589 --> 00:39:58,079
time of maximum emission

1038
00:40:01,829 --> 00:39:59,599

of those jets

1039
00:40:04,470 --> 00:40:01,839
the jets vary by about a factor of three

1040
00:40:06,309 --> 00:40:04,480
in emission and here for the first time

1041
00:40:08,069 --> 00:40:06,319
the end of 2015 will be able to really

1042
00:40:10,069 --> 00:40:08,079
make measurements more detailed

1043
00:40:12,790 --> 00:40:10,079
compositional measurements to find out

1044
00:40:14,550 --> 00:40:12,800
what's coming out of these jets

1045
00:40:16,390 --> 00:40:14,560
and also we'll get a chance one of these

1046
00:40:18,790 --> 00:40:16,400
flybys to look at the north pole of

1047
00:40:21,190 --> 00:40:18,800
enceladus at very high resolution

1048
00:40:22,790 --> 00:40:21,200
now with the sun high in the sky we'll

1049
00:40:25,670 --> 00:40:22,800
look for evidence of what might look

1050
00:40:28,550 --> 00:40:25,680
like ancient fractures ancient tiger

1051
00:40:31,030 --> 00:40:28,560
stripes and to answer the question was

1052
00:40:33,670 --> 00:40:31,040
tight was in cell this is north pole

1053
00:40:35,829 --> 00:40:33,680
active as active as perhaps the south

1054
00:40:38,069 --> 00:40:35,839
pole is today so a lot of very

1055
00:40:40,309 --> 00:40:38,079
interesting things coming up in the

1056
00:40:41,430 --> 00:40:40,319
future years with cassini and mysteries

1057
00:40:43,589 --> 00:40:41,440
to solve

1058
00:40:45,990 --> 00:40:43,599
and finally this set of orbits besides

1059
00:40:48,309 --> 00:40:46,000
returning really great science and

1060
00:40:50,230 --> 00:40:48,319
looking at a new season on saturn is

1061
00:40:52,470 --> 00:40:50,240
going to put us in great position for

1062
00:40:54,230 --> 00:40:52,480
cassini's endgame these orbits are

1063
00:40:56,950 --> 00:40:54,240

carefully positioning us so that we can

1064
00:40:58,390 --> 00:40:56,960
get the best data possible back

1065
00:41:01,190 --> 00:40:58,400
and it turns out one of those final

1066
00:41:02,950 --> 00:41:01,200
orbits will actually dive in between the

1067
00:41:05,030 --> 00:41:02,960
innermost ring and the top of the

1068
00:41:06,470 --> 00:41:05,040
atmosphere on saturn and make

1069
00:41:08,630 --> 00:41:06,480
measurements for the first time of the

1070
00:41:10,790 --> 00:41:08,640
mass of the rings something we really

1071
00:41:12,790 --> 00:41:10,800
don't have a good handle on measure a

1072
00:41:14,230 --> 00:41:12,800
new place in the system that we've never

1073
00:41:16,230 --> 00:41:14,240
seen before

1074
00:41:18,069 --> 00:41:16,240
that'll be very very exciting

1075
00:41:20,710 --> 00:41:18,079
also make really good measurements of

1076
00:41:22,870 --> 00:41:20,720
the gravity field and the magnetic field

1077
00:41:25,670 --> 00:41:22,880
around saturn and maybe get a handle on

1078
00:41:28,150 --> 00:41:25,680
what that rotation rate might be for the

1079
00:41:30,630 --> 00:41:28,160
planet and here and i've been very

1080
00:41:32,950 --> 00:41:30,640
excited to watch when that data comes

1081
00:41:35,030 --> 00:41:32,960
back from the very first orbit what new

1082
00:41:37,829 --> 00:41:35,040
discoveries might be in store for

1083
00:41:40,150 --> 00:41:37,839
cassini as we go into this new region

1084
00:41:40,870 --> 00:41:40,160
that we've never probed before

1085
00:41:42,950 --> 00:41:40,880
and

1086
00:41:45,109 --> 00:41:42,960
so after that i'd like to turn this over

1087
00:41:46,950 --> 00:41:45,119
to earl mays and he'll talk about

1088
00:41:49,589 --> 00:41:46,960

how do we shape the orbits to get the

1089
00:41:51,829 --> 00:41:49,599
science back it'll be coming back and

1090
00:41:54,069 --> 00:41:51,839
what do we have for the end game so earl

1091
00:41:58,550 --> 00:41:54,079
all right thanks linda maybe we could

1092
00:42:00,550 --> 00:41:58,560
cue the first animation um this is uh in

1093
00:42:02,950 --> 00:42:00,560
typical cassini scale this is our hour

1094
00:42:04,790 --> 00:42:02,960
and a half of terror mars had their

1095
00:42:06,309 --> 00:42:04,800
seven minutes we have an hour and a half

1096
00:42:08,390 --> 00:42:06,319
this is us passing through the ring

1097
00:42:10,230 --> 00:42:08,400
plane and actually going into orbit

1098
00:42:12,630 --> 00:42:10,240
around saturn if this had not

1099
00:42:14,069 --> 00:42:12,640
accomplished uh just perfectly we would

1100
00:42:15,030 --> 00:42:14,079
not be having talking about the mission

1101
00:42:17,829 --> 00:42:15,040
today

1102
00:42:19,430 --> 00:42:17,839
um this cassini spacecraft this was nine

1103
00:42:22,069 --> 00:42:19,440
and a half years ago is performing

1104
00:42:25,030 --> 00:42:22,079
absolutely flawlessly we are in great

1105
00:42:27,270 --> 00:42:25,040
shape um we are six weeks into our 17th

1106
00:42:28,230 --> 00:42:27,280
year in flight as you carol mentioned it

1107
00:42:30,150 --> 00:42:28,240
took us

1108
00:42:32,470 --> 00:42:30,160
uh seven years to get here we're nine

1109
00:42:34,150 --> 00:42:32,480
and a half years into our into our

1110
00:42:36,309 --> 00:42:34,160
mission and everything's working well it

1111
00:42:38,630 --> 00:42:36,319
said the engineering systems are working

1112
00:42:41,270 --> 00:42:38,640
very very well and the instruments are

1113
00:42:43,589 --> 00:42:41,280

continuing to turn phenomenal science

1114
00:42:44,710 --> 00:42:43,599
uh with a mission like this at this

1115
00:42:46,710 --> 00:42:44,720
level of

1116
00:42:49,190 --> 00:42:46,720
duration uh one of the things the flight

1117
00:42:51,190 --> 00:42:49,200
teams have to be very careful about is

1118
00:42:53,750 --> 00:42:51,200
consumables uh the prime mission for

1119
00:42:55,829 --> 00:42:53,760
cassini was seven years cruz four years

1120
00:42:59,030 --> 00:42:55,839
in prime mission and so when you think

1121
00:43:00,950 --> 00:42:59,040
about us now being into our 17th year a

1122
00:43:03,030 --> 00:43:00,960
lot of things are being used up we have

1123
00:43:06,150 --> 00:43:03,040
to keep very careful track of things

1124
00:43:07,589 --> 00:43:06,160
like power and on off cycles instruments

1125
00:43:08,470 --> 00:43:07,599
are used up though we don't want them to

1126
00:43:11,190 --> 00:43:08,480
be

1127
00:43:13,030 --> 00:43:11,200
overused one of the things we watch most

1128
00:43:15,430 --> 00:43:13,040
carefully is obviously as you can see

1129
00:43:17,190 --> 00:43:15,440
here is propellant

1130
00:43:19,750 --> 00:43:17,200
very very carefully watching the

1131
00:43:21,510 --> 00:43:19,760
propellant cassini has two separate

1132
00:43:23,589 --> 00:43:21,520
propulsion systems

1133
00:43:26,630 --> 00:43:23,599
a bi-propellant system that powers the

1134
00:43:29,349 --> 00:43:26,640
main engine as the graphic shows and

1135
00:43:31,270 --> 00:43:29,359
we've used about ninety percent of that

1136
00:43:33,270 --> 00:43:31,280
during the prime mission and we used

1137
00:43:35,190 --> 00:43:33,280
another six percent of that

1138
00:43:36,950 --> 00:43:35,200

during the extended mission the first

1139
00:43:39,109 --> 00:43:36,960
two years of the sole suspicion so right

1140
00:43:41,109 --> 00:43:39,119
now we've got about four percent of our

1141
00:43:43,270 --> 00:43:41,119
propellant left um

1142
00:43:44,710 --> 00:43:43,280
there's a jackson brown song about that

1143
00:43:46,870 --> 00:43:44,720
and uh

1144
00:43:48,790 --> 00:43:46,880
running on empty is uh is not a good

1145
00:43:50,470 --> 00:43:48,800
situation to be in fortunately we've got

1146
00:43:51,430 --> 00:43:50,480
another propellant system

1147
00:43:53,990 --> 00:43:51,440
the

1148
00:43:56,150 --> 00:43:54,000
uh spacecraft is also equipped with a

1149
00:43:58,390 --> 00:43:56,160
hydrazine system that's small that

1150
00:43:59,829 --> 00:43:58,400
powers the smaller thrusters

1151
00:44:02,230 --> 00:43:59,839
and they're used for attitude control

1152
00:44:04,710 --> 00:44:02,240
and for very small veneer burns to

1153
00:44:07,589 --> 00:44:04,720
control our trajectory the good news is

1154
00:44:09,670 --> 00:44:07,599
that we've got uh over 30 percent of

1155
00:44:10,950 --> 00:44:09,680
that propellant still left and that is

1156
00:44:11,829 --> 00:44:10,960
more than enough to finish up the

1157
00:44:13,430 --> 00:44:11,839
mission

1158
00:44:15,829 --> 00:44:13,440
the way we accomplish this and maybe we

1159
00:44:17,910 --> 00:44:15,839
could cue the next video uh the way we

1160
00:44:21,030 --> 00:44:17,920
do this is with a very carefully

1161
00:44:23,510 --> 00:44:21,040
designed mission that uses

1162
00:44:26,150 --> 00:44:23,520
saturn's largest moon titan in order to

1163
00:44:27,750 --> 00:44:26,160

bend and reshape the trajectory i should

1164
00:44:30,069 --> 00:44:27,760
point out as you'll see in this graphic

1165
00:44:32,630 --> 00:44:30,079
uh no one has ever done anything like

1166
00:44:35,030 --> 00:44:32,640
this before nothing this complex what we

1167
00:44:37,349 --> 00:44:35,040
do is by carefully controlling how we

1168
00:44:39,109 --> 00:44:37,359
fly by titan we can bend the trajectory

1169
00:44:42,150 --> 00:44:39,119
up bend it down right now you can see

1170
00:44:43,910 --> 00:44:42,160
it's in a very highly inclined orbit

1171
00:44:45,910 --> 00:44:43,920
we can bend it up bend it down we can

1172
00:44:47,589 --> 00:44:45,920
rotate it around we can lengthen it we

1173
00:44:49,510 --> 00:44:47,599
can shorten it

1174
00:44:51,990 --> 00:44:49,520
by carefully flying by tightening we can

1175
00:44:54,309 --> 00:44:52,000
add or subtract nearly 800 meters per

1176
00:44:56,150 --> 00:44:54,319
second to the spacecraft's trajectory

1177
00:44:58,309 --> 00:44:56,160
and pretty much do go wherever we want

1178
00:45:00,550 --> 00:44:58,319
as you can see we've spent a lot of time

1179
00:45:02,710 --> 00:45:00,560
traveling around in various parts of the

1180
00:45:05,190 --> 00:45:02,720
of the saturn system

1181
00:45:07,030 --> 00:45:05,200
if we've done it very very carefully we

1182
00:45:09,670 --> 00:45:07,040
can actually control the trajectory of

1183
00:45:11,990 --> 00:45:09,680
the point where we need very very little

1184
00:45:14,390 --> 00:45:12,000
propellant as a matter of fact

1185
00:45:16,470 --> 00:45:14,400
we need hardly any and that's why this

1186
00:45:18,790 --> 00:45:16,480
hydrazine system works so well what it

1187
00:45:20,790 --> 00:45:18,800
does require though is very meticulous

1188
00:45:23,270 --> 00:45:20,800

attention from the flight team

1189
00:45:25,109 --> 00:45:23,280
they've got to be um so i like to say

1190
00:45:27,670 --> 00:45:25,119
this is a very sporty course because we

1191
00:45:29,270 --> 00:45:27,680
have so little propellant left we've got

1192
00:45:31,190 --> 00:45:29,280
to be very very careful and very

1193
00:45:33,030 --> 00:45:31,200
diligent about managing the trajectory

1194
00:45:34,790 --> 00:45:33,040
even a slight miss at one of these

1195
00:45:37,030 --> 00:45:34,800
titans can put us off into a different

1196
00:45:38,710 --> 00:45:37,040
path where we really don't have enough

1197
00:45:41,270 --> 00:45:38,720
repellent to get us back on

1198
00:45:43,030 --> 00:45:41,280
force us into a pretty serious redesign

1199
00:45:44,550 --> 00:45:43,040
which we um

1200
00:45:46,309 --> 00:45:44,560
really would be ill-equipped to do at

1201
00:45:47,750 --> 00:45:46,319
this point so we're very careful about

1202
00:45:49,670 --> 00:45:47,760
it the flight team has done an excellent

1203
00:45:51,910 --> 00:45:49,680
job of maintaining trajectory we do very

1204
00:45:53,750 --> 00:45:51,920
tiny maneuvers sometimes on the order of

1205
00:45:55,349 --> 00:45:53,760
maybe a few tens of millimeters per

1206
00:45:56,950 --> 00:45:55,359
second or very carefully tweak the

1207
00:45:59,430 --> 00:45:56,960
trajectory to manage

1208
00:46:01,670 --> 00:45:59,440
um its uh

1209
00:46:03,190 --> 00:46:01,680
gets flybys and to accomplish the

1210
00:46:04,870 --> 00:46:03,200
science for the next four years so we

1211
00:46:07,190 --> 00:46:04,880
actually have uh what we would call

1212
00:46:08,390 --> 00:46:07,200
margin for the next few years

1213
00:46:10,069 --> 00:46:08,400

um

1214
00:46:11,750 --> 00:46:10,079
you can see uh maybe i'll just point to

1215
00:46:14,230 --> 00:46:11,760
a few things here in the animation we

1216
00:46:15,910 --> 00:46:14,240
have highly inclined orbits these purple

1217
00:46:17,910 --> 00:46:15,920
orbits and then we come flattening back

1218
00:46:20,230 --> 00:46:17,920
down now we're coming back up as you see

1219
00:46:21,829 --> 00:46:20,240
in the animation flattening it back down

1220
00:46:23,829 --> 00:46:21,839
we will lower this back down for the

1221
00:46:25,030 --> 00:46:23,839
final as linda pointed out the final set

1222
00:46:26,390 --> 00:46:25,040
of orbits

1223
00:46:29,030 --> 00:46:26,400
for um

1224
00:46:30,470 --> 00:46:29,040
enceladus and then after that we'll wind

1225
00:46:31,670 --> 00:46:30,480
it back up and we're going to do

1226
00:46:33,349 --> 00:46:31,680
something entirely differently and

1227
00:46:34,950 --> 00:46:33,359
that's what you can see now

1228
00:46:36,870 --> 00:46:34,960
the final year of the mission will be

1229
00:46:39,030 --> 00:46:36,880
very very different we're going to use

1230
00:46:41,349 --> 00:46:39,040
the final titan flight one one of the

1231
00:46:44,150 --> 00:46:41,359
last final flight wise titan flybys

1232
00:46:46,790 --> 00:46:44,160
excuse me to move ourselves into the

1233
00:46:48,710 --> 00:46:46,800
very edge of the most sensible set of

1234
00:46:50,870 --> 00:46:48,720
the rings it's called the f ring we're

1235
00:46:53,190 --> 00:46:50,880
going to spend 20 orbits flirting with

1236
00:46:55,990 --> 00:46:53,200
the f ring and then with one more titan

1237
00:46:57,430 --> 00:46:56,000
flyby we're going to uh if you'll permit

1238
00:46:59,750 --> 00:46:57,440

me a southern california surfing

1239
00:47:03,030 --> 00:46:59,760
metaphor we're going to shoot the pier

1240
00:47:05,270 --> 00:47:03,040
there is a 1200 mile gap between the

1241
00:47:07,030 --> 00:47:05,280
d-ring the innermost saturn ring and

1242
00:47:09,030 --> 00:47:07,040
saturn's atmosphere and we've done a lot

1243
00:47:10,550 --> 00:47:09,040
of analysis on that area and it looks to

1244
00:47:13,190 --> 00:47:10,560
be very

1245
00:47:15,589 --> 00:47:13,200
safe not very safe but safe enough for

1246
00:47:16,870 --> 00:47:15,599
us to go through so what we're going to

1247
00:47:19,670 --> 00:47:16,880
do is we're going to use the one last

1248
00:47:22,069 --> 00:47:19,680
titan flyby to push us into that gap and

1249
00:47:24,630 --> 00:47:22,079
we're going to spend 22 orbits in 22

1250
00:47:25,910 --> 00:47:24,640
weeks going through that period uh that

1251
00:47:28,950 --> 00:47:25,920
space oh and here's a here's a

1252
00:47:30,870 --> 00:47:28,960
spacecraft view of this uh gap

1253
00:47:32,870 --> 00:47:30,880
as you can see we've whiz to very very

1254
00:47:34,230 --> 00:47:32,880
quickly we travel to about 30 kilometers

1255
00:47:36,150 --> 00:47:34,240
per second as we go through there we're

1256
00:47:38,790 --> 00:47:36,160
going to do that 22 times

1257
00:47:40,790 --> 00:47:38,800
uh exploring regions that we have never

1258
00:47:42,870 --> 00:47:40,800
seen before in sampling saturn's

1259
00:47:44,710 --> 00:47:42,880
atmosphere the inner rings of the dust

1260
00:47:47,589 --> 00:47:44,720
and getting gravity measurements that

1261
00:47:51,990 --> 00:47:47,599
we've never been able to accomplish um

1262
00:47:53,990 --> 00:47:52,000
and then finally on september 11th 2017

1263
00:47:57,750 --> 00:47:54,000

we're going to use one last titan flyby

1264
00:48:03,030 --> 00:47:57,760
to nudge us into uh saturn's atmosphere

1265
00:48:06,950 --> 00:48:05,349
the flyby is going to be such that we

1266
00:48:09,030 --> 00:48:06,960
will you know

1267
00:48:11,349 --> 00:48:09,040
be uh irreversibly entering into

1268
00:48:13,430 --> 00:48:11,359
saturn's atmosphere and at 30 kilometers

1269
00:48:15,910 --> 00:48:13,440
per second the spacecraft will be

1270
00:48:18,069 --> 00:48:15,920
destroyed almost immediately uh nearly

1271
00:48:20,390 --> 00:48:18,079
four days after the flyby

1272
00:48:22,710 --> 00:48:20,400
um thus the end to an incredibly

1273
00:48:25,109 --> 00:48:22,720
glorious exploration of the saturnian

1274
00:48:26,230 --> 00:48:25,119
system a legacy of science and

1275
00:48:27,990 --> 00:48:26,240
science data and engineering

1276
00:48:30,630 --> 00:48:28,000
achievements that will i don't believe

1277
00:48:32,390 --> 00:48:30,640
be duplicated for a very long time

1278
00:48:34,950 --> 00:48:32,400
and i think a wealth of information for

1279
00:48:39,910 --> 00:48:34,960
generations to come yes our final

1280
00:48:44,710 --> 00:48:42,150
thanks lyndon earl i love that picture

1281
00:48:47,270 --> 00:48:44,720
of uh cassini kind of being crushed by

1282
00:48:49,990 --> 00:48:47,280
the embrace of saturn

1283
00:48:51,829 --> 00:48:50,000
whom it's been circling for so long um

1284
00:48:54,309 --> 00:48:51,839
well sounds like cassini really has a

1285
00:48:56,790 --> 00:48:54,319
great to-do list in front of it um i

1286
00:48:59,109 --> 00:48:56,800
have a question uh this one i think

1287
00:49:02,230 --> 00:48:59,119
linda can take on twitter from tim

1288
00:49:04,230 --> 00:49:02,240

johnson who uh is asking on behalf of

1289
00:49:06,390 --> 00:49:04,240
the conox school

1290
00:49:10,069 --> 00:49:06,400
um damian from the school asks what

1291
00:49:11,829 --> 00:49:10,079
kinds of storms are common on saturn

1292
00:49:14,470 --> 00:49:11,839
the kinds of storms that are common on

1293
00:49:17,190 --> 00:49:14,480
saturn we've had one very huge storm it

1294
00:49:19,349 --> 00:49:17,200
started in december 2010 and lasted for

1295
00:49:21,270 --> 00:49:19,359
about nine months so we can have huge

1296
00:49:23,829 --> 00:49:21,280
storms that happen about once every 30

1297
00:49:25,990 --> 00:49:23,839
years around saturn we can have giant

1298
00:49:28,230 --> 00:49:26,000
hurricanes at the north and south poles

1299
00:49:30,470 --> 00:49:28,240
of saturn and can also have smaller

1300
00:49:32,470 --> 00:49:30,480
vortices there's a region we call dragon

1301
00:49:34,309 --> 00:49:32,480
alley really in the mission in the south

1302
00:49:38,549 --> 00:49:34,319
where we had lots of storms and

1303
00:49:42,390 --> 00:49:40,230
thing i remember you're telling me is

1304
00:49:44,630 --> 00:49:42,400
that these huge storms actually occur

1305
00:49:47,270 --> 00:49:44,640
once every 30 years or they had been in

1306
00:49:48,950 --> 00:49:47,280
the past but did we get it early will we

1307
00:49:50,309 --> 00:49:48,960
get another one

1308
00:49:52,950 --> 00:49:50,319
yeah it turns out that these storms

1309
00:49:55,510 --> 00:49:52,960
about once every 30 years tend to occur

1310
00:49:57,190 --> 00:49:55,520
closer to saturn solstice and so we got

1311
00:49:58,549 --> 00:49:57,200
this storm a little bit early sort of in

1312
00:50:00,069 --> 00:49:58,559
saturn spring

1313
00:50:02,390 --> 00:50:00,079

and so we wonder perhaps is there

1314
00:50:04,470 --> 00:50:02,400
another giant storm in store or just

1315
00:50:09,190 --> 00:50:04,480
like earth weather is variable did we

1316
00:50:15,030 --> 00:50:11,109
um great okay well we've got another

1317
00:50:18,230 --> 00:50:15,040
question um this one i think uh

1318
00:50:19,430 --> 00:50:18,240
i'm gonna maybe send to carolyn um

1319
00:50:22,069 --> 00:50:19,440
it's uh

1320
00:50:24,630 --> 00:50:22,079
reginald on our ustream box is asking

1321
00:50:27,750 --> 00:50:24,640
are the cameras capable of gathering

1322
00:50:31,030 --> 00:50:27,760
spectra to identify chemical bond types

1323
00:50:31,910 --> 00:50:31,040
in the clouds at saturn

1324
00:50:33,109 --> 00:50:31,920
um

1325
00:50:35,910 --> 00:50:33,119
cameras

1326
00:50:38,870 --> 00:50:35,920
uh generally don't unless they're

1327
00:50:42,470 --> 00:50:38,880
outfitted with a spectrometer

1328
00:50:44,630 --> 00:50:42,480
and for example the vims instrument is

1329
00:50:47,750 --> 00:50:44,640
has an imaging component and then also

1330
00:50:50,870 --> 00:50:47,760
has um a spectrometer

1331
00:50:52,630 --> 00:50:50,880
uh with it also in both the visual and

1332
00:50:55,270 --> 00:50:52,640
in the infrared

1333
00:50:56,630 --> 00:50:55,280
unless you have an instrument that can

1334
00:51:00,470 --> 00:50:56,640
spread

1335
00:51:01,990 --> 00:51:00,480
the uh light out very finely in

1336
00:51:04,710 --> 00:51:02,000
wavelength

1337
00:51:08,309 --> 00:51:04,720
so that you have high resolution in the

1338
00:51:10,470 --> 00:51:08,319

wavelength domain you generally can't do

1339
00:51:12,790 --> 00:51:10,480
a whole lot of detailed chemical

1340
00:51:15,190 --> 00:51:12,800
identification so we don't have that

1341
00:51:17,349 --> 00:51:15,200
with the cassini cameras we have

1342
00:51:19,270 --> 00:51:17,359
uh very broadband filters and then

1343
00:51:22,150 --> 00:51:19,280
moderately broadband

1344
00:51:25,030 --> 00:51:22,160
um so we're not so much in the business

1345
00:51:26,710 --> 00:51:25,040
of identifying whether or not it's

1346
00:51:28,390 --> 00:51:26,720
you know

1347
00:51:29,910 --> 00:51:28,400
well i can't even guess right now but

1348
00:51:32,470 --> 00:51:29,920
we're not we're not identifying

1349
00:51:34,390 --> 00:51:32,480
particular chemicals or chemical bonds

1350
00:51:36,470 --> 00:51:34,400
what we can do is we can say that we

1351
00:51:37,270 --> 00:51:36,480
have an ice on the surface

1352
00:51:39,510 --> 00:51:37,280
that

1353
00:51:42,390 --> 00:51:39,520
absorbs a lot in the infrared but maybe

1354
00:51:44,549 --> 00:51:42,400
not so much in the ultraviolet in some

1355
00:51:46,710 --> 00:51:44,559
sense colors is really

1356
00:51:50,390 --> 00:51:46,720
uh the spectral information that we can

1357
00:51:53,670 --> 00:51:51,910
you mentioned that cassini actually does

1358
00:51:56,870 --> 00:51:53,680
have other capabilities to do something

1359
00:51:59,910 --> 00:51:58,069
are you asking me

1360
00:52:01,510 --> 00:51:59,920
uh i'm gonna throw it back to linda just

1361
00:52:03,910 --> 00:52:01,520
to mention it for a second i think you

1362
00:52:06,150 --> 00:52:03,920
might be on mute but um does cassini

1363
00:52:07,829 --> 00:52:06,160

have something else that could do

1364
00:52:09,349 --> 00:52:07,839
science of that type right for

1365
00:52:11,910 --> 00:52:09,359
composition we have an instrument called

1366
00:52:14,150 --> 00:52:11,920
the composite infrared spectrometer it

1367
00:52:15,990 --> 00:52:14,160
looks in the the mid and far ir and it

1368
00:52:17,910 --> 00:52:16,000
can actually make measurements that tell

1369
00:52:20,069 --> 00:52:17,920
you what kind of molecules that you have

1370
00:52:21,430 --> 00:52:20,079
in the atmosphere not only hydrogen

1371
00:52:23,109 --> 00:52:21,440
which is the main constituent of

1372
00:52:24,950 --> 00:52:23,119
saturn's atmosphere but you can also

1373
00:52:27,589 --> 00:52:24,960
measure things like methane and

1374
00:52:29,910 --> 00:52:27,599
hydrocarbons it can measure those bonds

1375
00:52:31,190 --> 00:52:29,920
i think that we're being asked about so

1376
00:52:32,470 --> 00:52:31,200
we have that with a composite infrared

1377
00:52:35,430 --> 00:52:32,480
spectrometer then the visual and

1378
00:52:39,030 --> 00:52:35,440
infrared spectrometer also can make

1379
00:52:42,870 --> 00:52:40,470
thanks for answering those questions

1380
00:52:45,990 --> 00:52:42,880
linda and carolyn so i've got another

1381
00:52:48,069 --> 00:52:46,000
hexagon question um for kunio and maybe

1382
00:52:50,549 --> 00:52:48,079
you can also elaborate some more on the

1383
00:52:52,549 --> 00:52:50,559
storm since i think uh you actually did

1384
00:52:54,870 --> 00:52:52,559
your dissertation

1385
00:52:57,270 --> 00:52:54,880
on storms on saturn um so here's a

1386
00:53:00,069 --> 00:52:57,280
question from veronica vixen on twitter

1387
00:53:03,030 --> 00:53:00,079
is the hexagon on the actual surface of

1388
00:53:05,430 --> 00:53:03,040

saturn or is it an optical illusion um

1389
00:53:08,790 --> 00:53:05,440
or or gases like the clouds

1390
00:53:11,270 --> 00:53:08,800
okay it's definitely not an um illusion

1391
00:53:13,589 --> 00:53:11,280
of any kind this is a real real feature

1392
00:53:15,589 --> 00:53:13,599
that does exist and it has been there

1393
00:53:19,270 --> 00:53:15,599
since 1981.

1394
00:53:21,829 --> 00:53:19,280
um it is gas so it's clear

1395
00:53:24,549 --> 00:53:21,839
well it's a pattern of clouds so it's

1396
00:53:27,430 --> 00:53:24,559
gaseous it's not it's a solid feature

1397
00:53:29,430 --> 00:53:27,440
that we have on the surface of saturn

1398
00:53:31,510 --> 00:53:29,440
saturn is a gas giant planet so there's

1399
00:53:33,829 --> 00:53:31,520
no such thing as mountains and valleys

1400
00:53:36,150 --> 00:53:33,839
or even oceans on saturn

1401
00:53:38,309 --> 00:53:36,160
what we have is a bottomless

1402
00:53:41,750 --> 00:53:38,319
atmosphere if you try to land on saturn

1403
00:53:45,270 --> 00:53:41,760
we're just going to sit sick to the core

1404
00:53:47,670 --> 00:53:45,280
basically of the atmosphere there's no

1405
00:53:50,710 --> 00:53:47,680
solid ground we can stand on but the

1406
00:53:53,430 --> 00:53:50,720
hexagon is a real feature it is a jet

1407
00:53:55,829 --> 00:53:53,440
stream as i said earlier it is folded

1408
00:53:57,910 --> 00:53:55,839
into six sided shape and it is a very

1409
00:54:00,230 --> 00:53:57,920
stable feature that is a surprising part

1410
00:54:02,069 --> 00:54:00,240
of it and we are starting to study

1411
00:54:03,589 --> 00:54:02,079
that feature and

1412
00:54:05,109 --> 00:54:03,599
you said there was a question about the

1413
00:54:06,710 --> 00:54:05,119

storm as well

1414
00:54:11,109 --> 00:54:06,720
or should i just launch into the

1415
00:54:14,790 --> 00:54:13,349
uh well why don't you uh just tell us a

1416
00:54:16,230 --> 00:54:14,800
little bit more about the storm we were

1417
00:54:17,190 --> 00:54:16,240
talking about how

1418
00:54:19,670 --> 00:54:17,200
um

1419
00:54:21,670 --> 00:54:19,680
uh you know they seem to appear once

1420
00:54:24,150 --> 00:54:21,680
every 30 years or so i mean was the

1421
00:54:25,910 --> 00:54:24,160
storm that we saw for instance um a

1422
00:54:28,710 --> 00:54:25,920
couple of years ago the biggest that

1423
00:54:30,069 --> 00:54:28,720
we've ever seen a comparable or give us

1424
00:54:33,109 --> 00:54:30,079
a little perspective right the third

1425
00:54:35,430 --> 00:54:33,119
year storms um yeah so this is a very

1426
00:54:38,230 --> 00:54:35,440
special kind of storms because saturn is

1427
00:54:40,549 --> 00:54:38,240
of course very cold but what's special

1428
00:54:42,789 --> 00:54:40,559
about these storm is that it lasts so

1429
00:54:44,870 --> 00:54:42,799
long and it's so big that it actually

1430
00:54:48,150 --> 00:54:44,880
wraps around the planet it's a single

1431
00:54:51,750 --> 00:54:48,160
thunderstorm that blows up once once one

1432
00:54:53,990 --> 00:54:51,760
spot but the cloud extends out so much

1433
00:54:55,990 --> 00:54:54,000
saturn is a big planet to start with on

1434
00:54:58,470 --> 00:54:56,000
that big planet this storm cloud

1435
00:54:59,589 --> 00:54:58,480
completely wraps around the planet so

1436
00:55:02,549 --> 00:54:59,599
this is a very

1437
00:55:03,829 --> 00:55:02,559
special um kind of storm um

1438
00:55:05,750 --> 00:55:03,839

that is

1439
00:55:08,309 --> 00:55:05,760
that actually wrap around the planet yay

1440
00:55:10,309 --> 00:55:08,319
there's the image so this is um i think

1441
00:55:14,870 --> 00:55:10,319
this is images from

1442
00:55:16,470 --> 00:55:14,880
around um february or march of 2011 and

1443
00:55:19,430 --> 00:55:16,480
this is you're seeing the phase of the

1444
00:55:21,510 --> 00:55:19,440
storm that um in which the storm has not

1445
00:55:24,069 --> 00:55:21,520
wrapped around the planet yet at the

1446
00:55:27,030 --> 00:55:24,079
left end um this sort of looks like a

1447
00:55:29,750 --> 00:55:27,040
comet so the actual thunderstorm the

1448
00:55:31,910 --> 00:55:29,760
most intense intense thunderstorm is

1449
00:55:35,030 --> 00:55:31,920
happening at the left tip

1450
00:55:37,750 --> 00:55:35,040
of this image that's where

1451
00:55:39,510 --> 00:55:37,760
the storm's core is located and then

1452
00:55:41,750 --> 00:55:39,520
that storm cloud is getting blown

1453
00:55:43,589 --> 00:55:41,760
downwind by other jet streams that's

1454
00:55:45,990 --> 00:55:43,599
surrounding the result

1455
00:55:48,150 --> 00:55:46,000
and so this is about three months into

1456
00:55:51,270 --> 00:55:48,160
the storm so the storm started in

1457
00:55:53,589 --> 00:55:51,280
december of 2010 so i'm guessing just

1458
00:55:54,789 --> 00:55:53,599
i've seen these pictures hundreds of

1459
00:55:57,109 --> 00:55:54,799
times so

1460
00:55:58,630 --> 00:55:57,119
um it looks like a morphology we had in

1461
00:56:02,230 --> 00:55:58,640
like february march

1462
00:56:04,390 --> 00:56:02,240
of 2011. at that phase the storm has had

1463
00:56:06,630 --> 00:56:04,400

wrapped around the planet only half of

1464
00:56:09,349 --> 00:56:06,640
the longitude so it has going around

1465
00:56:13,190 --> 00:56:09,359
only half of the planet but in june of

1466
00:56:15,750 --> 00:56:13,200
2011 the storm's head actually

1467
00:56:17,430 --> 00:56:15,760
caught up with the tail of the storm

1468
00:56:20,230 --> 00:56:17,440
and then when this

1469
00:56:22,069 --> 00:56:20,240
when the head bit the tail somehow the

1470
00:56:24,150 --> 00:56:22,079
head disappeared so that was a really

1471
00:56:26,549 --> 00:56:24,160
exciting event that we were not

1472
00:56:29,510 --> 00:56:26,559
expecting it to happen that way um the

1473
00:56:31,589 --> 00:56:29,520
storm lasted for 200 days the

1474
00:56:33,510 --> 00:56:31,599
earth days

1475
00:56:35,190 --> 00:56:33,520
and then the when the head caught up

1476
00:56:37,190 --> 00:56:35,200
with the tail the head actually

1477
00:56:38,870 --> 00:56:37,200
disintegrated and that's how the storm

1478
00:56:40,710 --> 00:56:38,880
ended so that was really dramatically

1479
00:56:41,829 --> 00:56:40,720
done

1480
00:56:44,470 --> 00:56:41,839
um can i actually

1481
00:56:46,309 --> 00:56:44,480
reenactment oh sure okay carolyn

1482
00:56:47,510 --> 00:56:46,319
i just want to say about this storm

1483
00:56:49,670 --> 00:56:47,520
another

1484
00:56:51,190 --> 00:56:49,680
really important aspect of it is that

1485
00:56:54,069 --> 00:56:51,200
they're

1486
00:56:55,910 --> 00:56:54,079
estimating from the lightning strikes

1487
00:56:57,829 --> 00:56:55,920
that occur in it

1488
00:57:00,789 --> 00:56:57,839

uh the estimate of the total amount of

1489
00:57:02,789 --> 00:57:00,799
energy in this storm makes it comparable

1490
00:57:05,109 --> 00:57:02,799
to the amount of energy that's coming

1491
00:57:06,390 --> 00:57:05,119
out of saturn so that means that this

1492
00:57:08,870 --> 00:57:06,400
storm in the

1493
00:57:10,549 --> 00:57:08,880
frequency of the storms once every 30

1494
00:57:12,789 --> 00:57:10,559
years and so on

1495
00:57:15,430 --> 00:57:12,799
if these storms are playing a role in

1496
00:57:17,589 --> 00:57:15,440
the thermal evolution of the planet so

1497
00:57:19,510 --> 00:57:17,599
that was to me as a non-atmospheric

1498
00:57:21,430 --> 00:57:19,520
scientist that was one of the most

1499
00:57:24,630 --> 00:57:21,440
exciting discoveries

1500
00:57:27,030 --> 00:57:24,640
uh in being there to witness

1501
00:57:29,430 --> 00:57:27,040
this event that happens only once every

1502
00:57:31,990 --> 00:57:29,440
30 years and it's just another

1503
00:57:33,750 --> 00:57:32,000
example of why it is so important if you

1504
00:57:35,430 --> 00:57:33,760
really want to understand

1505
00:57:37,990 --> 00:57:35,440
how planets work

1506
00:57:40,789 --> 00:57:38,000
to we need to have our our robots our

1507
00:57:41,990 --> 00:57:40,799
machinery in orbit around

1508
00:57:44,630 --> 00:57:42,000
planets

1509
00:57:48,950 --> 00:57:44,640
my give having the time to monitor them

1510
00:57:53,430 --> 00:57:51,430
thanks carolyn um so we're getting a lot

1511
00:57:55,430 --> 00:57:53,440
of great questions on our social media

1512
00:57:58,309 --> 00:57:55,440
outlets and in fact we're getting um

1513
00:58:00,710 --> 00:57:58,319

some budget questions like from crystal

1514
00:58:02,789 --> 00:58:00,720
uh on google plus about the given the

1515
00:58:05,270 --> 00:58:02,799
announcement of restructuring of nasa's

1516
00:58:08,309 --> 00:58:05,280
planetary sciences um what's the future

1517
00:58:09,990 --> 00:58:08,319
of cassini uh you know i think that

1518
00:58:12,630 --> 00:58:10,000
these are all great questions and we

1519
00:58:15,589 --> 00:58:12,640
don't yet know the answers um we have a

1520
00:58:16,950 --> 00:58:15,599
lot yet to learn at saturn and um you

1521
00:58:19,190 --> 00:58:16,960
know we hope the mission continues

1522
00:58:20,950 --> 00:58:19,200
through 2017 uh but you know you can

1523
00:58:22,549 --> 00:58:20,960
always ask your questions to nasa

1524
00:58:24,870 --> 00:58:22,559
headquarters they're the folks that make

1525
00:58:27,829 --> 00:58:24,880
the decisions about the budget so

1526
00:58:30,230 --> 00:58:27,839
um we're going to do one last question

1527
00:58:33,190 --> 00:58:30,240
and this one i'm going to throw to earl

1528
00:58:33,990 --> 00:58:33,200
we have a question from at the real jet

1529
00:58:35,109 --> 00:58:34,000
jab

1530
00:58:37,750 --> 00:58:35,119
on twitter

1531
00:58:39,910 --> 00:58:37,760
um and so he's asked how many more years

1532
00:58:42,150 --> 00:58:39,920
of operation do we expect to get from

1533
00:58:44,069 --> 00:58:42,160
the cassini probe so i know that we've

1534
00:58:46,549 --> 00:58:44,079
got this kind of planned

1535
00:58:49,109 --> 00:58:46,559
dive into saturn in 2017 but you know

1536
00:58:51,670 --> 00:58:49,119
have we basically eeked out the last

1537
00:58:53,430 --> 00:58:51,680
fumes here on cassini or could it go for

1538
00:58:58,069 --> 00:58:53,440

longer

1539
00:59:00,069 --> 00:58:58,079
but not much one of the

1540
00:59:01,030 --> 00:59:00,079
very important things about end of

1541
00:59:03,030 --> 00:59:01,040
mission

1542
00:59:05,510 --> 00:59:03,040
scenarios with these

1543
00:59:09,270 --> 00:59:05,520
probes that are exploring uh systems

1544
00:59:11,589 --> 00:59:09,280
that have potentially prebiotic uh

1545
00:59:12,870 --> 00:59:11,599
environments like enceladus titan or in

1546
00:59:15,030 --> 00:59:12,880
case of euro

1547
00:59:17,670 --> 00:59:15,040
europa at jupiter is that we must

1548
00:59:19,349 --> 00:59:17,680
dispose of the spacecraft cleanly and so

1549
00:59:21,270 --> 00:59:19,359
we can't just let it run out of

1550
00:59:23,349 --> 00:59:21,280
propellant and drift aimlessly in the

1551
00:59:25,349 --> 00:59:23,359
system we have to have enough

1552
00:59:27,829 --> 00:59:25,359
margin left in the system to dispose of

1553
00:59:30,069 --> 00:59:27,839
it properly and that is in into saturn's

1554
00:59:32,309 --> 00:59:30,079
atmosphere where it can't you know

1555
00:59:34,630 --> 00:59:32,319
possibly contaminate anything so we

1556
00:59:36,470 --> 00:59:34,640
could maybe eke out a little bit more

1557
00:59:38,710 --> 00:59:36,480
but we've got it planned now to the

1558
00:59:40,390 --> 00:59:38,720
point where it's just it's a perfect

1559
00:59:41,829 --> 00:59:40,400
into the mission we'll have very little

1560
00:59:44,150 --> 00:59:41,839
propellant left

1561
00:59:47,750 --> 00:59:44,160
and uh that's i think the best way for

1562
00:59:51,430 --> 00:59:49,430
great um well we've had a really

1563
00:59:54,549 --> 00:59:51,440

wonderful google hangout thank you to

1564
00:59:56,069 --> 00:59:54,559
everybody who's participated um you know

1565
00:59:58,549 --> 00:59:56,079
the conversation doesn't have to stop

1566
01:00:00,390 --> 00:59:58,559
here we can continue to work on all the

1567
01:00:01,589 --> 01:00:00,400
questions that we can get to on social

1568
01:00:04,150 --> 01:00:01,599
media

1569
01:00:06,470 --> 01:00:04,160
cassini has a twitter account at cassini

1570
01:00:08,950 --> 01:00:06,480
saturn we also um

1571
01:00:10,789 --> 01:00:08,960
have the web pages and we've got a slate

1572
01:00:13,349 --> 01:00:10,799
sort of showing you how you can keep in

1573
01:00:14,870 --> 01:00:13,359
contact with us kunio has also

1574
01:00:16,549 --> 01:00:14,880
volunteered to answer some more

1575
01:00:19,510 --> 01:00:16,559
questions on his twitter account and

1576
01:00:21,670 --> 01:00:19,520
that's at windy planets so thank you

1577
01:00:23,510 --> 01:00:21,680
very much to everybody who participated