
Weird &
Wonderful Saturn
Watch Live Dec. 4, 2013
12:30 p.m. PT (2030 UTC)
NASA
Jet Propulsion Laboratory
California Institute of Technology
#AskCassini

1
00:00:00,690 --> 00:00:41,320
you

2
00:00:47,420 --> 00:00:44,660
hi everyone welcome to our Google+

3
00:00:49,160 --> 00:00:47,430
hangout on air we're going to be talking

4
00:00:50,930 --> 00:00:49,170
to you today about the weird and

5
00:00:53,090 --> 00:00:50,940
wonderful things that NASA's Cassini

6
00:00:56,660 --> 00:00:53,100
spacecraft has been sending back about

7
00:00:58,760 --> 00:00:56,670
Saturn i'm your moderator Jerry cook I'm

8
00:01:00,770 --> 00:00:58,770
the Cassini meteor rep based here at

9
00:01:03,590 --> 00:01:00,780
NASA's Jet Propulsion Laboratory in

10
00:01:06,200 --> 00:01:03,600
Pasadena California JPL is where

11
00:01:08,420 --> 00:01:06,210
Cassini's mission is managed but we have

12
00:01:11,240 --> 00:01:08,430
some great speakers for you today from

13
00:01:13,670 --> 00:01:11,250

across the country so our hangout today

14
00:01:15,650 --> 00:01:13,680
is provocatively titled weird and

15
00:01:17,480 --> 00:01:15,660
wonderful Saturn but we'll have some

16
00:01:18,800 --> 00:01:17,490
scientists here to tell you why some of

17
00:01:20,560 --> 00:01:18,810
the things that might seem weird on the

18
00:01:23,240 --> 00:01:20,570
surface aren't actually all that weird

19
00:01:26,170 --> 00:01:23,250
so our hangout is going to happen in

20
00:01:29,510 --> 00:01:26,180
three acts our first act is going to be

21
00:01:31,999 --> 00:01:29,520
brought to you by kunio saya na jie he's

22
00:01:34,580 --> 00:01:32,009
a Cassini imaging team associate based

23
00:01:35,870 --> 00:01:34,590
at Hampton University in Virginia he is

24
00:01:38,680 --> 00:01:35,880
going to be telling you about this

25
00:01:40,820 --> 00:01:38,690
really unique six-sided jet stream

26
00:01:44,120 --> 00:01:40,830
around the North Pole of Saturn that we

27
00:01:46,400 --> 00:01:44,130
call the hexagon we've actually just

28
00:01:48,560 --> 00:01:46,410
released some new images and video of

29
00:01:52,279 --> 00:01:48,570
the hexagon which you can see on our

30
00:01:57,469 --> 00:01:52,289
websites at nasa.gov slash Cassini and

31
00:01:59,809 --> 00:01:57,479
Saturn JPL nasa gov he's going to be

32
00:02:02,359 --> 00:01:59,819
showing you our new views of the hexagon

33
00:02:06,529 --> 00:02:02,369
and telling you a little bit about you

34
00:02:09,469 --> 00:02:06,539
know how it works our second act is

35
00:02:12,110 --> 00:02:09,479
going to be Carolyn Porco she's our

36
00:02:14,050 --> 00:02:12,120
imaging team lead she's based at the

37
00:02:16,250 --> 00:02:14,060
Space Science Institute in Colorado

38
00:02:19,210 --> 00:02:16,260

she's going to be talking about this

39
00:02:21,740 --> 00:02:19,220
really gorgeous multi image mosaic that

40
00:02:24,740 --> 00:02:21,750
Cassini has been able to put together of

41
00:02:28,970 --> 00:02:24,750
the Saturn system it shows Saturn its

42
00:02:31,520 --> 00:02:28,980
rings a lot of moons and then also our

43
00:02:32,660 --> 00:02:31,530
inner planets of our solar system she's

44
00:02:34,730 --> 00:02:32,670
going to give you a tour through the

45
00:02:37,220 --> 00:02:34,740
image and then tell you how it came to

46
00:02:41,780 --> 00:02:37,230
be our third act is going to involve

47
00:02:44,300 --> 00:02:41,790
Linda Spilker and Earl mais linda is our

48
00:02:46,340 --> 00:02:44,310
Cassini project scientist and Earl is

49
00:02:49,910 --> 00:02:46,350
our Cassini program manager and they are

50
00:02:52,220 --> 00:02:49,920
based here at JPL as well Cassini Linda

51
00:02:53,480 --> 00:02:52,230
is going to tell you what's up what's

52
00:02:55,850 --> 00:02:53,490
coming up next for

53
00:02:57,170 --> 00:02:55,860
cassini science all the exciting things

54
00:02:59,000 --> 00:02:57,180
that we're going to do in the next

55
00:03:01,340 --> 00:02:59,010
couple years and then Earl is going to

56
00:03:03,230 --> 00:03:01,350
tell you how does our spacecraft do all

57
00:03:06,050 --> 00:03:03,240
the acrobatics it needs to do in order

58
00:03:10,370 --> 00:03:06,060
to get that great science so we're going

59
00:03:12,770 --> 00:03:10,380
to start off with cuneo hi so I will be

60
00:03:14,810 --> 00:03:12,780
talking about the I will be talking

61
00:03:19,310 --> 00:03:14,820
about the images we are releasing today

62
00:03:21,800 --> 00:03:19,320
on Saturn's hexagons and that so we are

63
00:03:23,660 --> 00:03:21,810

imaging we are looking at Saturn from

64
00:03:25,940 --> 00:03:23,670
Cassini spacecraft in vantage point

65
00:03:28,550 --> 00:03:25,950
which is an orbit around Saturn since

66
00:03:30,410 --> 00:03:28,560
2004 so I have been studying this

67
00:03:32,900 --> 00:03:30,420
feature called the hexagon around North

68
00:03:35,150 --> 00:03:32,910
Pole of Saturn and the feature is not

69
00:03:39,550 --> 00:03:35,160
new just to be sure we've known that it

70
00:03:43,010 --> 00:03:39,560
existed since i'm at least since 81 and

71
00:03:45,560 --> 00:03:43,020
um we confirmed that as soon as Cassini

72
00:03:48,590 --> 00:03:45,570
went into orbit around Saturn it is

73
00:03:50,480 --> 00:03:48,600
thought it was still active in 2004 I

74
00:03:53,840 --> 00:03:50,490
think we're still waiting for the image

75
00:03:56,150 --> 00:03:53,850
so we are in orbit around Saturn the

76
00:03:58,580 --> 00:03:56,160
images we're releasing today let's see

77
00:04:01,430 --> 00:03:58,590
the emails just that just showed up is

78
00:04:05,240 --> 00:04:01,440
how Saturn's North Polar area looks like

79
00:04:07,910 --> 00:04:05,250
from orbit of Saturn so straight in the

80
00:04:09,830 --> 00:04:07,920
middle is um North Pole of Saturn but

81
00:04:14,060 --> 00:04:09,840
darker spot and then you can see the

82
00:04:17,090 --> 00:04:14,070
clear geometric hexagon geometric shape

83
00:04:18,590 --> 00:04:17,100
um which has six sides and corners

84
00:04:23,870 --> 00:04:18,600
that's why we've been calling it the

85
00:04:28,430 --> 00:04:23,880
hexagon so this is the view we have from

86
00:04:29,870 --> 00:04:28,440
from the order and let's see so what's

87
00:04:32,960 --> 00:04:29,880
new about what we were going to talk

88
00:04:35,510 --> 00:04:32,970

about today is the view we have Saturn

89
00:04:37,700 --> 00:04:35,520
was in on Saturn's North Pole was in

90
00:04:40,400 --> 00:04:37,710
winter darkness for me or when we

91
00:04:42,500 --> 00:04:40,410
entered orbit around Saturn in 2004 and

92
00:04:44,300 --> 00:04:42,510
sunlight has been slowly starting to

93
00:04:46,760 --> 00:04:44,310
shine on North Pole during the earlier

94
00:04:49,820 --> 00:04:46,770
part of mr. on and then that that brings

95
00:04:53,690 --> 00:04:49,830
us to the next image that we be released

96
00:04:57,500 --> 00:04:53,700
in 2009 so this is the rehab we had in

97
00:04:59,600 --> 00:04:57,510
2008 and released in 2009 so we still

98
00:05:02,290 --> 00:04:59,610
had a hole around North Pole this is the

99
00:05:05,210 --> 00:05:02,300
best image we had previously today

100
00:05:07,040 --> 00:05:05,220
before today so you can still see the

101
00:05:07,340 --> 00:05:07,050
hexagonal pattern you can see the wavy

102
00:05:11,390 --> 00:05:07,350
pattern

103
00:05:13,340 --> 00:05:11,400
really radiating off the corners so this

104
00:05:16,580 --> 00:05:13,350
is what we started seeing around two

105
00:05:21,350 --> 00:05:16,590
thousand eight and then let's move on to

106
00:05:24,530 --> 00:05:21,360
the view we have today Cassini has been

107
00:05:26,840 --> 00:05:24,540
in orbit around Saturn since 2004 and we

108
00:05:28,400 --> 00:05:26,850
change orbit once in a while so that we

109
00:05:31,460 --> 00:05:28,410
can have a better view of different

110
00:05:33,920 --> 00:05:31,470
parts of the planet so um Saturn when

111
00:05:36,470 --> 00:05:33,930
Tyrion equinox earlier a few years ago

112
00:05:38,270 --> 00:05:36,480
and we just changed settings I'm sorry

113
00:05:40,730 --> 00:05:38,280

continues orbit so that we can have

114
00:05:42,770 --> 00:05:40,740
better views of North Pole so that we

115
00:05:45,170 --> 00:05:42,780
can have movies like this so this is a

116
00:05:48,320 --> 00:05:45,180
this is a view we had about a year ago

117
00:05:50,990 --> 00:05:48,330
and then it takes us a bit of time to

118
00:05:52,880 --> 00:05:51,000
put together a makeup map we have the

119
00:05:54,470 --> 00:05:52,890
stitch together in terms of images they

120
00:05:57,800 --> 00:05:54,480
put together in found this movie and

121
00:05:59,420 --> 00:05:57,810
this w we have today in the middle you

122
00:06:01,610 --> 00:05:59,430
can see that counterclockwise is

123
00:06:04,580 --> 00:06:01,620
spinning fast for texts we have been

124
00:06:09,530 --> 00:06:04,590
calling it bipolar her game and then you

125
00:06:11,420 --> 00:06:09,540
see around the around five o'clock spot

126
00:06:14,090 --> 00:06:11,430
you can see a counterclockwise side

127
00:06:16,250 --> 00:06:14,100
clockwise spinning vortex that's it that

128
00:06:18,560 --> 00:06:16,260
is another vortex and then you see of

129
00:06:21,860 --> 00:06:18,570
course the hexagonal pattern and outline

130
00:06:24,920 --> 00:06:21,870
so I hope you can see the clouds zipping

131
00:06:27,530 --> 00:06:24,930
through the hexagonal outline um this

132
00:06:31,580 --> 00:06:27,540
shows that the hexagon is actually a

133
00:06:37,370 --> 00:06:31,590
feature geometric pattern 11 by the jet

134
00:06:39,440 --> 00:06:37,380
stream at that latitude so the jet

135
00:06:42,440 --> 00:06:39,450
stream has a lot of effect on the club

136
00:06:44,780 --> 00:06:42,450
dynamics and we can in one another of

137
00:06:47,210 --> 00:06:44,790
the V we are releasing today we can

138
00:06:49,640 --> 00:06:47,220

actually tell the UM a little bit more

139
00:06:53,150 --> 00:06:49,650
about the cloud properties of the clouds

140
00:06:57,170 --> 00:06:53,160
affected by the district which is coming

141
00:06:59,330 --> 00:06:57,180
up now so in this view I hope you can

142
00:07:02,960 --> 00:06:59,340
see the shark color boundary between

143
00:07:05,420 --> 00:07:02,970
blue to darker darker color color and

144
00:07:09,590 --> 00:07:05,430
then green that is the color boundary

145
00:07:12,230 --> 00:07:09,600
formed by the jet stream so um a jet

146
00:07:14,660 --> 00:07:12,240
stream can act as a transport barrier

147
00:07:17,000 --> 00:07:14,670
let's see it can prevent materials from

148
00:07:19,580 --> 00:07:17,010
going across the jet stream because it's

149
00:07:21,230 --> 00:07:19,590
just so blowing so fast you can kind of

150
00:07:24,110 --> 00:07:21,240
imagine that it's easy to move

151
00:07:27,020 --> 00:07:24,120
along the stream of the jet but it's

152
00:07:28,430 --> 00:07:27,030
really hard to cross that stream so when

153
00:07:31,100 --> 00:07:28,440
there is a strong jet stream flowing

154
00:07:34,400 --> 00:07:31,110
like this it tends to create and create

155
00:07:37,159 --> 00:07:34,410
a wall like this and in this image and

156
00:07:39,770 --> 00:07:37,169
this is a false-color view red color is

157
00:07:42,920 --> 00:07:39,780
responding to large particles or large

158
00:07:46,900 --> 00:07:42,930
droplets of clouds and then green

159
00:07:48,950 --> 00:07:46,910
channel is assigned to assign two

160
00:07:51,700 --> 00:07:48,960
similar particles but at higher

161
00:07:55,670 --> 00:07:51,710
altitudes so red is deep big particles

162
00:07:58,219 --> 00:07:55,680
green is high large particles and then

163
00:08:01,700 --> 00:07:58,229

the blue channel is assigned to a

164
00:08:04,339 --> 00:08:01,710
wavelength that is responsive to tiny

165
00:08:07,100 --> 00:08:04,349
aerosols higher up in the atmosphere so

166
00:08:09,140 --> 00:08:07,110
this color composite is showing

167
00:08:11,089 --> 00:08:09,150
properties of clouds that exist in

168
00:08:12,760 --> 00:08:11,099
different area and you can clearly see

169
00:08:16,879 --> 00:08:12,770
that there's a sharp boundary and the

170
00:08:19,909 --> 00:08:16,889
composition of or makeup of the clouds

171
00:08:22,640 --> 00:08:19,919
that we see across the hexagon so I've

172
00:08:25,279 --> 00:08:22,650
been talking about um I said that this

173
00:08:29,149 --> 00:08:25,289
jet stream has a six-sided pattern it

174
00:08:33,050 --> 00:08:29,159
looks really well particularly picky

175
00:08:35,269 --> 00:08:33,060
look peculiar maybe um and it looks it

176
00:08:37,670 --> 00:08:35,279
is the surprising thing is that it's

177
00:08:41,079 --> 00:08:37,680
really stable it has been there since at

178
00:08:44,510 --> 00:08:41,089
least 1981 um this is a really exciting

179
00:08:46,340 --> 00:08:44,520
thing we can see um it looks you might

180
00:08:48,620 --> 00:08:46,350
sign you might think that it's really

181
00:08:50,510 --> 00:08:48,630
weird but similar thing actually happens

182
00:08:55,400 --> 00:08:50,520
on earth which is the next movie that

183
00:08:58,190 --> 00:08:55,410
we're going to show first has optimal

184
00:09:00,319 --> 00:08:58,200
strike jet streams um this is the this

185
00:09:02,090 --> 00:09:00,329
is the weather system this is the this

186
00:09:05,569 --> 00:09:02,100
is the flow that moves the weather

187
00:09:08,449 --> 00:09:05,579
systems across the North America a

188
00:09:11,240 --> 00:09:08,459

continent for example across north north

189
00:09:13,130 --> 00:09:11,250
north america you might notice that we

190
00:09:14,990 --> 00:09:13,140
see weather patterns moving from west to

191
00:09:17,449 --> 00:09:15,000
the east so what skills feels the

192
00:09:19,730 --> 00:09:17,459
weather even those storms before they

193
00:09:22,250 --> 00:09:19,740
reach east coast that is because there's

194
00:09:24,920 --> 00:09:22,260
this jet stream on flowing across high

195
00:09:27,410 --> 00:09:24,930
altitudes around earth so that actually

196
00:09:30,500 --> 00:09:27,420
totally wraps around the planet and you

197
00:09:34,910 --> 00:09:30,510
you can see that this path of this jet

198
00:09:36,620 --> 00:09:34,920
stream is actually meandering and um

199
00:09:39,199 --> 00:09:36,630
the meandering shape is not stable on

200
00:09:41,389 --> 00:09:39,209
earth because on earth that jet stream

201
00:09:43,310 --> 00:09:41,399
has to blow over mountain ranges and it

202
00:09:45,560 --> 00:09:43,320
has to cross the boundary between the

203
00:09:47,660 --> 00:09:45,570
continents and oceans where it is

204
00:09:49,370 --> 00:09:47,670
basically really messy so the

205
00:09:50,810 --> 00:09:49,380
interaction between the hard ground and

206
00:09:53,269 --> 00:09:50,820
the jet stream is going to make an

207
00:09:56,990 --> 00:09:53,279
unstable pattern but of course Saturn is

208
00:09:59,329 --> 00:09:57,000
a gas giant planet that's why Saturn can

209
00:10:02,150 --> 00:09:59,339
maintain that kind of sable sable

210
00:10:03,439 --> 00:10:02,160
geometric shape and then I talked a

211
00:10:05,090 --> 00:10:03,449
little bit about the compositional

212
00:10:07,370 --> 00:10:05,100
boundary that was created by the

213
00:10:09,170 --> 00:10:07,380

district similar thing actually happens

214
00:10:11,930 --> 00:10:09,180
on earth and which is called the

215
00:10:15,050 --> 00:10:11,940
unpacking ozone hole which we are going

216
00:10:18,199 --> 00:10:15,060
to show next here the colors are showing

217
00:10:20,660 --> 00:10:18,209
that blue is a region with less

218
00:10:23,540 --> 00:10:20,670
concentration of ozone and then green

219
00:10:26,210 --> 00:10:23,550
and warmer colors are showing higher

220
00:10:28,639 --> 00:10:26,220
concentration of ozone the outline of

221
00:10:30,829 --> 00:10:28,649
this ozone hole is actually maintained

222
00:10:33,439 --> 00:10:30,839
by another gesturing that's blowing

223
00:10:35,990 --> 00:10:33,449
around Antarctic continent so this is

224
00:10:38,870 --> 00:10:36,000
another example of a wall that was

225
00:10:41,689 --> 00:10:38,880
imposed by a jet stream inside inside

226
00:10:47,240 --> 00:10:41,699
the jet stream the ozone is destroyed

227
00:10:48,800 --> 00:10:47,250
depleted by man-made CFCs and the ozone

228
00:10:50,329 --> 00:10:48,810
that was created outside cannot go

229
00:10:53,420 --> 00:10:50,339
inside of the jet stream that's why

230
00:10:56,410 --> 00:10:53,430
there's this whole of ozone that gets

231
00:11:01,340 --> 00:10:56,420
maintained during winter and Antarctica

232
00:11:03,829 --> 00:11:01,350
so um I like to compare the atmospheric

233
00:11:07,370 --> 00:11:03,839
dynamics of other systems of Saturn and

234
00:11:13,180 --> 00:11:07,380
earth because well the goal here is to

235
00:11:16,250 --> 00:11:13,190
understand this thing cold weather so um

236
00:11:19,250 --> 00:11:16,260
I'd like to talk about when i talk about

237
00:11:22,519 --> 00:11:19,260
why study other planets i like to say

238
00:11:24,860 --> 00:11:22,529

well and bring up the topic of

239
00:11:26,540 --> 00:11:24,870
psychology you do not claim to

240
00:11:28,970 --> 00:11:26,550
understand psychology by just talking

241
00:11:32,210 --> 00:11:28,980
about one person not just by studying

242
00:11:34,309 --> 00:11:32,220
one on one person's mind if you want to

243
00:11:36,620 --> 00:11:34,319
understand psychology you studied many

244
00:11:38,420 --> 00:11:36,630
many persons so it's the same thing

245
00:11:40,129 --> 00:11:38,430
about weathering all you want to

246
00:11:42,319 --> 00:11:40,139
understand the weather you don't just

247
00:11:43,970 --> 00:11:42,329
focus on one planet this is our solar

248
00:11:47,079 --> 00:11:43,980
system we have a lot of atmospheres

249
00:11:48,770 --> 00:11:47,089
starting with Venus Earth Mars Jupiter

250
00:11:52,670 --> 00:11:48,780
Saturn

251
00:11:55,340 --> 00:11:52,680
Titan they all had interesting weather

252
00:11:57,170 --> 00:11:55,350
systems so it is really important we

253
00:12:00,290 --> 00:11:57,180
compare all these different weather

254
00:12:03,920 --> 00:12:00,300
systems and so that we wider range of

255
00:12:07,880 --> 00:12:03,930
perspective on our example and that's

256
00:12:10,360 --> 00:12:07,890
what I have okay great cuneo thanks very

257
00:12:12,230 --> 00:12:10,370
much just for all of you guys out there

258
00:12:13,940 --> 00:12:12,240
participating in our hangout right now

259
00:12:16,670 --> 00:12:13,950
just wanted to let you guys know how you

260
00:12:18,500 --> 00:12:16,680
can ask questions we you can ask

261
00:12:20,780 --> 00:12:18,510
questions on the google hangout page

262
00:12:23,870 --> 00:12:20,790
itself you can ask them in the chat box

263
00:12:27,440 --> 00:12:23,880

on ustream you can also ask them on

264
00:12:29,390 --> 00:12:27,450
twitter via hashtag ask Cassini and you

265
00:12:31,100 --> 00:12:29,400
can also do it by email if you want it

266
00:12:37,690 --> 00:12:31,110
the slightly more old-fashioned way

267
00:12:40,190 --> 00:12:37,700
email V McGregor at JPL nasa gov so

268
00:12:42,470 --> 00:12:40,200
we'll be taking those throughout and

269
00:12:44,330 --> 00:12:42,480
we're gonna break up each speaker

270
00:12:48,830 --> 00:12:44,340
session with some questions at the end

271
00:12:50,720 --> 00:12:48,840
so uh well for cuneo let me just ask you

272
00:12:52,730 --> 00:12:50,730
my first question which is how excited

273
00:12:54,080 --> 00:12:52,740
were you to see these images I mean you

274
00:12:56,210 --> 00:12:54,090
know the false color one it's pretty

275
00:12:58,940 --> 00:12:56,220
psychedelic and to see a complete view I

276
00:13:01,550 --> 00:12:58,950
mean how exciting was it to actually see

277
00:13:03,740 --> 00:13:01,560
these things come down I actually

278
00:13:05,690 --> 00:13:03,750
remember the evening I first processed

279
00:13:08,240 --> 00:13:05,700
those images those images came down and

280
00:13:10,580 --> 00:13:08,250
then I got to see the images so the

281
00:13:14,780 --> 00:13:10,590
first thing i do when i get these images

282
00:13:16,220 --> 00:13:14,790
is to map crude generic maps so i showed

283
00:13:18,140 --> 00:13:16,230
you the very first image that wasn't

284
00:13:19,580 --> 00:13:18,150
perspective view from Saturn it's

285
00:13:21,350 --> 00:13:19,590
actually really hard to tell where

286
00:13:23,420 --> 00:13:21,360
exactly on the planet those cloud

287
00:13:27,170 --> 00:13:23,430
features are so the first thing I do is

288
00:13:30,290 --> 00:13:27,180

to project it on a known coordinate

289
00:13:32,180 --> 00:13:30,300
system and then when I do that when i do

290
00:13:33,770 --> 00:13:32,190
that i can start tracking things and

291
00:13:37,100 --> 00:13:33,780
then I don't start stitching together

292
00:13:39,290 --> 00:13:37,110
the images so when I first started

293
00:13:41,510 --> 00:13:39,300
getting to the images that cover the

294
00:13:43,130 --> 00:13:41,520
hexagon the images actually didn't show

295
00:13:45,980 --> 00:13:43,140
the Empire hexagon but as I started

296
00:13:48,080 --> 00:13:45,990
stitching together the images I the full

297
00:13:50,210 --> 00:13:48,090
view of the hexagon actually in color as

298
00:13:52,010 --> 00:13:50,220
well naming the view that everything I

299
00:13:54,140 --> 00:13:52,020
was actually just going to process just

300
00:13:56,420 --> 00:13:54,150
a very first spring I was pretty tired

301
00:13:59,000 --> 00:13:56,430
that I finished I was about to be done

302
00:14:00,890 --> 00:13:59,010
with the first image about 1am actually

303
00:14:02,630 --> 00:14:00,900
worked late at night and then I was

304
00:14:04,310 --> 00:14:02,640
going to go home but as soon as I sold

305
00:14:07,400 --> 00:14:04,320
very first image I just couldn't stop

306
00:14:09,890 --> 00:14:07,410
right i I just processed the rest of it

307
00:14:11,270 --> 00:14:09,900
and and I just stayed up until 5am so

308
00:14:16,070 --> 00:14:11,280
yeah that was a really memorable you

309
00:14:18,890 --> 00:14:16,080
mean oh great so then one question that

310
00:14:21,470 --> 00:14:18,900
came in via email is what's your

311
00:14:23,300 --> 00:14:21,480
favorite image of the mission I mean is

312
00:14:24,950 --> 00:14:23,310
it this hexagon one or have you got some

313
00:14:27,860 --> 00:14:24,960

other ones that you know are dear to

314
00:14:32,030 --> 00:14:27,870
your heart as well well the hexagon is

315
00:14:33,920 --> 00:14:32,040
definitely um very memorable let's see

316
00:14:35,450 --> 00:14:33,930
yeah the 2008 year of the hexagon that

317
00:14:38,030 --> 00:14:35,460
was really exciting because that was the

318
00:14:40,010 --> 00:14:38,040
first very first complete view of the

319
00:14:41,930 --> 00:14:40,020
hexagon understand under sunlight and

320
00:14:44,840 --> 00:14:41,940
then that was the highest resolution

321
00:14:50,150 --> 00:14:44,850
ever of this of the feature as well

322
00:14:52,880 --> 00:14:50,160
let's see um something that comes close

323
00:14:54,500 --> 00:14:52,890
are the some images of the storm that

324
00:14:57,950 --> 00:14:54,510
there was a storm that blew up in

325
00:14:59,840 --> 00:14:57,960
December 2010 and lasted for 200 days it

326
00:15:02,540 --> 00:14:59,850
was a single thunderstorm giant

327
00:15:05,810 --> 00:15:02,550
thunderstorm that kept going for 200

328
00:15:07,970 --> 00:15:05,820
days and we have a lot of good images

329
00:15:10,310 --> 00:15:07,980
from that we got a lot of press press

330
00:15:13,520 --> 00:15:10,320
coverage is out of images and many of

331
00:15:15,050 --> 00:15:13,530
those the turbulent wakes showing a lot

332
00:15:19,450 --> 00:15:15,060
of details and the controller dynamics

333
00:15:22,310 --> 00:15:19,460
builder those images are very well um I

334
00:15:25,160 --> 00:15:22,320
I don't think I well those are different

335
00:15:27,770 --> 00:15:25,170
features I really like both hexagon and

336
00:15:30,110 --> 00:15:27,780
the big storm yeah those are the two big

337
00:15:33,680 --> 00:15:30,120
things that have happened during Cassini

338
00:15:35,060 --> 00:15:33,690

oh yeah okay well I know it's a little

339
00:15:38,260 --> 00:15:35,070
like choosing among your children and

340
00:15:40,730 --> 00:15:38,270
you can't really have a favorite someone

341
00:15:44,090 --> 00:15:40,740
but someone who is also really familiar

342
00:15:45,800 --> 00:15:44,100
with images and in fact the whole span

343
00:15:47,390 --> 00:15:45,810
of all the images that Cassini has been

344
00:15:49,490 --> 00:15:47,400
sending back for the over nine years

345
00:15:52,580 --> 00:15:49,500
that we've been at Saturn is Carolyn

346
00:15:54,440 --> 00:15:52,590
Porco so Carolyn why don't you tell us a

347
00:15:57,500 --> 00:15:54,450
little bit about the big multi image

348
00:16:01,070 --> 00:15:57,510
mosaic that Cassini took on July 19th of

349
00:16:03,620 --> 00:16:01,080
this year okay well I have I think the

350
00:16:07,160 --> 00:16:03,630
best job of everybody here because I get

351
00:16:10,280 --> 00:16:07,170
to tell you about this fabulous and

352
00:16:12,080 --> 00:16:10,290
unusual event that occurred on July 19th

353
00:16:15,230 --> 00:16:12,090
an event we call the day the earth

354
00:16:15,970 --> 00:16:15,240
smiled on which we took the Cassini

355
00:16:17,920 --> 00:16:15,980
cameras

356
00:16:19,360 --> 00:16:17,930
and turn them in the direction of Saturn

357
00:16:23,560 --> 00:16:19,370
and the earth and took a big lawyer

358
00:16:26,260 --> 00:16:23,570
musaic like I Regis told you and my

359
00:16:27,730 --> 00:16:26,270
attachment to the idea of taking a

360
00:16:31,630 --> 00:16:27,740
picture of Earth goes all the way back

361
00:16:33,850 --> 00:16:31,640
to Voyager when i worked with Carl Sagan

362
00:16:36,730 --> 00:16:33,860
on what has now become the very famous

363
00:16:40,690 --> 00:16:36,740

pale blue dot that pale blue dot was

364
00:16:42,970 --> 00:16:40,700
actually part of a mosaic of six planets

365
00:16:45,310 --> 00:16:42,980
in the inner solar system and I had had

366
00:16:47,650 --> 00:16:45,320
this idea I just been added to the

367
00:16:49,990 --> 00:16:47,660
Voyager imaging team and I'd had this

368
00:16:53,830 --> 00:16:50,000
idea that it would be fabulous to show

369
00:16:55,560 --> 00:16:53,840
the world what our solar system look

370
00:16:58,960 --> 00:16:55,570
like to the point of view of an alien

371
00:17:01,270 --> 00:16:58,970
making an approach from outside the

372
00:17:05,500 --> 00:17:01,280
solar system and approaching our star

373
00:17:07,270 --> 00:17:05,510
and I had found after came up with this

374
00:17:10,000 --> 00:17:07,280
idea that Carl Sagan had come up with

375
00:17:12,610 --> 00:17:10,010
this idea two years before I did and in

376
00:17:14,350 --> 00:17:12,620
fact other people have also had also

377
00:17:17,890 --> 00:17:14,360
come up with this idea so I joined

378
00:17:20,440 --> 00:17:17,900
forces with Carl and he and others

379
00:17:23,920 --> 00:17:20,450
planned and executed the pale blue dot

380
00:17:25,660 --> 00:17:23,930
image now if you recall the pale blue

381
00:17:27,610 --> 00:17:25,670
dot image and let's bring that up to

382
00:17:31,390 --> 00:17:27,620
show everybody remind them what it

383
00:17:33,550 --> 00:17:31,400
looked like the pale blue dot image was

384
00:17:36,340 --> 00:17:33,560
not a great image you kind of look at it

385
00:17:40,960 --> 00:17:36,350
and say what you call that an image it

386
00:17:45,130 --> 00:17:40,970
was just a the dot of Earth no stars

387
00:17:48,640 --> 00:17:45,140
forgot to add in car proposal to the

388
00:17:51,070 --> 00:17:48,650

Voyager project he said the idea was to

389
00:17:54,910 --> 00:17:51,080
take a picture of the earth and i quote

390
00:17:57,220 --> 00:17:54,920
awash in a sea of stars well you look at

391
00:18:00,180 --> 00:17:57,230
the pale blue dot image and you don't

392
00:18:03,100 --> 00:18:00,190
see any stars and you see the earth

393
00:18:05,620 --> 00:18:03,110
sitting on a beam of light that is in

394
00:18:07,420 --> 00:18:05,630
fact scattered in the optics of the of

395
00:18:10,630 --> 00:18:07,430
course none of this really mattered

396
00:18:14,110 --> 00:18:10,640
because was what Carl had to say about

397
00:18:18,100 --> 00:18:14,120
this image and the way you romanced it

398
00:18:21,520 --> 00:18:18,110
and turned it into an allegory of the

399
00:18:24,580 --> 00:18:21,530
human condition that made ever since has

400
00:18:28,210 --> 00:18:24,590
made the phrase pale blue dot synonymous

401
00:18:29,470 --> 00:18:28,220
with an inspirational call to protect

402
00:18:33,210 --> 00:18:29,480
the environment and

403
00:18:36,220 --> 00:18:33,220
a call to planetary Brotherhood well

404
00:18:38,980 --> 00:18:36,230
ever since the beginning of my tenure as

405
00:18:41,260 --> 00:18:38,990
the leader of the imaging team on

406
00:18:42,930 --> 00:18:41,270
Cassini I am wanted to do that picture

407
00:18:45,370 --> 00:18:42,940
over again only make it better and

408
00:18:48,030 --> 00:18:45,380
somewhere along the line it occurred to

409
00:18:51,940 --> 00:18:48,040
me wouldn't it be just absolutely

410
00:18:54,730 --> 00:18:51,950
fabulous if we could at the moment that

411
00:18:56,799 --> 00:18:54,740
if we could tell people in advance at

412
00:19:00,220 --> 00:18:56,809
this moment your picture is going to be

413
00:19:04,270 --> 00:19:00,230

taken from the orbit of Saturn a billion

414
00:19:07,419 --> 00:19:04,280
miles away and invite them at that of

415
00:19:13,530 --> 00:19:07,429
the appropriate time to go out look up

416
00:19:16,930 --> 00:19:13,540
and with an acute sense of awareness

417
00:19:19,299 --> 00:19:16,940
contemplate their cosmic whereabouts

418
00:19:22,780 --> 00:19:19,309
think about the utter isolation of the

419
00:19:27,940 --> 00:19:22,790
earth in the neverending blackness of

420
00:19:30,070 --> 00:19:27,950
space Marvel the the beauty and the

421
00:19:33,190 --> 00:19:30,080
rarity of our planet among all the

422
00:19:37,419 --> 00:19:33,200
planets around the Sun appreciate the

423
00:19:41,610 --> 00:19:37,429
lushness in the life on our planet and

424
00:19:45,250 --> 00:19:41,620
marvel at their own existence and also

425
00:19:48,220 --> 00:19:45,260
appreciate and contemplate the magnitude

426
00:19:52,210 --> 00:19:48,230
of the accomplishment the technological

427
00:19:56,350 --> 00:19:52,220
and scientific accomplishment that made

428
00:20:01,780 --> 00:19:56,360
this interplanetary salute between robot

429
00:20:04,960 --> 00:20:01,790
and maker possible and and so that's in

430
00:20:07,270 --> 00:20:04,970
fact what happened on july 19th of this

431
00:20:10,090 --> 00:20:07,280
past year the Cassini cameras were

432
00:20:13,720 --> 00:20:10,100
turned toward Saturn while it eclipsed

433
00:20:16,570 --> 00:20:13,730
the Sun and it took another pale blue

434
00:20:18,490 --> 00:20:16,580
dot image of the earth and we send out

435
00:20:22,419 --> 00:20:18,500
the word ahead of time get out there

436
00:20:25,390 --> 00:20:22,429
feel the cosmic love a smile and

437
00:20:28,240 --> 00:20:25,400
celebration and to borrow a line Bob

438
00:20:31,539 --> 00:20:28,250

Dylan dance beneath the diamond sky with

439
00:20:33,820 --> 00:20:31,549
one hand waving free and i have to say

440
00:20:36,010 --> 00:20:33,830
we had a lot of help in spreading the

441
00:20:38,710 --> 00:20:36,020
word an organization called astronomers

442
00:20:41,310 --> 00:20:38,720
Without Borders spread the word they

443
00:20:43,180 --> 00:20:41,320
organized events all over the globe and

444
00:20:44,950 --> 00:20:43,190
JPL did its own

445
00:20:46,660 --> 00:20:44,960
wave at Saturn program which I'm sure

446
00:20:52,330 --> 00:20:46,670
you all know about and you're going to

447
00:20:54,280 --> 00:20:52,340
hear about afterwards but the whole

448
00:20:57,070 --> 00:20:54,290
thing about just went off tremendously

449
00:20:59,560 --> 00:20:57,080
well it was joyous people all over the

450
00:21:02,650 --> 00:20:59,570
world got involved and they responded

451
00:21:05,230 --> 00:21:02,660
exactly the way I had hoped we got a lot

452
00:21:06,880 --> 00:21:05,240
of comments some of the comments I got

453
00:21:08,770 --> 00:21:06,890
of course we got comments like I hope

454
00:21:12,490 --> 00:21:08,780
you saw me I'm the one wearing the funny

455
00:21:15,280 --> 00:21:12,500
hat but by and large we received many

456
00:21:18,190 --> 00:21:15,290
comments I want to read some to you

457
00:21:20,620 --> 00:21:18,200
because they're wonderful someone

458
00:21:22,870 --> 00:21:20,630
Richard from Pennsylvania wrote what a

459
00:21:25,510 --> 00:21:22,880
great way to feel connected to the

460
00:21:28,330 --> 00:21:25,520
universe the planet and every single

461
00:21:30,910 --> 00:21:28,340
person on it we are truly all in this

462
00:21:33,400 --> 00:21:30,920
together and tests from somewhere I

463
00:21:35,980 --> 00:21:33,410

don't know where said at the appropriate

464
00:21:39,310 --> 00:21:35,990
time I left the table at a restaurant

465
00:21:41,710 --> 00:21:39,320
and I went to the parking lot i turn my

466
00:21:44,290 --> 00:21:41,720
face to the sky and I spent a few

467
00:21:47,410 --> 00:21:44,300
minutes watching and listening to what

468
00:21:50,020 --> 00:21:47,420
life on Earth was like right there right

469
00:21:52,990 --> 00:21:50,030
at that moment knowing that millions of

470
00:21:55,780 --> 00:21:53,000
miles away a spacecraft was turning its

471
00:21:58,270 --> 00:21:55,790
lands towards our amazing planet and

472
00:22:00,760 --> 00:21:58,280
taking photos what a feeling of

473
00:22:03,520 --> 00:22:00,770
connection and oneness with the miracle

474
00:22:06,460 --> 00:22:03,530
that is life on Earth this experience

475
00:22:09,760 --> 00:22:06,470
was beyond meaningful was transcendent

476
00:22:13,300 --> 00:22:09,770
what a beautiful thing and then finally

477
00:22:16,090 --> 00:22:13,310
from Lake Ontario I had been entranced

478
00:22:18,790 --> 00:22:16,100
by this project ever since I heard about

479
00:22:21,130 --> 00:22:18,800
it and was determined to join in the

480
00:22:24,070 --> 00:22:21,140
celebration I just never knew how

481
00:22:26,650 --> 00:22:24,080
emotional I would feel I stood on the

482
00:22:29,620 --> 00:22:26,660
edge of Lake Ontario and I spun in

483
00:22:32,770 --> 00:22:29,630
circles waving at the sky we may not be

484
00:22:35,890 --> 00:22:32,780
unique we may be transient we may be

485
00:22:38,770 --> 00:22:35,900
only flying along on a decimal but darn

486
00:22:41,650 --> 00:22:38,780
it for 15 minutes we were there we were

487
00:22:44,320 --> 00:22:41,660
aware and we smile and so the whole

488
00:22:47,290 --> 00:22:44,330

thing was a great success and here now

489
00:22:50,590 --> 00:22:47,300
is the image that was taken on the day

490
00:22:53,080 --> 00:22:50,600
the earth smile and if you really want

491
00:22:54,820 --> 00:22:53,090
to see the details in this image you you

492
00:22:56,410 --> 00:22:54,830
won't see them in pictures we could show

493
00:22:57,250 --> 00:22:56,420
you on a google hangout you'll have to

494
00:22:59,110 --> 00:22:57,260
go on the web

495
00:23:01,150 --> 00:22:59,120
there are many places as you probably

496
00:23:03,190 --> 00:23:01,160
know they're on the Cyclops website

497
00:23:05,080 --> 00:23:03,200
there on the JPL website they're on the

498
00:23:08,170 --> 00:23:05,090
NASA website and in fact the images on

499
00:23:10,690 --> 00:23:08,180
viral its many places but you can see

500
00:23:13,480 --> 00:23:10,700
center stage you can see the globe of

501
00:23:16,720 --> 00:23:13,490
Saturn it's eclipsing the Sun so the Sun

502
00:23:18,400 --> 00:23:16,730
is behind it the main rings they look

503
00:23:22,800 --> 00:23:18,410
like they're glowing the sunlight is

504
00:23:26,200 --> 00:23:22,810
actually diffusing through them you see

505
00:23:28,740 --> 00:23:26,210
you see the narrow jeering but the big

506
00:23:32,020 --> 00:23:28,750
blue ring that you see the beautiful one

507
00:23:34,950 --> 00:23:32,030
is most prominent and that ring is

508
00:23:40,030 --> 00:23:34,960
created by a hundred geysers erupting

509
00:23:41,800 --> 00:23:40,040
from the South Pole of Enceladus I'll

510
00:23:46,990 --> 00:23:41,810
say more about that in a minute and also

511
00:23:51,720 --> 00:23:47,000
in this picture we captured four planets

512
00:23:55,720 --> 00:23:51,730
we captured not only Saturn Venus and

513
00:23:59,530 --> 00:23:55,730

Mars end of course the earth so I think

514
00:24:02,530 --> 00:23:59,540
that this may be the only picture that's

515
00:24:05,050 --> 00:24:02,540
captured that many planets since the day

516
00:24:08,110 --> 00:24:05,060
of pale blue dot since a day Voyager

517
00:24:11,920 --> 00:24:08,120
which captured six and in the next

518
00:24:14,170 --> 00:24:11,930
picture is a close-up of Enceladus I

519
00:24:17,080 --> 00:24:14,180
want to concentrate on Enceladus because

520
00:24:20,140 --> 00:24:17,090
I feel this is our most profound

521
00:24:23,170 --> 00:24:20,150
discovery with Cassini you see the plume

522
00:24:26,680 --> 00:24:23,180
of material issuing forth from the

523
00:24:28,750 --> 00:24:26,690
southern half of the moon that is as I

524
00:24:32,050 --> 00:24:28,760
said it's a material erupting from a

525
00:24:35,110 --> 00:24:32,060
hundred geysers and they come from what

526
00:24:37,840 --> 00:24:35,120
we believe is a habitable the habitable

527
00:24:41,400 --> 00:24:37,850
zone within the small moon and because

528
00:24:44,380 --> 00:24:41,410
those geysers are connected to this

529
00:24:46,570 --> 00:24:44,390
reservoir of liquid water suffuse with

530
00:24:50,100 --> 00:24:46,580
organic material inside this moon it

531
00:24:52,900 --> 00:24:50,110
makes Enceladus the most accessible

532
00:24:55,300 --> 00:24:52,910
habitable zone in all the solar system

533
00:24:57,700 --> 00:24:55,310
you can fly through those geysers and

534
00:25:00,130 --> 00:24:57,710
scoop up material and it's not out of

535
00:25:02,440 --> 00:25:00,140
the question that it could be snowing

536
00:25:05,830 --> 00:25:02,450
microbes at the South Pole of Enceladus

537
00:25:10,120 --> 00:25:05,840
so this is just one of very many reasons

538
00:25:10,780 --> 00:25:10,130

why we really are desperate to make sure

539
00:25:13,240 --> 00:25:10,790
that we

540
00:25:17,740 --> 00:25:13,250
continue through the rest of the Cassini

541
00:25:19,540 --> 00:25:17,750
mission out to 2017 because Enceladus is

542
00:25:22,360 --> 00:25:19,550
one of the prime targets that we wish to

543
00:25:28,810 --> 00:25:22,370
fill them and then of course this

544
00:25:31,030 --> 00:25:28,820
picture you look over the right shoulder

545
00:25:36,010 --> 00:25:31,040
as it were of Saturn beneath the Rings

546
00:25:38,170 --> 00:25:36,020
and you will see our planet Earth right

547
00:25:39,790 --> 00:25:38,180
there that bright dot and again you may

548
00:25:42,280 --> 00:25:39,800
not be able to see it on the screen but

549
00:25:46,090 --> 00:25:42,290
if you go on the web you will see that

550
00:25:48,340 --> 00:25:46,100
it is a wash and sea of stars and it is

551
00:25:51,760 --> 00:25:48,350
there a billion miles away in this image

552
00:25:54,280 --> 00:25:51,770
freezes in time a unique moment when

553
00:25:56,920 --> 00:25:54,290
people all around the globe at the

554
00:26:00,430 --> 00:25:56,930
instant this picture was taken were

555
00:26:02,320 --> 00:26:00,440
saluting Cassini and thinking about the

556
00:26:04,570 --> 00:26:02,330
magnificence of what we have

557
00:26:07,600 --> 00:26:04,580
accomplished in exploring the solar

558
00:26:11,350 --> 00:26:07,610
system and I have to add that I can't

559
00:26:14,140 --> 00:26:11,360
help but when I look at this image think

560
00:26:16,900 --> 00:26:14,150
that it represents the very very best

561
00:26:21,090 --> 00:26:16,910
that humanity has to offer because we

562
00:26:24,130 --> 00:26:21,100
are no but the small and truth and

563
00:26:27,430 --> 00:26:24,140

warlike inhabitants of one tiny little

564
00:26:30,820 --> 00:26:27,440
dot of a planet but it serves us well to

565
00:26:34,060 --> 00:26:30,830
always remember we are also the seekers

566
00:26:37,720 --> 00:26:34,070
and the thinkers and the explorers who

567
00:26:40,510 --> 00:26:37,730
took this picture One World clear across

568
00:26:44,680 --> 00:26:40,520
interplanetary space to it and to be

569
00:26:47,200 --> 00:26:44,690
that small and reach so far is in the

570
00:26:49,660 --> 00:26:47,210
end what makes us the extraordinary

571
00:26:53,050 --> 00:26:49,670
citizens of planet Earth so if you're

572
00:26:55,480 --> 00:26:53,060
ever down and out and you're listening

573
00:26:57,910 --> 00:26:55,490
to the news and you're nothing but one

574
00:27:00,220 --> 00:26:57,920
bad thing after another but look at our

575
00:27:02,980 --> 00:27:00,230
Cassini picture of Earth and be reminded

576
00:27:06,580 --> 00:27:02,990
of just exactly how far we have come and

577
00:27:09,070 --> 00:27:06,590
how great we really are thank you all

578
00:27:10,570 --> 00:27:09,080
right thanks Carolyn certainly a lot of

579
00:27:12,880 --> 00:27:10,580
the comments and feedback that we got

580
00:27:14,230 --> 00:27:12,890
from that picture about how looking at

581
00:27:15,700 --> 00:27:14,240
this picture really puts things in

582
00:27:18,600 --> 00:27:15,710
perspective and I think you really

583
00:27:23,980 --> 00:27:18,610
nicely encapsulated that so we have a

584
00:27:27,100 --> 00:27:23,990
question here from twitter at q8 fail AK

585
00:27:29,650 --> 00:27:27,110
um the Rings are obviously a big feature

586
00:27:32,140 --> 00:27:29,660
in that new mosaic that we put out and

587
00:27:34,840 --> 00:27:32,150
this person wants to know what is the

588
00:27:36,669 --> 00:27:34,850

thickness of the Rings oh well oh

589
00:27:38,760 --> 00:27:36,679
depends which rings you're talking about

590
00:27:42,730 --> 00:27:38,770
but I presume he means the main rings

591
00:27:46,360 --> 00:27:42,740
and they are really very within uh they

592
00:27:48,280 --> 00:27:46,370
are no bigger there about 30 feet thick

593
00:27:51,910 --> 00:27:48,290
and that makes them no bigger than about

594
00:27:54,340 --> 00:27:51,920
two stories in a modern-day building

595
00:27:57,130 --> 00:27:54,350
though they're very thin despite the

596
00:27:59,140 --> 00:27:57,140
fact that Saturn's rings are across

597
00:28:01,240 --> 00:27:59,150
there about one light-second they're

598
00:28:04,360 --> 00:28:01,250
only there about 280,000 this is only

599
00:28:07,210 --> 00:28:04,370
the main rings about 280,000 kilometers

600
00:28:08,830 --> 00:28:07,220
across and in fact I'd love to add this

601
00:28:11,650 --> 00:28:08,840
statistic because I think it's marvelous

602
00:28:16,240 --> 00:28:11,660
if you took all the mass and Saturn's

603
00:28:18,250 --> 00:28:16,250
rings and recomposed it into a moon for

604
00:28:19,870 --> 00:28:18,260
of the proper density for the Saturn

605
00:28:22,240 --> 00:28:19,880
system it would be no bigger than

606
00:28:24,570 --> 00:28:22,250
Enceladus which is a moon that's no

607
00:28:27,160 --> 00:28:24,580
bigger across than Great Britain so it's

608
00:28:32,470 --> 00:28:27,170
tremendous visual spectacle for very

609
00:28:35,230 --> 00:28:32,480
little mess ok well we have another

610
00:28:38,140 --> 00:28:35,240
question from cali center grin on

611
00:28:41,410 --> 00:28:38,150
google+ if you are planning the next

612
00:28:43,030 --> 00:28:41,420
mission to Saturn what would your

613
00:28:45,400 --> 00:28:43,040

Cassini two point oh look like what

614
00:28:46,630 --> 00:28:45,410
instruments would it have so maybe you

615
00:28:48,430 --> 00:28:46,640
can tell us a little bit about the

616
00:28:51,280 --> 00:28:48,440
cameras that Cassini has right now and

617
00:28:52,930 --> 00:28:51,290
then you know if you had your wishes uh

618
00:28:56,290 --> 00:28:52,940
what kind of camera would you really

619
00:28:58,750 --> 00:28:56,300
like out there well I will what much on

620
00:29:00,370 --> 00:28:58,760
uh well okay like the cameras let me

621
00:29:02,940 --> 00:29:00,380
describe the Cassini cameras they're the

622
00:29:04,990 --> 00:29:02,950
most sophisticated cameras in fact

623
00:29:06,669 --> 00:29:05,000
Cassini's payload is the most

624
00:29:09,610 --> 00:29:06,679
sophisticated payload that was ever

625
00:29:11,590 --> 00:29:09,620
taken into the outer solar system in our

626
00:29:14,740 --> 00:29:11,600
cameras we have two of them we call them

627
00:29:16,450 --> 00:29:14,750
cameras they're actually telescopes and

628
00:29:20,110 --> 00:29:16,460
outfitted with many spectral filters

629
00:29:22,090 --> 00:29:20,120
that's why cuneo can look at the hexagon

630
00:29:24,040 --> 00:29:22,100
and all sorts of different spectral

631
00:29:27,100 --> 00:29:24,050
filters and they kind of slice the

632
00:29:30,460 --> 00:29:27,110
Saturn atmosphere and give us a shot at

633
00:29:32,830 --> 00:29:30,470
different levels in the atmosphere other

634
00:29:35,770 --> 00:29:32,840
images like the one our mosaic is made

635
00:29:37,870 --> 00:29:35,780
of this are this particular mosaic

636
00:29:41,170 --> 00:29:37,880
where's our red green and blue

637
00:29:44,020 --> 00:29:41,180
can use those to make network you might

638
00:29:47,290 --> 00:29:44,030

call natural color but they also have

639
00:29:49,420 --> 00:29:47,300
scientific purposes you look at surfaces

640
00:29:51,370 --> 00:29:49,430
of moons for example in different colors

641
00:29:56,080 --> 00:29:51,380
you might be able to pick out different

642
00:29:57,430 --> 00:29:56,090
types of Isis and so on so um and then

643
00:29:59,980 --> 00:29:57,440
and then there's many other capabilities

644
00:30:03,070 --> 00:29:59,990
in the cameras I don't have to the time

645
00:30:05,890 --> 00:30:03,080
to go into but i will tell you first you

646
00:30:09,910 --> 00:30:05,900
need to know if you ask this picture at

647
00:30:12,100 --> 00:30:09,920
this question of any planetary scientist

648
00:30:15,610 --> 00:30:12,110
you get a different answer probably from

649
00:30:19,540 --> 00:30:15,620
each one but my favorite thing to do

650
00:30:23,380 --> 00:30:19,550
with a mission that goes back to Saturn

651
00:30:25,750 --> 00:30:23,390
is concentrate on Enceladus because we

652
00:30:28,930 --> 00:30:25,760
need to know did biological processes

653
00:30:32,050 --> 00:30:28,940
ever get started on Enceladus and so if

654
00:30:34,390 --> 00:30:32,060
we equipped a spacecraft returning to

655
00:30:37,690 --> 00:30:34,400
Saturn with an instrument that could

656
00:30:40,090 --> 00:30:37,700
scoop up materials and do a more

657
00:30:42,430 --> 00:30:40,100
sophisticated job of chemical analysis

658
00:30:44,170 --> 00:30:42,440
than Cassini is equipped to do we might

659
00:30:47,380 --> 00:30:44,180
actually be able to answer the question

660
00:30:49,750 --> 00:30:47,390
and we're not a biotic prophecies have

661
00:30:51,700 --> 00:30:49,760
gotten started on Enceladus and then my

662
00:30:54,160 --> 00:30:51,710
other favorite I would combine these

663
00:30:57,340 --> 00:30:54,170

into one mission my other favorite would

664
00:30:59,830 --> 00:30:57,350
be to study Titan because Titan is the

665
00:31:01,900 --> 00:30:59,840
only place in our solar system where we

666
00:31:03,760 --> 00:31:01,910
have liquid organics punted on the

667
00:31:07,090 --> 00:31:03,770
surface and it has a thick atmosphere

668
00:31:09,730 --> 00:31:07,100
and in many regards it is very similar

669
00:31:13,060 --> 00:31:09,740
to our planet except that it has liquid

670
00:31:17,440 --> 00:31:13,070
organic so we could study organic and

671
00:31:19,090 --> 00:31:17,450
sit you if if you please in a way that

672
00:31:21,310 --> 00:31:19,100
we can't do it any longer on the earth

673
00:31:24,070 --> 00:31:21,320
because the earth has oxygen and free

674
00:31:26,740 --> 00:31:24,080
oxygen oxidizes man destroys organic

675
00:31:29,650 --> 00:31:26,750
materials so that's what I do with a

676
00:31:35,260 --> 00:31:29,660
mission after a Cassini and I think we

677
00:31:39,220 --> 00:31:35,270
should start it in 2018 um well that's a

678
00:31:40,480 --> 00:31:39,230
very passionate answer um one question

679
00:31:41,830 --> 00:31:40,490
that we got I'm going to throw it back

680
00:31:44,710 --> 00:31:41,840
to cuneo for a minute because we had a

681
00:31:48,280 --> 00:31:44,720
question come in about the hexagon this

682
00:31:51,310 --> 00:31:48,290
is on Twitter from JP major is there or

683
00:31:55,480 --> 00:31:51,320
why isn't there a similar hexagon around

684
00:31:58,660 --> 00:31:55,490
Saturn South Pole so on the meandering

685
00:32:01,240 --> 00:31:58,670
property of the biz jet so I said that

686
00:32:05,380 --> 00:32:01,250
the hexagons are North Pole of Saturn is

687
00:32:07,240 --> 00:32:05,390
a meandering jet so the meandering

688
00:32:10,840 --> 00:32:07,250

property really depends on the details

689
00:32:14,230 --> 00:32:10,850
of the jet so the the jet around North

690
00:32:18,160 --> 00:32:14,240
Pole has the right speed and what to

691
00:32:21,220 --> 00:32:18,170
have to fit in a way basically it to

692
00:32:23,680 --> 00:32:21,230
fold into six sided shape Saturn South

693
00:32:26,610 --> 00:32:23,690
Pole actually doesn't have a similar jet

694
00:32:29,620 --> 00:32:26,620
stream that's that's wrapping around and

695
00:32:31,480 --> 00:32:29,630
they won't it's well there's a jet but

696
00:32:33,840 --> 00:32:31,490
it's the property is actually very

697
00:32:37,090 --> 00:32:33,850
different from the around North Pole

698
00:32:40,330 --> 00:32:37,100
there's a jet that does me under it

699
00:32:43,030 --> 00:32:40,340
sometimes takes Tom cited for Tom sided

700
00:32:46,510 --> 00:32:43,040
shape it's not very stable but it does

701
00:32:48,640 --> 00:32:46,520
develop a many-sided pattern but it

702
00:32:50,440 --> 00:32:48,650
doesn't look as visually striking but

703
00:32:54,660 --> 00:32:50,450
it's a very similar dynamics that's

704
00:32:58,090 --> 00:32:54,670
happening around South Pole as well and

705
00:33:01,300 --> 00:32:58,100
then of course we had a lot of vortices

706
00:33:03,730 --> 00:33:01,310
and but what we do have around Saturn

707
00:33:06,010 --> 00:33:03,740
styles so 4 is the hurricane like

708
00:33:07,390 --> 00:33:06,020
structure that we do have a North Pole

709
00:33:11,770 --> 00:33:07,400
so there are similarities and

710
00:33:14,440 --> 00:33:11,780
differences also I mean it is a very

711
00:33:16,330 --> 00:33:14,450
special sort of a thing because it

712
00:33:18,910 --> 00:33:16,340
doesn't even appear at the other giant

713
00:33:21,160 --> 00:33:18,920

planets in our solar system does it no

714
00:33:23,380 --> 00:33:21,170
it does not so old giant planets

715
00:33:26,230 --> 00:33:23,390
actually most most planets in general

716
00:33:29,410 --> 00:33:26,240
have a strong vortex around each of

717
00:33:32,200 --> 00:33:29,420
their poles Venus had penises poles have

718
00:33:34,630 --> 00:33:32,210
more disease earth holes have jet

719
00:33:36,930 --> 00:33:34,640
streams or districts that's wrapping

720
00:33:38,920 --> 00:33:36,940
around the pole is basically a vortex

721
00:33:41,980 --> 00:33:38,930
Jupiter we've actually never seen

722
00:33:44,560 --> 00:33:41,990
Jupiter in reflected sunlight and

723
00:33:46,240 --> 00:33:44,570
Jupiter's polar regions of Jupiter and

724
00:33:49,480 --> 00:33:46,250
reflected sunlight so that's actually a

725
00:33:53,140 --> 00:33:49,490
lot of exploration we're that's going to

726
00:33:56,230 --> 00:33:53,150
happen soon NASA's Juno spacecraft that

727
00:33:58,630 --> 00:33:56,240
will have a first view or a first

728
00:34:02,230 --> 00:33:58,640
detailed view of the polar regions on

729
00:34:04,690 --> 00:34:02,240
Saturn eye of Jupiter and then you're

730
00:34:07,300 --> 00:34:04,700
listen ftn right we do not have

731
00:34:10,720 --> 00:34:07,310
polyvinyl structures but we they too

732
00:34:13,090 --> 00:34:10,730
have for disease so yeah right the

733
00:34:15,040 --> 00:34:13,100
question was about why no hexagon or

734
00:34:16,720 --> 00:34:15,050
polygon there another planet right we

735
00:34:19,140 --> 00:34:16,730
don't have polygons but all of them do

736
00:34:22,450 --> 00:34:19,150
you have this dream is going around

737
00:34:26,440 --> 00:34:22,460
great thanks Cuneo we're going to make a

738
00:34:28,540 --> 00:34:26,450

transition here and I'm gonna introduce

739
00:34:30,880 --> 00:34:28,550
Linda next she's going to talk about

740
00:34:32,950 --> 00:34:30,890
some of the mysteries that we still have

741
00:34:34,690 --> 00:34:32,960
to solve around Saturn and then after

742
00:34:38,500 --> 00:34:34,700
that Earl will talk about how we're

743
00:34:40,180 --> 00:34:38,510
going to do that Linda well I think if

744
00:34:42,250 --> 00:34:40,190
someone asked me what is your favorite

745
00:34:44,500 --> 00:34:42,260
image I'd have to say that the Saturn

746
00:34:46,600 --> 00:34:44,510
mosaic that just came back is one of my

747
00:34:49,420 --> 00:34:46,610
new very favorite images it's so

748
00:34:51,460 --> 00:34:49,430
beautiful it's almost heart stopping to

749
00:34:53,050 --> 00:34:51,470
look at it and with that in mind let me

750
00:34:55,960 --> 00:34:53,060
go to the first slide let's look at that

751
00:34:57,400 --> 00:34:55,970
image in a very different way and what

752
00:35:01,120 --> 00:34:57,410
you see when it comes up is this is a

753
00:35:03,430 --> 00:35:01,130
collage that includes 1600 images that

754
00:35:06,070 --> 00:35:03,440
were sent by members of the public to us

755
00:35:08,530 --> 00:35:06,080
as part of Cassini's wave at saturn

756
00:35:10,120 --> 00:35:08,540
campaign we asked people to go out in

757
00:35:12,580 --> 00:35:10,130
that 20-minute window when we were

758
00:35:14,830 --> 00:35:12,590
taking pictures of the earth to raise

759
00:35:17,500 --> 00:35:14,840
their hand and wave at Saturn take a

760
00:35:19,540 --> 00:35:17,510
picture of themselves a selfie and send

761
00:35:22,600 --> 00:35:19,550
it to us so those pictures are here in

762
00:35:23,920 --> 00:35:22,610
fact my husband Tom and I also have our

763
00:35:25,510 --> 00:35:23,930

picture in there and it's kind of fun to

764
00:35:28,270 --> 00:35:25,520
try and hunt down and look for your

765
00:35:30,700 --> 00:35:28,280
friends and family in this giant collage

766
00:35:33,760 --> 00:35:30,710
and I just like to say a big thank you

767
00:35:36,460 --> 00:35:33,770
to everyone who participated in the wave

768
00:35:38,530 --> 00:35:36,470
at Saturn smile at Saturn campaigns you

769
00:35:41,800 --> 00:35:38,540
really helped us celebrate this very

770
00:35:43,510 --> 00:35:41,810
phenomenal event and with that like to

771
00:35:45,880 --> 00:35:43,520
move on to some of the mysteries that we

772
00:35:48,580 --> 00:35:45,890
might solve as we continue over the next

773
00:35:52,270 --> 00:35:48,590
few years with Cassini and if we go to

774
00:35:54,970 --> 00:35:52,280
the next image clearly the seasons are

775
00:35:57,370 --> 00:35:54,980
changing at Saturn this is a wide-angle

776
00:36:00,520 --> 00:35:57,380
view of Saturn with Titan crossing in

777
00:36:02,920 --> 00:36:00,530
front of it basically you can see sort

778
00:36:05,140 --> 00:36:02,930
of a bluish tint or hue if you go back

779
00:36:07,960 --> 00:36:05,150
ten years to when Cassini first arrived

780
00:36:11,110 --> 00:36:07,970
at Saturn the northern hemisphere was in

781
00:36:13,230 --> 00:36:11,120
winter and it had a bluish tint and now

782
00:36:15,370 --> 00:36:13,240
we see that that tint is slowly

783
00:36:17,560 --> 00:36:15,380
lightning in the northern hemisphere and

784
00:36:18,620 --> 00:36:17,570
is moving to the southern hemisphere the

785
00:36:20,749 --> 00:36:18,630
colors are

786
00:36:23,839 --> 00:36:20,759
cursing as we're approaching winter in

787
00:36:25,940 --> 00:36:23,849
the southern hemisphere of Saturn in

788
00:36:28,999 --> 00:36:25,950

fact this is a unique opportunity to

789
00:36:32,359 --> 00:36:29,009
look at Saturn and were so close to

790
00:36:35,299 --> 00:36:32,369
solstice just a few years away from that

791
00:36:38,029 --> 00:36:35,309
summer solstice and no spacecraft has

792
00:36:39,620 --> 00:36:38,039
been this close to Saturn anywhere near

793
00:36:42,710 --> 00:36:39,630
the summer solstice so it offers a

794
00:36:45,410 --> 00:36:42,720
unique opportunity to study Saturn and

795
00:36:47,839 --> 00:36:45,420
tighten and the moons in this new season

796
00:36:50,180 --> 00:36:47,849
in fact if you think about it it takes

797
00:36:53,749 --> 00:36:50,190
Saturn 30 years to go around the Sun a

798
00:36:56,960 --> 00:36:53,759
single time so three decades will pass

799
00:37:00,019 --> 00:36:56,970
before we have the opportunity to once

800
00:37:03,109 --> 00:37:00,029
again observe Saturn and tighten at the

801
00:37:06,349 --> 00:37:03,119
summer solstice and moving on to my next

802
00:37:08,180 --> 00:37:06,359
graphic in fact for Titan the next few

803
00:37:11,809 --> 00:37:08,190
years will be some of the most exciting

804
00:37:13,430 --> 00:37:11,819
time for Titan whether this image Titan

805
00:37:16,009 --> 00:37:13,440
is huge it's about the size of the

806
00:37:18,529 --> 00:37:16,019
planet Mercury it has a thick nitrogen

807
00:37:20,210 --> 00:37:18,539
atmosphere and as Carolyn mentioned it's

808
00:37:23,109 --> 00:37:20,220
one of the only worlds besides the earth

809
00:37:25,099 --> 00:37:23,119
where liquids pool on the surface and

810
00:37:27,019 --> 00:37:25,109
minus two hundred ninety degrees

811
00:37:29,059 --> 00:37:27,029
Fahrenheit those liquids are methane and

812
00:37:32,150 --> 00:37:29,069
ethane and there are lots of organics on

813
00:37:34,720 --> 00:37:32,160

the surface of Titan if you look at this

814
00:37:37,549 --> 00:37:34,730
image here this is a near infrared image

815
00:37:38,990 --> 00:37:37,559
basically a false-color image it turns

816
00:37:41,359 --> 00:37:39,000
out that if you look in the visible you

817
00:37:43,609 --> 00:37:41,369
can't see through to titan's surface but

818
00:37:45,529 --> 00:37:43,619
if you look in the near-infrared you can

819
00:37:47,779 --> 00:37:45,539
then start to see those details and

820
00:37:50,960 --> 00:37:47,789
those black splotches up toward the top

821
00:37:52,789 --> 00:37:50,970
of the image are these lakes that we see

822
00:37:55,130 --> 00:37:52,799
on Titan and it's just very intriguing

823
00:37:58,220 --> 00:37:55,140
to think about not only it's tight in a

824
00:38:00,499 --> 00:37:58,230
giant laboratory for how life might have

825
00:38:02,660 --> 00:38:00,509
started on the earth one also wonders

826
00:38:05,089 --> 00:38:02,670
could there possibly be some kind of

827
00:38:06,950 --> 00:38:05,099
methane based life that might be in the

828
00:38:09,319 --> 00:38:06,960
lakes and then of course Titan has a

829
00:38:11,210 --> 00:38:09,329
liquid ocean and so perhaps in that

830
00:38:13,759 --> 00:38:11,220
liquid ocean so in what we have with

831
00:38:17,120 --> 00:38:13,769
Europa perhaps that's another habitat

832
00:38:19,009 --> 00:38:17,130
for life as well and so let's look at

833
00:38:22,039 --> 00:38:19,019
one of those one of those seas up close

834
00:38:24,559 --> 00:38:22,049
if we go on to the next graphic this is

835
00:38:27,680 --> 00:38:24,569
like I amare it's the second largest sea

836
00:38:29,029 --> 00:38:27,690
on Titan it's about the size of one of

837
00:38:32,420 --> 00:38:29,039
the great lakes that you see at the

838
00:38:34,220 --> 00:38:32,430

us-canadian border this lake is filled

839
00:38:36,860 --> 00:38:34,230
with organics with methane and ethane

840
00:38:39,020 --> 00:38:36,870
and all of the lakes on Titan seem to be

841
00:38:41,000 --> 00:38:39,030
congregated pretty much at the North

842
00:38:44,060 --> 00:38:41,010
Pole the exception of just a few lakes

843
00:38:45,560 --> 00:38:44,070
and this is a view at radar wavelength

844
00:38:48,500 --> 00:38:45,570
so again we can see in the near infrared

845
00:38:50,870 --> 00:38:48,510
and radar wavelengths so use all of the

846
00:38:53,390 --> 00:38:50,880
tools that we have on Cassini including

847
00:38:55,660 --> 00:38:53,400
the cameras to help us reveal Titan in

848
00:38:58,010 --> 00:38:55,670
its surface and over the next few years

849
00:39:00,470 --> 00:38:58,020
one of the mysteries we wonder what will

850
00:39:02,810 --> 00:39:00,480
happen with the lakes well the methane

851
00:39:05,330 --> 00:39:02,820
and ethane start to evaporate when we

852
00:39:07,460 --> 00:39:05,340
see clouds of methane come over and fill

853
00:39:10,130 --> 00:39:07,470
what looked like dry ancient lake beds

854
00:39:11,720 --> 00:39:10,140
at the North Pole will there be wind

855
00:39:13,670 --> 00:39:11,730
that will be strong enough to create

856
00:39:16,640 --> 00:39:13,680
waves on the lakes that would be able to

857
00:39:18,980 --> 00:39:16,650
see with the radar data and maybe even

858
00:39:21,950 --> 00:39:18,990
tiny hurricanes depending on how strong

859
00:39:24,200 --> 00:39:21,960
the winds blow at the North Pole so the

860
00:39:25,790 --> 00:39:24,210
seasons are changing and we're really

861
00:39:29,210 --> 00:39:25,800
anxious to see what will happen when

862
00:39:31,790 --> 00:39:29,220
that Sun shines down on the North Pole

863
00:39:33,410 --> 00:39:31,800

of Titan and perhaps we'll answer some

864
00:39:35,540 --> 00:39:33,420
of the mysteries about the lakes why

865
00:39:38,180 --> 00:39:35,550
they're just so predominant at the North

866
00:39:40,550 --> 00:39:38,190
Pole and how they might evolve with the

867
00:39:44,090 --> 00:39:40,560
seasons I'm moving on to Enceladus

868
00:39:46,370 --> 00:39:44,100
that's my next slide and Sela this is

869
00:39:49,340 --> 00:39:46,380
one of the most intriguing objects in

870
00:39:51,440 --> 00:39:49,350
the solar system it has a water ice

871
00:39:54,020 --> 00:39:51,450
surface and as Caroline pointed out you

872
00:39:56,810 --> 00:39:54,030
have Jets of material coming out from

873
00:39:59,210 --> 00:39:56,820
the South Pole primarily liquid water a

874
00:40:01,280 --> 00:39:59,220
lot of it falls back to the surface but

875
00:40:04,010 --> 00:40:01,290
we also have carbon dioxide we have

876
00:40:06,050 --> 00:40:04,020
organics we have nitrogen we basically

877
00:40:08,690 --> 00:40:06,060
have the ingredients there for life

878
00:40:12,350 --> 00:40:08,700
possibly in that liquid water reservoir

879
00:40:14,810 --> 00:40:12,360
beneath Titans South Pole and in fact

880
00:40:17,000 --> 00:40:14,820
the South Pole of Titan or South Levin

881
00:40:19,040 --> 00:40:17,010
cela this is now dark and that's very

882
00:40:21,380 --> 00:40:19,050
interesting because with it dark we can

883
00:40:23,690 --> 00:40:21,390
now measure the heat coming out of the

884
00:40:25,520 --> 00:40:23,700
South Pole very accurately and that

885
00:40:28,520 --> 00:40:25,530
might help tell us what's happening with

886
00:40:31,100 --> 00:40:28,530
Enceladus and why it is so very active

887
00:40:34,490 --> 00:40:31,110
and now if we just zoom in on some of

888
00:40:37,790 --> 00:40:34,500

those Jets up close we have three flybys

889
00:40:39,710 --> 00:40:37,800
coming up in the end of 2015 one of

890
00:40:42,260 --> 00:40:39,720
those flybys is going to fly right

891
00:40:44,000 --> 00:40:42,270
through those Jets and it's going to be

892
00:40:45,799 --> 00:40:44,010
it for the very first time at the time

893
00:40:48,650 --> 00:40:45,809
of maximum emission

894
00:40:51,289 --> 00:40:48,660
of those Jets the Jets vary by about a

895
00:40:53,719 --> 00:40:51,299
factor of three in emission and here for

896
00:40:55,400 --> 00:40:53,729
the first time the end of 2015 will be

897
00:40:57,650 --> 00:40:55,410
able to really make measurements more

898
00:40:59,630 --> 00:40:57,660
detailed compositional measurements to

899
00:41:02,449 --> 00:40:59,640
find out what's coming out of these Jets

900
00:41:04,130 --> 00:41:02,459
and also we'll get a chance one of these

901
00:41:07,069 --> 00:41:04,140
flybys to look at the North Pole of

902
00:41:09,469 --> 00:41:07,079
Enceladus at very high resolution now if

903
00:41:11,150 --> 00:41:09,479
the Sun high in the sky will look for

904
00:41:14,719 --> 00:41:11,160
evidence of what might look like ancient

905
00:41:17,179 --> 00:41:14,729
fractures ancient tiger stripes and to

906
00:41:20,660 --> 00:41:17,189
answer the question was tight was in

907
00:41:23,449 --> 00:41:20,670
selasis North Pole active as active as

908
00:41:25,370 --> 00:41:23,459
perhaps the South Pole is today so a lot

909
00:41:27,529 --> 00:41:25,380
of very interesting things coming up in

910
00:41:30,410 --> 00:41:27,539
the future years with Cassini and

911
00:41:32,660 --> 00:41:30,420
mysteries to solve and finally this set

912
00:41:35,089 --> 00:41:32,670
of orbits besides returning really great

913
00:41:37,249 --> 00:41:35,099

science and looking at a new season on

914
00:41:39,829 --> 00:41:37,259
Saturn is going to put us in great

915
00:41:41,809 --> 00:41:39,839
position for Cassini's endgame these

916
00:41:43,219 --> 00:41:41,819
orbits are carefully positioning us so

917
00:41:46,339 --> 00:41:43,229
that we can get the best data possible

918
00:41:49,130 --> 00:41:46,349
back and it turns out all of those final

919
00:41:50,870 --> 00:41:49,140
orbits will actually dive in between the

920
00:41:52,939 --> 00:41:50,880
innermost ring and the top of the

921
00:41:54,349 --> 00:41:52,949
atmosphere on Saturn and make

922
00:41:56,419 --> 00:41:54,359
measurements for the first time of the

923
00:41:58,640 --> 00:41:56,429
mass of the Rings something we really

924
00:42:00,529 --> 00:41:58,650
don't have a good handle on measure a

925
00:42:02,989 --> 00:42:00,539
new place in the system that we've never

926
00:42:05,239 --> 00:42:02,999
seen before that'll be very very

927
00:42:07,279 --> 00:42:05,249
exciting also make really good

928
00:42:09,650 --> 00:42:07,289
measurements of the gravity field and

929
00:42:11,749 --> 00:42:09,660
the magnetic field around Saturn and

930
00:42:15,109 --> 00:42:11,759
maybe get a handle on what that rotation

931
00:42:17,239 --> 00:42:15,119
rate might be for the planet and here

932
00:42:19,279 --> 00:42:17,249
and I've been very excited to watch when

933
00:42:22,429 --> 00:42:19,289
that data comes back from the very first

934
00:42:24,890 --> 00:42:22,439
orbit what new discoveries might be in

935
00:42:27,289 --> 00:42:24,900
store for Cassini as we go into this new

936
00:42:30,589 --> 00:42:27,299
region that we've never probed before

937
00:42:32,229 --> 00:42:30,599
and so after that I'd like to turn this

938
00:42:34,819 --> 00:42:32,239

over to Earl maze and he'll talk about

939
00:42:36,949 --> 00:42:34,829
how do we shape the orbits to get the

940
00:42:38,989 --> 00:42:36,959
science back that will be coming back

941
00:42:41,809 --> 00:42:38,999
and what do we have for the end game so

942
00:42:45,949 --> 00:42:41,819
Earl all right thanks Linda maybe we

943
00:42:48,349 --> 00:42:45,959
could cue the first animation this is in

944
00:42:50,839 --> 00:42:48,359
typical Cassini scale this is our hour

945
00:42:52,609 --> 00:42:50,849
and a half of terror Mars had their

946
00:42:54,140 --> 00:42:52,619
seven minutes we have an hour and a half

947
00:42:56,239 --> 00:42:54,150
this is us passing through the ring

948
00:42:58,099 --> 00:42:56,249
plane and actually going into orbit

949
00:42:59,250 --> 00:42:58,109
around Saturn if this had not

950
00:43:01,020 --> 00:42:59,260
accomplished

951
00:43:03,780 --> 00:43:01,030
just perfectly we would not be having

952
00:43:05,940 --> 00:43:03,790
talking about the mission today um this

953
00:43:07,890 --> 00:43:05,950
Cassini spacecraft this was nine and a

954
00:43:11,250 --> 00:43:07,900
half years ago is performing absolutely

955
00:43:13,530 --> 00:43:11,260
flawlessly we are in great shape we are

956
00:43:15,390 --> 00:43:13,540
six weeks into our 17th year in flight

957
00:43:18,030 --> 00:43:15,400
is you Carolyn mentioned it to be took

958
00:43:20,370 --> 00:43:18,040
us seven years to get here we're nine

959
00:43:21,960 --> 00:43:20,380
and a half years into our into our

960
00:43:23,370 --> 00:43:21,970
mission and everything's working well if

961
00:43:25,980 --> 00:43:23,380
it said the engineering systems are

962
00:43:27,420 --> 00:43:25,990
working very very well and the

963
00:43:30,000 --> 00:43:27,430

instruments are continuing to turn

964
00:43:33,900 --> 00:43:30,010
phenomenal science with a mission like

965
00:43:35,400 --> 00:43:33,910
this at this level of duration one of

966
00:43:38,490 --> 00:43:35,410
the things the flight teams have to be

967
00:43:40,020 --> 00:43:38,500
very careful about is consumables up the

968
00:43:42,630 --> 00:43:40,030
prime mission for Cassini was seven

969
00:43:45,150 --> 00:43:42,640
years cruise four years in prime mission

970
00:43:47,640 --> 00:43:45,160
and so when you think about us now being

971
00:43:49,350 --> 00:43:47,650
into our 17th year a lot of things are

972
00:43:51,900 --> 00:43:49,360
being used up we have to keep very

973
00:43:54,540 --> 00:43:51,910
careful track of things like power and

974
00:43:56,700 --> 00:43:54,550
on/off cycles instruments are used up

975
00:43:58,920 --> 00:43:56,710
though we don't want them to be overused

976
00:44:00,870 --> 00:43:58,930
one of the things we watch most

977
00:44:04,470 --> 00:44:00,880
carefully as obviously as you can see

978
00:44:06,390 --> 00:44:04,480
here is propellant very very carefully

979
00:44:09,690 --> 00:44:06,400
watching the propellant talk Cassini has

980
00:44:11,730 --> 00:44:09,700
two separate propulsion systems a by

981
00:44:14,700 --> 00:44:11,740
propellant system that powers the main

982
00:44:17,610 --> 00:44:14,710
engine is the graphic shows and we've

983
00:44:19,410 --> 00:44:17,620
used about ninety percent of that during

984
00:44:22,290 --> 00:44:19,420
the prime mission and we used another

985
00:44:23,640 --> 00:44:22,300
six percent of that during the extended

986
00:44:25,770 --> 00:44:23,650
mission in the first two years of the

987
00:44:27,360 --> 00:44:25,780
sole suspicion so right now we've got

988
00:44:30,630 --> 00:44:27,370

about four percent of our propellant

989
00:44:34,560 --> 00:44:30,640
left there's a Jackson Browne song about

990
00:44:36,360 --> 00:44:34,570
that and running on empty is uh is not a

991
00:44:39,230 --> 00:44:36,370
good situation to be in fortunately

992
00:44:41,520 --> 00:44:39,240
we've got another propellant system the

993
00:44:43,830 --> 00:44:41,530
spacecraft is also equipped with a

994
00:44:46,680 --> 00:44:43,840
hydrazine a system that small that

995
00:44:48,240 --> 00:44:46,690
powers the smaller thrusters and they're

996
00:44:50,640 --> 00:44:48,250
used for attitude control and for very

997
00:44:53,040 --> 00:44:50,650
small veneer burns to control our

998
00:44:55,560 --> 00:44:53,050
trajectory the good news is that we've

999
00:44:57,810 --> 00:44:55,570
got of over thirty percent of that

1000
00:44:59,970 --> 00:44:57,820
propellant still left and that is more

1001
00:45:01,350 --> 00:44:59,980
than enough to finish up the mission the

1002
00:45:03,720 --> 00:45:01,360
way we accomplished this and maybe we

1003
00:45:05,760 --> 00:45:03,730
could cue the next video of the way we

1004
00:45:09,300 --> 00:45:05,770
do this is with a very carefully

1005
00:45:11,910 --> 00:45:09,310
designed mission that uses Saturn's

1006
00:45:13,060 --> 00:45:11,920
largest moon Titan in order to bend and

1007
00:45:15,100 --> 00:45:13,070
reshape the trajectory

1008
00:45:17,530 --> 00:45:15,110
should point out as you'll see in this

1009
00:45:19,540 --> 00:45:17,540
graphic no one has ever done anything

1010
00:45:22,390 --> 00:45:19,550
like this before nothing this complex

1011
00:45:24,610 --> 00:45:22,400
what we do is by carefully controlling

1012
00:45:26,620 --> 00:45:24,620
how we fly by Titan we can bend the

1013
00:45:28,570 --> 00:45:26,630

trajectory up bend it down right now you

1014
00:45:31,690 --> 00:45:28,580
can see it's in a very highly inclined

1015
00:45:33,640 --> 00:45:31,700
orbit we can bend it up bend it down we

1016
00:45:36,670 --> 00:45:33,650
can rotate it around we can lengthen it

1017
00:45:39,460 --> 00:45:36,680
we can shorten it by carefully flying by

1018
00:45:41,230 --> 00:45:39,470
Titan we can add or subtract nearly 800

1019
00:45:43,330 --> 00:45:41,240
meters per second to the spacecraft's

1020
00:45:45,160 --> 00:45:43,340
trajectory and pretty much do go

1021
00:45:46,840 --> 00:45:45,170
wherever we want as you can see we've

1022
00:45:49,120 --> 00:45:46,850
spending a lot of time traveling around

1023
00:45:52,150 --> 00:45:49,130
in various parts of the of the Saturn

1024
00:45:54,250 --> 00:45:52,160
system if we've done it very very

1025
00:45:56,080 --> 00:45:54,260
carefully we can actually control the

1026
00:45:58,780 --> 00:45:56,090
trajectory to the point where we need

1027
00:46:01,840 --> 00:45:58,790
very very little propellant as a matter

1028
00:46:03,550 --> 00:46:01,850
of fact we need hardly any and that's

1029
00:46:05,830 --> 00:46:03,560
why this hydrogen system works so well

1030
00:46:07,780 --> 00:46:05,840
what it does require though is very

1031
00:46:11,200 --> 00:46:07,790
meticulous attention from the flight

1032
00:46:13,030 --> 00:46:11,210
team they've got to be so I like to say

1033
00:46:15,310 --> 00:46:13,040
this is a very sporty course because we

1034
00:46:17,080 --> 00:46:15,320
have some little propellant left we've

1035
00:46:18,760 --> 00:46:17,090
got to be very very careful and very

1036
00:46:20,890 --> 00:46:18,770
diligent about managing a few ejector II

1037
00:46:22,720 --> 00:46:20,900
even a slight miss at one of these

1038
00:46:24,970 --> 00:46:22,730

Titans can put us off into a different

1039
00:46:27,340 --> 00:46:24,980
path where we really don't have enough

1040
00:46:31,210 --> 00:46:27,350
repent to get us back on force us into a

1041
00:46:32,560 --> 00:46:31,220
pretty serious redesign which we really

1042
00:46:34,480 --> 00:46:32,570
would be not deal equipped to do at this

1043
00:46:35,920 --> 00:46:34,490
point so we're very careful about it the

1044
00:46:37,870 --> 00:46:35,930
flight team has done an excellent job of

1045
00:46:39,400 --> 00:46:37,880
maintaining trajectory we do very tiny

1046
00:46:41,530 --> 00:46:39,410
maneuvers sometimes when the order of

1047
00:46:43,300 --> 00:46:41,540
maybe a few tens of millimeters per

1048
00:46:48,370 --> 00:46:43,310
second or very carefully tweaked the

1049
00:46:50,200 --> 00:46:48,380
trajectory to manage its its flybys and

1050
00:46:52,390 --> 00:46:50,210
to accomplish the science for the next

1051
00:46:54,100 --> 00:46:52,400
four years so we actually have what we

1052
00:46:57,670 --> 00:46:54,110
would call a margin for the next few

1053
00:46:59,290 --> 00:46:57,680
years um you can see of maybe I'll just

1054
00:47:01,720 --> 00:46:59,300
point a few things here on the animation

1055
00:47:03,040 --> 00:47:01,730
we have highly inclined orbits these

1056
00:47:05,050 --> 00:47:03,050
purple orbits and then we come

1057
00:47:06,130 --> 00:47:05,060
flattening back down now we're coming

1058
00:47:08,680 --> 00:47:06,140
back up as you see in the animation

1059
00:47:10,540 --> 00:47:08,690
flattening it back down we will lower

1060
00:47:13,060 --> 00:47:10,550
this back down for the final as Linda

1061
00:47:16,540 --> 00:47:13,070
pointed out the final set of orbits for

1062
00:47:18,370 --> 00:47:16,550
on Enceladus and then after that we'll

1063
00:47:19,780 --> 00:47:18,380

wind it back up and we're going to do

1064
00:47:22,000 --> 00:47:19,790
something entirely differently that's

1065
00:47:23,500 --> 00:47:22,010
what you can see now the final year of

1066
00:47:25,750 --> 00:47:23,510
the mission will be very very different

1067
00:47:26,800 --> 00:47:25,760
we're going to use the final type of

1068
00:47:28,780 --> 00:47:26,810
life one

1069
00:47:31,930 --> 00:47:28,790
of the last final flight wise Titan

1070
00:47:34,570 --> 00:47:31,940
flybys excuse me to move ourselves in to

1071
00:47:36,130 --> 00:47:34,580
the very edge of the most sensible set

1072
00:47:38,680 --> 00:47:36,140
of the Rings it's called the F ring

1073
00:47:40,690 --> 00:47:38,690
we're going to spend 20 orbits flirting

1074
00:47:43,480 --> 00:47:40,700
with the F ring and then with a lot more

1075
00:47:45,250 --> 00:47:43,490
Titan flyby we're going to if you'll

1076
00:47:46,870 --> 00:47:45,260
permit me a Southern California surfing

1077
00:47:50,950 --> 00:47:46,880
metaphor we're going to shoot the pier

1078
00:47:52,750 --> 00:47:50,960
there is a 1200 my lap between the

1079
00:47:54,970 --> 00:47:52,760
d-ring the interval Saturn ring and

1080
00:47:56,980 --> 00:47:54,980
Saturn's atmosphere and we've done a lot

1081
00:48:00,130 --> 00:47:56,990
of analysis on that area and it looks to

1082
00:48:03,220 --> 00:48:00,140
be very safe not very safe but safe

1083
00:48:04,390 --> 00:48:03,230
enough for us to go through so what

1084
00:48:06,430 --> 00:48:04,400
we're going to do is we're me use the

1085
00:48:08,500 --> 00:48:06,440
one last Titan flyby to push us into

1086
00:48:11,290 --> 00:48:08,510
that gap and we're going to spend 22

1087
00:48:13,450 --> 00:48:11,300
orbits in 22 weeks going through that

1088
00:48:17,140 --> 00:48:13,460

period that space all right here's it

1089
00:48:18,820 --> 00:48:17,150
here's a spacecraft view of this gap as

1090
00:48:20,230 --> 00:48:18,830
you can see we whizzed through very very

1091
00:48:21,850 --> 00:48:20,240
quickly when we traveled about 30

1092
00:48:23,380 --> 00:48:21,860
kilometers per second as we go through

1093
00:48:26,530 --> 00:48:23,390
there we're going to do that 22 times

1094
00:48:28,660 --> 00:48:26,540
are exploring regions that we have never

1095
00:48:30,250 --> 00:48:28,670
seen before in sampling Saturn's

1096
00:48:32,680 --> 00:48:30,260
atmosphere the inner rings of the dust

1097
00:48:34,890 --> 00:48:32,690
and getting gravity measurements that

1098
00:48:39,280 --> 00:48:34,900
we've never been able to accomplish and

1099
00:48:41,710 --> 00:48:39,290
then finally on sep tember 11th 2017

1100
00:48:50,070 --> 00:48:41,720
we're going to use one last titan flyby

1101
00:48:56,740 --> 00:48:53,290
the flyby is going to be such that we

1102
00:48:59,800 --> 00:48:56,750
will you know be irreversibly entering

1103
00:49:02,020 --> 00:48:59,810
into Saturn's atmosphere and in 30 km/s

1104
00:49:04,570 --> 00:49:02,030
the spacecraft will be destroyed almost

1105
00:49:07,600 --> 00:49:04,580
immediately nearly four days after the

1106
00:49:10,000 --> 00:49:07,610
fight flyby um thus the end to an

1107
00:49:12,520 --> 00:49:10,010
incredibly glorious exploration of the

1108
00:49:14,170 --> 00:49:12,530
Saturnian system a legacy of science and

1109
00:49:15,820 --> 00:49:14,180
injured at ax and engineering

1110
00:49:18,820 --> 00:49:15,830
achievements that will I don't believe

1111
00:49:20,290 --> 00:49:18,830
be duplicated for a very long time and I

1112
00:49:22,720 --> 00:49:20,300
think a wealth of information for

1113
00:49:27,270 --> 00:49:22,730

generations to come it's our final

1114
00:49:30,360 --> 00:49:27,280
goodbye to Cassini in September 2017

1115
00:49:32,650 --> 00:49:30,370
excellent eneral I love that picture of

1116
00:49:35,710 --> 00:49:32,660
Cassini kind of being crushed by the

1117
00:49:38,560 --> 00:49:35,720
embrace of Saturn whom it's been

1118
00:49:40,660 --> 00:49:38,570
circling for so long well sounds like

1119
00:49:43,780 --> 00:49:40,670
cocina really has a great to do

1120
00:49:46,210 --> 00:49:43,790
in front of it I have a question this

1121
00:49:49,750 --> 00:49:46,220
one I think Linda can take on Twitter

1122
00:49:53,559 --> 00:49:49,760
from Tim Johnson who is asking on behalf

1123
00:49:56,020 --> 00:49:53,569
of the conex school Damien from this

1124
00:49:59,500 --> 00:49:56,030
glass what kind of storms are common on

1125
00:50:02,170 --> 00:49:59,510
Saturn kinds of storms that are common

1126
00:50:04,990 --> 00:50:02,180
on Saturn we've had one very huge storm

1127
00:50:06,940 --> 00:50:05,000
it started in december 2010 and lasted

1128
00:50:08,710 --> 00:50:06,950
for about nine months so we can have

1129
00:50:11,289 --> 00:50:08,720
huge storms that happen about once every

1130
00:50:13,120 --> 00:50:11,299
thirty years around Saturn we can have

1131
00:50:15,760 --> 00:50:13,130
giant hurricanes at the North and South

1132
00:50:17,589 --> 00:50:15,770
Poles of Saturn and can also have

1133
00:50:19,900 --> 00:50:17,599
smaller vortices there's a region we

1134
00:50:21,520 --> 00:50:19,910
call dragon alley early in the mission

1135
00:50:27,549 --> 00:50:21,530
in the south where we had lots of storms

1136
00:50:29,500 --> 00:50:27,559
and lightning with it I remember you're

1137
00:50:31,930 --> 00:50:29,510
telling me is that these huge storms

1138
00:50:34,000 --> 00:50:31,940

actually occur once every 30 years or

1139
00:50:37,150 --> 00:50:34,010
they had been in the past but did we get

1140
00:50:38,589 --> 00:50:37,160
it early will we get another one it

1141
00:50:41,319 --> 00:50:38,599
turns out that these stars about once

1142
00:50:43,900 --> 00:50:41,329
every 30 years tend to occur closer to

1143
00:50:45,490 --> 00:50:43,910
Saturn solstice and so he got this storm

1144
00:50:48,039 --> 00:50:45,500
a little bit early sort of in Saturn's

1145
00:50:50,319 --> 00:50:48,049
spring and so we wonder perhaps is there

1146
00:50:52,420 --> 00:50:50,329
another giant storm in store or just

1147
00:50:58,000 --> 00:50:52,430
like Earth weather is variable did we

1148
00:51:00,549 --> 00:50:58,010
get our big storm early I'm great okay

1149
00:51:04,270 --> 00:51:00,559
well we've got another question um this

1150
00:51:08,559 --> 00:51:04,280
one I think I'm going to maybe send to

1151
00:51:11,530 --> 00:51:08,569
Carolyn it's uh Reginald on our ustream

1152
00:51:14,710 --> 00:51:11,540
box is asking are the cameras capable of

1153
00:51:19,319 --> 00:51:14,720
gathering spectra to identify chemical

1154
00:51:23,770 --> 00:51:19,329
bond types in the clouds at Saturn um

1155
00:51:27,370 --> 00:51:23,780
cameras generally don't unless they're

1156
00:51:30,730 --> 00:51:27,380
outfitted with a spectrometer and for

1157
00:51:33,510 --> 00:51:30,740
example the bim's instrument is as an

1158
00:51:37,599 --> 00:51:33,520
imaging component and that also has a

1159
00:51:41,170 --> 00:51:37,609
spectrometer with it also in both the

1160
00:51:44,910 --> 00:51:41,180
visual and in the infrared unless you

1161
00:51:49,319 --> 00:51:44,920
have an instrument that can spread the

1162
00:51:52,599 --> 00:51:49,329
light out very finely in wavelengths so

1163
00:51:54,010 --> 00:51:52,609

that you have high resolution in the

1164
00:51:56,920 --> 00:51:54,020
wavelength domain

1165
00:52:00,100 --> 00:51:56,930
you generally can't do a whole lot of

1166
00:52:01,990 --> 00:52:00,110
detailed chemical identification so we

1167
00:52:05,200 --> 00:52:02,000
don't have that with the Cassini cameras

1168
00:52:08,770 --> 00:52:05,210
we have very broad band filters and then

1169
00:52:11,080 --> 00:52:08,780
moderately broadband so we're not so

1170
00:52:14,890 --> 00:52:11,090
much in the business of identifying

1171
00:52:16,690 --> 00:52:14,900
whether or not it's you know well I

1172
00:52:18,100 --> 00:52:16,700
can't even guess right now but we're not

1173
00:52:20,950 --> 00:52:18,110
we're not identifying particular

1174
00:52:23,140 --> 00:52:20,960
chemicals or chemical bonds what we can

1175
00:52:26,260 --> 00:52:23,150
do is we can say that we have an ice on

1176
00:52:28,240 --> 00:52:26,270
the surface that absorbs a lot in the

1177
00:52:31,540 --> 00:52:28,250
infrared but maybe not so much in the

1178
00:52:34,360 --> 00:52:31,550
ultraviolet and in some sense colors is

1179
00:52:38,500 --> 00:52:34,370
really a the spectral information that

1180
00:52:39,760 --> 00:52:38,510
we can get with the cameras you

1181
00:52:41,590 --> 00:52:39,770
mentioned that Cassini actually does

1182
00:52:46,480 --> 00:52:41,600
have other capabilities to do something

1183
00:52:47,980 --> 00:52:46,490
like that oh are you asking you it's

1184
00:52:49,390 --> 00:52:47,990
going to throw it back to Linda just to

1185
00:52:51,910 --> 00:52:49,400
mention it for a second I think you

1186
00:52:54,550 --> 00:52:51,920
might be on mute but does Cassini have

1187
00:52:56,680 --> 00:52:54,560
something else that could do science of

1188
00:52:58,000 --> 00:52:56,690

that type right for composition we have

1189
00:53:00,430 --> 00:52:58,010
an instrument called the composite

1190
00:53:02,200 --> 00:53:00,440
infrared spectrometer it looks in the

1191
00:53:04,030 --> 00:53:02,210
the mid and far I are and it can

1192
00:53:05,980 --> 00:53:04,040
actually make measurements to tell you

1193
00:53:08,140 --> 00:53:05,990
what kind of molecules that you have in

1194
00:53:09,670 --> 00:53:08,150
the atmosphere not only hydrogen which

1195
00:53:11,170 --> 00:53:09,680
is the main constituent of Saturn's

1196
00:53:14,170 --> 00:53:11,180
atmosphere but you can also measure

1197
00:53:16,000 --> 00:53:14,180
things like methane and hydrocarbons it

1198
00:53:18,340 --> 00:53:16,010
can measure those bonds I think that

1199
00:53:19,750 --> 00:53:18,350
we're being asked about so we have that

1200
00:53:21,030 --> 00:53:19,760
with a composite of red spectrometer

1201
00:53:23,860 --> 00:53:21,040
than the visual and infrared

1202
00:53:27,610 --> 00:53:23,870
spectrometer also can make measurements

1203
00:53:29,980 --> 00:53:27,620
of the composition thanks for answering

1204
00:53:33,010 --> 00:53:29,990
those questions Linda and Carolyn so

1205
00:53:35,320 --> 00:53:33,020
I've got another hexagon question for

1206
00:53:37,840 --> 00:53:35,330
cuneo and maybe you can also elaborate

1207
00:53:40,960 --> 00:53:37,850
some more on the storm since I think you

1208
00:53:43,300 --> 00:53:40,970
actually did your dissertation on storms

1209
00:53:46,030 --> 00:53:43,310
on Saturn so here's a question from

1210
00:53:49,120 --> 00:53:46,040
Veronica vixen on twitter is the hexagon

1211
00:53:52,120 --> 00:53:49,130
on the actual surface of Saturn or is it

1212
00:53:55,440 --> 00:53:52,130
an optical illusion or org assets like

1213
00:53:58,600 --> 00:53:55,450

the clouds okay it's definitely not an

1214
00:54:01,180 --> 00:53:58,610
illusion of any kind this is a real real

1215
00:54:06,640 --> 00:54:01,190
feature that does exist and it has been

1216
00:54:07,660 --> 00:54:06,650
there since 1981 it is gas so it's clear

1217
00:54:09,970 --> 00:54:07,670
well

1218
00:54:12,730 --> 00:54:09,980
it's a pattern of cloud so its gaseous

1219
00:54:15,700 --> 00:54:12,740
it's not it's a solid feature that we

1220
00:54:17,770 --> 00:54:15,710
have on the surface of Saturn that is a

1221
00:54:19,809 --> 00:54:17,780
gas giant planet so there's no such

1222
00:54:22,630 --> 00:54:19,819
thing as mountains and valleys or even

1223
00:54:25,390 --> 00:54:22,640
oceans on Saturn what we have is a

1224
00:54:27,250 --> 00:54:25,400
bottomless apples here if you try to

1225
00:54:31,059 --> 00:54:27,260
line on Saturn we're just going to sick

1226
00:54:33,970 --> 00:54:31,069
sick to the core basically the

1227
00:54:36,700 --> 00:54:33,980
atmosphere there's no solid ground we

1228
00:54:39,579 --> 00:54:36,710
can stand on but the hexagon is a real

1229
00:54:42,400 --> 00:54:39,589
feature it is a jet stream as I said

1230
00:54:44,470 --> 00:54:42,410
earlier it is folded it into six sided

1231
00:54:46,569 --> 00:54:44,480
shape and it is a very stable features

1232
00:54:49,140 --> 00:54:46,579
that is a surprising part of it and we

1233
00:54:51,490 --> 00:54:49,150
are starting to study that feature and

1234
00:54:54,010 --> 00:54:51,500
he said there was a question about the

1235
00:55:00,099 --> 00:54:54,020
storm as well or should I just launch

1236
00:55:02,049 --> 00:55:00,109
into the discussion uh well why don't

1237
00:55:04,589 --> 00:55:02,059
you just tell us a little bit more about

1238
00:55:07,839 --> 00:55:04,599

the storm we were talking about how um

1239
00:55:09,849 --> 00:55:07,849
you know they seem to appear once every

1240
00:55:12,460 --> 00:55:09,859
thirty years or so I mean was the storm

1241
00:55:14,109 --> 00:55:12,470
that we saw for instance a couple of

1242
00:55:16,839 --> 00:55:14,119
years ago the biggest that we've ever

1243
00:55:18,819 --> 00:55:16,849
seen a comparable or gotta see what

1244
00:55:21,400 --> 00:55:18,829
perspective right there near storms um

1245
00:55:23,680 --> 00:55:21,410
yeah so did this is a very special kind

1246
00:55:26,500 --> 00:55:23,690
of storms because Saturn is of course

1247
00:55:29,289 --> 00:55:26,510
spherical but what's special about these

1248
00:55:31,539 --> 00:55:29,299
storm is that it lasts so long and it's

1249
00:55:33,970 --> 00:55:31,549
so big that it actually wraps around the

1250
00:55:37,270 --> 00:55:33,980
planet it's a single stronger storm that

1251
00:55:40,180 --> 00:55:37,280
blows up on once once one spot but the

1252
00:55:42,309 --> 00:55:40,190
cloud extends that so much patterns on

1253
00:55:45,099 --> 00:55:42,319
big time to start with on that big

1254
00:55:46,900 --> 00:55:45,109
planet this storm cloud completely wraps

1255
00:55:51,940 --> 00:55:46,910
around the planet so this is a very

1256
00:55:53,589 --> 00:55:51,950
special I'm kind of storm that is that

1257
00:55:55,900 --> 00:55:53,599
actually wrap around the planet yeah

1258
00:55:59,470 --> 00:55:55,910
there's the image so this is I think

1259
00:56:03,160 --> 00:55:59,480
this is an image is from around the

1260
00:56:04,660 --> 00:56:03,170
brewery or march of 2011 and this is

1261
00:56:07,569 --> 00:56:04,670
you're seeing the phase of the storm

1262
00:56:09,870 --> 00:56:07,579
that in which the storm has not wrapped

1263
00:56:13,299 --> 00:56:09,880

around the planet yet at the left end

1264
00:56:15,609 --> 00:56:13,309
this sort of looks like a comment so the

1265
00:56:18,370 --> 00:56:15,619
action thunderstorm the most intense

1266
00:56:19,380 --> 00:56:18,380
intense thunderstorm is happening at the

1267
00:56:23,430 --> 00:56:19,390
left yet

1268
00:56:26,160 --> 00:56:23,440
of this image that's where the stone is

1269
00:56:28,410 --> 00:56:26,170
core is located and then that strong

1270
00:56:30,150 --> 00:56:28,420
cloud is getting blown down when by

1271
00:56:33,089 --> 00:56:30,160
other in jet streams that's surrounding

1272
00:56:35,430 --> 00:56:33,099
the result and so this is about three

1273
00:56:37,890 --> 00:56:35,440
months into the storm so the storm

1274
00:56:40,200 --> 00:56:37,900
started in december of 2010 so i'm

1275
00:56:43,559 --> 00:56:40,210
guessing just as i've seen these

1276
00:56:45,359 --> 00:56:43,569
pictures hundreds of times so it looks

1277
00:56:49,170 --> 00:56:45,369
like a morphology we had it like they're

1278
00:56:51,029 --> 00:56:49,180
very much of 2011 at that phase the

1279
00:56:54,059 --> 00:56:51,039
storm has had wrapped around the planet

1280
00:56:56,039 --> 00:56:54,069
only half of the logic age so it has

1281
00:57:00,319 --> 00:56:56,049
gone around only half of the planet but

1282
00:57:03,140 --> 00:57:00,329
in june of 2011 the storms head actually

1283
00:57:07,079 --> 00:57:03,150
caught up with the tail of the storm and

1284
00:57:09,569 --> 00:57:07,089
then when this one the head bit the pale

1285
00:57:12,029 --> 00:57:09,579
somehow the head disappeared so that was

1286
00:57:14,490 --> 00:57:12,039
really exciting event that we were not

1287
00:57:17,069 --> 00:57:14,500
expecting it to happen that way the

1288
00:57:20,670 --> 00:57:17,079

storm lasted for two hundred days at two

1289
00:57:22,769 --> 00:57:20,680
hundred first days and then that when

1290
00:57:24,660 --> 00:57:22,779
the head caught up with a pale the head

1291
00:57:25,769 --> 00:57:24,670
actually disintegrated and that's how

1292
00:57:30,420 --> 00:57:25,779
the song ended so that was really

1293
00:57:33,210 --> 00:57:30,430
dramatic either um can I am reenactment

1294
00:57:35,609 --> 00:57:33,220
oh sure okay Carolyn I just want to say

1295
00:57:38,809 --> 00:57:35,619
about this storm another really

1296
00:57:41,279 --> 00:57:38,819
important aspect of it is that they're

1297
00:57:45,059 --> 00:57:41,289
estimating from the lightning strikes

1298
00:57:46,740 --> 00:57:45,069
that occur in it ah the estimate of the

1299
00:57:49,740 --> 00:57:46,750
total amount of energy in this storm

1300
00:57:52,140 --> 00:57:49,750
makes it comparable to the amount of

1301
00:57:53,960 --> 00:57:52,150
energy that's coming out of Saturn so

1302
00:57:56,460 --> 00:57:53,970
that means that this storm in the

1303
00:57:59,370 --> 00:57:56,470
frequency of the storms once every

1304
00:58:01,410 --> 00:57:59,380
thirty years and so on it these storms

1305
00:58:04,019 --> 00:58:01,420
are playing a role in the thermal

1306
00:58:06,120 --> 00:58:04,029
evolution of the planet so that was to

1307
00:58:08,779 --> 00:58:06,130
me as a non atmospheric scientist that

1308
00:58:13,200 --> 00:58:08,789
was one of the most exciting discoveries

1309
00:58:15,150 --> 00:58:13,210
in being there to witness this event

1310
00:58:18,059 --> 00:58:15,160
that happens only once every thirty

1311
00:58:20,190 --> 00:58:18,069
years and it's just another example of

1312
00:58:23,490 --> 00:58:20,200
why it is so important if you really

1313
00:58:25,829 --> 00:58:23,500

want to understand how planets work so

1314
00:58:30,120 --> 00:58:25,839
we need to have ours are robots are

1315
00:58:32,640 --> 00:58:30,130
machinery in orbit around planets might

1316
00:58:33,599 --> 00:58:32,650
give having the time to monitor them in

1317
00:58:38,880 --> 00:58:33,609
order to understand

1318
00:58:40,529 --> 00:58:38,890
them in full thanks Carolyn so we're

1319
00:58:42,359 --> 00:58:40,539
getting a lot of great questions on our

1320
00:58:45,269 --> 00:58:42,369
social media outlets and in fact you're

1321
00:58:48,660 --> 00:58:45,279
getting some budget questions like from

1322
00:58:50,609 --> 00:58:48,670
crystal on Google+ about the given the

1323
00:58:53,220 --> 00:58:50,619
announcement of restructuring of NASA's

1324
00:58:56,400 --> 00:58:53,230
planetary sciences what's the future of

1325
00:58:58,529 --> 00:58:56,410
Cassini uh you know I think that these

1326
00:59:01,470 --> 00:58:58,539
are all great questions and we don't yet

1327
00:59:04,049 --> 00:59:01,480
know the answers we have a lot yet to

1328
00:59:06,870 --> 00:59:04,059
learn Saturn and you know we hope the

1329
00:59:08,069 --> 00:59:06,880
mission continues through 2017 but you

1330
00:59:09,989 --> 00:59:08,079
know you can always ask your questions

1331
00:59:11,640 --> 00:59:09,999
to NASA headquarters they're the folks

1332
00:59:14,970 --> 00:59:11,650
that make the decisions about the budget

1333
00:59:17,239 --> 00:59:14,980
so we're going to do one last question

1334
00:59:20,700 --> 00:59:17,249
and this one I'm going to throw to Earl

1335
00:59:25,019 --> 00:59:20,710
we have a question from at the real jet

1336
00:59:26,729 --> 00:59:25,029
jab on Twitter and so he's asked how

1337
00:59:29,220 --> 00:59:26,739
many more years of operation do we

1338
00:59:30,720 --> 00:59:29,230

expect to get from the cassini probe so

1339
00:59:34,079 --> 00:59:30,730
I know that we've got this kind of

1340
00:59:36,509 --> 00:59:34,089
planned dive into Saturn and 2017 but

1341
00:59:39,120 --> 00:59:36,519
you know how we basically eked out the

1342
00:59:43,079 --> 00:59:39,130
last fumes here on kissena or could it

1343
00:59:46,170 --> 00:59:43,089
go for longer we could maybe go a little

1344
00:59:48,660 --> 00:59:46,180
bit longer but not much one of the very

1345
00:59:51,569 --> 00:59:48,670
important things about end of mission of

1346
00:59:54,660 --> 00:59:51,579
scenarios with these probes that are

1347
00:59:58,289 --> 00:59:54,670
exploring systems that have potentially

1348
01:00:01,799 --> 00:59:58,299
prebiotic environments like Enceladus

1349
01:00:03,720 --> 01:00:01,809
Titan or in case of Euro Europa Jupiter

1350
01:00:06,239 --> 01:00:03,730
is that we must dispose of the

1351
01:00:08,309 --> 01:00:06,249
spacecraft cleanly and so we can't just

1352
01:00:10,289 --> 01:00:08,319
let it run out of propellant and drift

1353
01:00:12,630 --> 01:00:10,299
aimlessly in the system we have to have

1354
01:00:14,880 --> 01:00:12,640
enough margin left in the system to

1355
01:00:16,769 --> 01:00:14,890
dispose of it properly and that is in

1356
01:00:19,229 --> 01:00:16,779
into Saturn's atmosphere where it can't

1357
01:00:21,749 --> 01:00:19,239
you know possibly contaminate anything

1358
01:00:24,390 --> 01:00:21,759
so we could maybe eke out a little bit

1359
01:00:26,549 --> 01:00:24,400
more but we've got it planned now to the

1360
01:00:28,289 --> 01:00:26,559
point where it's just it's a perfect

1361
01:00:31,440 --> 01:00:28,299
into the mission will have very little

1362
01:00:36,599 --> 01:00:31,450
propellant left and that's I think the

1363
01:00:38,249 --> 01:00:36,609

best way for us to proceed great well

1364
01:00:39,989 --> 01:00:38,259
we've had a really wonderful google

1365
01:00:43,170 --> 01:00:39,999
hangout thank you to everybody who's

1366
01:00:44,670 --> 01:00:43,180
participated you know the conversation

1367
01:00:46,799 --> 01:00:44,680
doesn't have to stop here we can

1368
01:00:47,430 --> 01:00:46,809
continue to work on all the questions

1369
01:00:50,550 --> 01:00:47,440
that we can get

1370
01:00:53,940 --> 01:00:50,560
to on social media Cassini has a twitter

1371
01:00:57,059 --> 01:00:53,950
account at Cassini Saturn we also have

1372
01:00:58,740 --> 01:00:57,069
the web pages and we've got a slate sort

1373
01:01:00,829 --> 01:00:58,750
of showing you how you can keep in

1374
01:01:02,730 --> 01:01:00,839
contact with us cuneo has also

1375
01:01:04,380 --> 01:01:02,740
volunteered to answer some more

1376
01:01:07,440 --> 01:01:04,390
questions on his Twitter account and

1377
01:01:09,450 --> 01:01:07,450
that's at windy planets so thank you

1378
01:01:11,280 --> 01:01:09,460
very much to everybody who participated

1379
01:01:13,500 --> 01:01:11,290
in our show and asked us questions and

1380
01:01:14,970 --> 01:01:13,510
we hope you guys will hear some more

1381
01:01:22,410 --> 01:01:14,980
about the wonderful things that cassini

1382
01:01:26,910 --> 01:01:22,420
is doing thanks everyone that turned out

1383
01:01:39,650 --> 01:01:26,920
that we have to be off right 130 so we