
THE SATURN SYSTEM
CASSINI-HUYGENS
MISSION TO SATURN
GRAND FINALE 09-15-17

1
00:00:07,349 --> 00:00:05,430
hello and welcome to nasa's jet

2
00:00:09,589 --> 00:00:07,359
propulsion laboratory in pasadena

3
00:00:11,910 --> 00:00:09,599
california i'm preston dykes

4
00:00:13,669 --> 00:00:11,920
well we are at the end of an era in

5
00:00:15,910 --> 00:00:13,679
planetary exploration

6
00:00:18,310 --> 00:00:15,920
in less than two days nasa's cassini

7
00:00:20,550 --> 00:00:18,320
spacecraft will make a fateful final

8
00:00:22,310 --> 00:00:20,560
plunge into the atmosphere of saturn

9
00:00:25,189 --> 00:00:22,320
collecting data until the very last

10
00:00:26,790 --> 00:00:25,199
moment as it ends its 13-year tour of

11
00:00:28,390 --> 00:00:26,800
the saturn system

12
00:00:29,990 --> 00:00:28,400
the purpose of our briefing today is to

13
00:00:32,549 --> 00:00:30,000

provide background on how we got here

14
00:00:34,709 --> 00:00:32,559
with cassini along with preparations for

15
00:00:35,910 --> 00:00:34,719
the final plunge and some of the science

16
00:00:39,190 --> 00:00:35,920
that the cassini team helps to

17
00:00:41,350 --> 00:00:39,200
accomplish as cassini heads into saturn

18
00:00:42,950 --> 00:00:41,360
our participants for the briefing today

19
00:00:44,869 --> 00:00:42,960
are

20
00:00:46,549 --> 00:00:44,879
from nasa headquarters in washington the

21
00:00:49,350 --> 00:00:46,559
director of nasa's planetary science

22
00:00:51,110 --> 00:00:49,360
division jim green

23
00:00:54,709 --> 00:00:51,120
up next we have the program manager for

24
00:00:56,630 --> 00:00:54,719
cassini here at jpl earl mays

25
00:00:59,349 --> 00:00:56,640
to his left the cassini project

26
00:01:02,069 --> 00:00:59,359
scientist linda spilker

27
00:01:03,910 --> 00:01:02,079
and finally team lead for cassini's ion

28
00:01:06,469 --> 00:01:03,920
and neutral mass spectrometer instrument

29
00:01:10,469 --> 00:01:06,479
or inms from southwest research

30
00:01:12,230 --> 00:01:10,479
institute in san antonio hunter weight

31
00:01:14,149 --> 00:01:12,240
all right a reminder to reporters dialed

32
00:01:15,990 --> 00:01:14,159
in on the phones please dial star one to

33
00:01:17,270 --> 00:01:16,000
get in the queue to ask a question and

34
00:01:19,190 --> 00:01:17,280
members of the public as well as the

35
00:01:22,070 --> 00:01:19,200
media can ask questions online via

36
00:01:23,590 --> 00:01:22,080
twitter using the hashtag asknasa and

37
00:01:26,789 --> 00:01:23,600
with that let's turn it over to jim to

38
00:01:28,310 --> 00:01:26,799

get started thank you very much preston

39
00:01:29,590 --> 00:01:28,320
you know we're here at a very historic

40
00:01:31,670 --> 00:01:29,600
time

41
00:01:34,469 --> 00:01:31,680
but it really started with the voyagers

42
00:01:36,550 --> 00:01:34,479
voyager one and two is uh as we see here

43
00:01:37,590 --> 00:01:36,560
in the in the auditorium a full-scale

44
00:01:38,710 --> 00:01:37,600
voyager

45
00:01:41,109 --> 00:01:38,720
passing

46
00:01:42,870 --> 00:01:41,119
through the saturn system

47
00:01:45,270 --> 00:01:42,880
begging us to go back

48
00:01:48,230 --> 00:01:45,280
and of course in 2004

49
00:01:50,950 --> 00:01:48,240
cassini made it to the saturn system and

50
00:01:52,710 --> 00:01:50,960
as you can see cassini this is a smaller

51
00:01:55,510 --> 00:01:52,720
scale model but if you can imagine the

52
00:01:56,950 --> 00:01:55,520
antenna size on voyager being the same

53
00:02:00,550 --> 00:01:56,960
as cassini

54
00:02:03,830 --> 00:02:00,560
this is a very capable large

55
00:02:05,190 --> 00:02:03,840
spacecraft that has been making fabulous

56
00:02:07,670 --> 00:02:05,200
measurements

57
00:02:08,869 --> 00:02:07,680
within the saturn system my first slide

58
00:02:11,110 --> 00:02:08,879
please

59
00:02:14,150 --> 00:02:11,120
of course saturn one of the

60
00:02:16,390 --> 00:02:14,160
beautiful gas giants in our solar system

61
00:02:18,470 --> 00:02:16,400
with the beautiful rings but studying

62
00:02:21,030 --> 00:02:18,480
the planet itself has been incredibly

63
00:02:22,949 --> 00:02:21,040

important the cloud dynamics and the

64
00:02:24,390 --> 00:02:22,959
storms that occurred and in fact while

65
00:02:26,630 --> 00:02:24,400
cassini was there

66
00:02:29,670 --> 00:02:26,640
a storm that lasted more than nine

67
00:02:31,430 --> 00:02:29,680
months raged in its northern hemisphere

68
00:02:33,670 --> 00:02:31,440
next slide please

69
00:02:34,550 --> 00:02:33,680
of course as we were able to get to

70
00:02:36,550 --> 00:02:34,560
higher

71
00:02:38,790 --> 00:02:36,560
latitudes we were able to look down at

72
00:02:40,550 --> 00:02:38,800
the polar region and see other

73
00:02:43,589 --> 00:02:40,560
spectacular things

74
00:02:45,990 --> 00:02:43,599
the hint of this hexagon pattern on the

75
00:02:48,470 --> 00:02:46,000
north pole was really observed first by

76
00:02:51,670 --> 00:02:48,480
the voyagers but we're now back to see

77
00:02:53,509 --> 00:02:51,680
that up close and personal the size of

78
00:02:55,990 --> 00:02:53,519
this whole hexagon

79
00:02:57,430 --> 00:02:56,000
which is actually a jet stream on the

80
00:03:01,830 --> 00:02:57,440
outer rim of it

81
00:03:03,990 --> 00:03:01,840
is about twice the size of our earth

82
00:03:06,149 --> 00:03:04,000
in addition to that we had opportunities

83
00:03:08,790 --> 00:03:06,159
to begin to look at the moons

84
00:03:10,309 --> 00:03:08,800
and here other surprises were well in

85
00:03:12,229 --> 00:03:10,319
store for us

86
00:03:13,910 --> 00:03:12,239
as seen in this image

87
00:03:16,390 --> 00:03:13,920
this is enceladus

88
00:03:19,110 --> 00:03:16,400

this is a small moon just outside the

89
00:03:20,949 --> 00:03:19,120
rings of saturn and what we thought was

90
00:03:23,270 --> 00:03:20,959
an icy ball

91
00:03:25,509 --> 00:03:23,280
when we observed the southern hemisphere

92
00:03:29,110 --> 00:03:25,519
and geysers of water

93
00:03:33,190 --> 00:03:29,120
spewing out into the saturn system it

94
00:03:36,550 --> 00:03:33,200
amazed us and began changing the way we

95
00:03:38,229 --> 00:03:36,560
view the habitability or potential

96
00:03:41,350 --> 00:03:38,239
habitability

97
00:03:42,869 --> 00:03:41,360
of moons in the outer part of our solar

98
00:03:44,710 --> 00:03:42,879
system

99
00:03:46,869 --> 00:03:44,720
my next image

100
00:03:48,390 --> 00:03:46,879
of course is the beautiful

101
00:03:50,070 --> 00:03:48,400
titan

102
00:03:51,910 --> 00:03:50,080
this moon is

103
00:03:52,949 --> 00:03:51,920
bigger than the

104
00:03:54,710 --> 00:03:52,959
planet

105
00:03:56,949 --> 00:03:54,720
mercury

106
00:03:58,789 --> 00:03:56,959
it has a atmosphere twice our

107
00:04:02,149 --> 00:03:58,799
atmospheric pressure

108
00:04:04,949 --> 00:04:02,159
if it was orbiting the sun and not

109
00:04:07,750 --> 00:04:04,959
saturn we would call it a planet

110
00:04:10,550 --> 00:04:07,760
it's truly a magnificent body the

111
00:04:13,750 --> 00:04:10,560
voyagers could only see

112
00:04:15,910 --> 00:04:13,760
the haziness of this beautiful object

113
00:04:17,990 --> 00:04:15,920

but with cassini our ability to

114
00:04:19,270 --> 00:04:18,000
penetrate through that haze with our

115
00:04:21,430 --> 00:04:19,280
radars

116
00:04:24,629 --> 00:04:21,440
and seeing what the surface structures

117
00:04:26,629 --> 00:04:24,639
and features are and the issa huygens

118
00:04:27,590 --> 00:04:26,639
probe going all the way down to the

119
00:04:30,310 --> 00:04:27,600
surface

120
00:04:32,950 --> 00:04:30,320
revolutionized our understanding of this

121
00:04:35,110 --> 00:04:32,960
spectacular moon

122
00:04:38,629 --> 00:04:35,120
this is the only other body in the solar

123
00:04:41,749 --> 00:04:38,639
system that has liquid on its surface

124
00:04:43,030 --> 00:04:41,759
its seas are about the size of our own

125
00:04:44,870 --> 00:04:43,040
black sea

126
00:04:48,629 --> 00:04:44,880
now they're not full of water but

127
00:04:51,749 --> 00:04:48,639
they're full of liquid methane

128
00:04:53,510 --> 00:04:51,759
this is a spectacular world in its own

129
00:04:55,430 --> 00:04:53,520
right

130
00:04:56,550 --> 00:04:55,440
next slide please

131
00:04:59,510 --> 00:04:56,560
of course

132
00:05:01,830 --> 00:04:59,520
saturn has more than 60 moons can't see

133
00:05:04,469 --> 00:05:01,840
them all but we saw approximately two

134
00:05:06,710 --> 00:05:04,479
dozen of them in addition to

135
00:05:08,950 --> 00:05:06,720
enceladus and titan

136
00:05:12,550 --> 00:05:08,960
beautiful moons with all sorts of

137
00:05:14,950 --> 00:05:12,560
structures those that even in fact

138
00:05:17,110 --> 00:05:14,960

modify the structure of the rings

139
00:05:19,670 --> 00:05:17,120
creating divisions

140
00:05:22,469 --> 00:05:19,680
are elements that accrete material and

141
00:05:23,350 --> 00:05:22,479
we begin to see all those processes up

142
00:05:25,590 --> 00:05:23,360
close

143
00:05:28,870 --> 00:05:25,600
and personal

144
00:05:30,390 --> 00:05:28,880
but one of the real stars of the show is

145
00:05:37,430 --> 00:05:30,400
titan

146
00:05:39,830 --> 00:05:37,440
about 20 saturn radii away from saturn

147
00:05:42,710 --> 00:05:39,840
allows us to use the very basic

148
00:05:46,070 --> 00:05:42,720
principle of gravity assist to change

149
00:05:47,749 --> 00:05:46,080
the plane of cassini's orbit provide new

150
00:05:50,070 --> 00:05:47,759
views

151
00:05:53,029 --> 00:05:50,080
and therefore observe

152
00:05:55,350 --> 00:05:53,039
in beautiful different ways

153
00:05:58,550 --> 00:05:55,360
uh the next animation

154
00:06:01,350 --> 00:05:58,560
shows you these flybys

155
00:06:04,629 --> 00:06:01,360
now what we'd normally do on flybys is

156
00:06:07,670 --> 00:06:04,639
just get a little idea of what that body

157
00:06:11,270 --> 00:06:07,680
is but these flybys have revolutionized

158
00:06:13,350 --> 00:06:11,280
our opportunity to use this concept for

159
00:06:15,670 --> 00:06:13,360
other missions

160
00:06:17,990 --> 00:06:15,680
we now know from these flybys how to

161
00:06:20,390 --> 00:06:18,000
construct a global view

162
00:06:22,629 --> 00:06:20,400
of this beautiful world and we're using

163
00:06:26,150 --> 00:06:22,639

it on the clipper mission

164
00:06:28,950 --> 00:06:26,160
that's going to jupiter and viewing the

165
00:06:31,830 --> 00:06:28,960
moon europa

166
00:06:34,710 --> 00:06:31,840
cassini has enabled us to make those

167
00:06:37,830 --> 00:06:34,720
future missions possible

168
00:06:40,230 --> 00:06:37,840
my next slide please

169
00:06:43,110 --> 00:06:40,240
americans had a wonderful

170
00:06:45,350 --> 00:06:43,120
view of an eclipse

171
00:06:47,590 --> 00:06:45,360
where the moon passed in front of the

172
00:06:50,790 --> 00:06:47,600
sun last month

173
00:06:53,430 --> 00:06:50,800
millions of people appreciate now what

174
00:06:57,510 --> 00:06:53,440
eclipses are all about

175
00:07:00,950 --> 00:06:57,520
from our view on cassini this is the

176
00:07:04,469 --> 00:07:00,960
eclipse with saturn moving in front of

177
00:07:06,070 --> 00:07:04,479
the sun this allows in the low light of

178
00:07:08,950 --> 00:07:06,080
blocking the sun

179
00:07:11,350 --> 00:07:08,960
opportunities to see in greater detail

180
00:07:14,469 --> 00:07:11,360
the ring structure

181
00:07:17,029 --> 00:07:14,479
and other elements in fact we were even

182
00:07:18,070 --> 00:07:17,039
able to see distant planets and the

183
00:07:21,029 --> 00:07:18,080
earth

184
00:07:23,749 --> 00:07:21,039
in a beautiful set of mosaic mosaic

185
00:07:25,670 --> 00:07:23,759
images that have been stitched together

186
00:07:27,990 --> 00:07:25,680
as shown here

187
00:07:31,110 --> 00:07:28,000
that outer ring that you see is called

188
00:07:33,830 --> 00:07:31,120

the e-ring we're able to illuminate it

189
00:07:36,790 --> 00:07:33,840
in ways that tells us

190
00:07:39,670 --> 00:07:36,800
that enceladus geysers

191
00:07:42,150 --> 00:07:39,680
water that being spewed out is creating

192
00:07:45,189 --> 00:07:42,160
this ring

193
00:07:48,390 --> 00:07:45,199
now because of the importance of

194
00:07:50,629 --> 00:07:48,400
enceladus that cassini has shown us

195
00:07:53,430 --> 00:07:50,639
and of titan

196
00:07:54,629 --> 00:07:53,440
another potential world that could be

197
00:07:58,390 --> 00:07:54,639
habitable

198
00:08:02,070 --> 00:07:58,400
for life perhaps not like we know it but

199
00:08:04,710 --> 00:08:02,080
perhaps completely different than ours

200
00:08:07,909 --> 00:08:04,720
we had to make decisions on how to

201
00:08:09,430 --> 00:08:07,919
dispose of the spacecraft

202
00:08:10,950 --> 00:08:09,440
and that led us

203
00:08:12,469 --> 00:08:10,960
inevitably

204
00:08:15,430 --> 00:08:12,479
to the plan

205
00:08:17,189 --> 00:08:15,440
of taking cassini and plunging it into

206
00:08:19,670 --> 00:08:17,199
saturn

207
00:08:23,749 --> 00:08:19,680
because of planetary protection

208
00:08:27,510 --> 00:08:23,759
and our desire to go back to enceladus

209
00:08:29,270 --> 00:08:27,520
and go back to titan go back to the cas

210
00:08:33,029 --> 00:08:29,280
the saturn system

211
00:08:35,909 --> 00:08:33,039
we must protect those bodies for future

212
00:08:38,949 --> 00:08:38,070
next slide please

213
00:08:41,269 --> 00:08:38,959

well

214
00:08:42,509 --> 00:08:41,279
in the visible camera we've seen more

215
00:08:46,470 --> 00:08:42,519
than

216
00:08:48,550 --> 00:08:46,480
450 000 images

217
00:08:51,269 --> 00:08:48,560
every one of them in their own way or

218
00:08:52,070 --> 00:08:51,279
absolutely spectacular

219
00:08:55,110 --> 00:08:52,080
but

220
00:08:56,470 --> 00:08:55,120
we made the decision to go through and

221
00:09:00,949 --> 00:08:56,480
pick

222
00:09:03,590 --> 00:09:00,959
the top 100 images videos in animation

223
00:09:06,829 --> 00:09:03,600
and create an e-book

224
00:09:08,389 --> 00:09:06,839
something that allows us to go back and

225
00:09:11,030 --> 00:09:08,399
view

226
00:09:14,150 --> 00:09:11,040
what we accomplished and the beautiful

227
00:09:17,110 --> 00:09:14,160
observations that this mission has done

228
00:09:18,470 --> 00:09:17,120
you can download this ebook in several

229
00:09:20,790 --> 00:09:18,480
formats

230
00:09:23,269 --> 00:09:20,800
at nasa.gov

231
00:09:25,190 --> 00:09:23,279
ebooks

232
00:09:27,670 --> 00:09:25,200
so with that

233
00:09:28,870 --> 00:09:27,680
let's learn how

234
00:09:32,389 --> 00:09:28,880
we plan

235
00:09:35,350 --> 00:09:32,399
to plunge cassini into saturn and what

236
00:09:38,470 --> 00:09:35,360
we will learn from that experience

237
00:09:42,389 --> 00:09:38,480
so let me turn it over to earl mays the

238
00:09:43,030 --> 00:09:42,399

project manager for cassini earl thank

239
00:09:49,030 --> 00:09:43,040
you

240
00:09:50,790 --> 00:09:49,040
and uh incredible privilege and pleasure

241
00:09:53,430 --> 00:09:50,800
to operate this spacecraft that before i

242
00:09:55,750 --> 00:09:53,440
go into its demise i'd like to talk just

243
00:09:57,990 --> 00:09:55,760
a little bit about some of its many

244
00:09:58,949 --> 00:09:58,000
accomplishments as jim pointed out

245
00:10:01,110 --> 00:09:58,959
almost

246
00:10:02,949 --> 00:10:01,120
half a billion five i'm sorry half a

247
00:10:06,150 --> 00:10:02,959
million images taken

248
00:10:07,389 --> 00:10:06,160
4.9 billion miles logged on this

249
00:10:10,550 --> 00:10:07,399
spacecraft

250
00:10:13,350 --> 00:10:10,560
635 gigabytes of data played back now

251
00:10:15,750 --> 00:10:13,360
that by modern standards is not a whole

252
00:10:17,670 --> 00:10:15,760
lot bigger than a flash drive but you

253
00:10:19,030 --> 00:10:17,680
got to think about 80s technology from a

254
00:10:21,470 --> 00:10:19,040
billion miles away and that all of a

255
00:10:24,550 --> 00:10:21,480
sudden becomes pretty amazing uh we had

256
00:10:26,630 --> 00:10:24,560
162 targeted flybys and as jim pointed

257
00:10:29,030 --> 00:10:26,640
out we've been using titan to great

258
00:10:30,310 --> 00:10:29,040
advantage and have been 127 of those can

259
00:10:32,790 --> 00:10:30,320
i have the first graphic please just to

260
00:10:34,389 --> 00:10:32,800
show you this incredible spacecraft now

261
00:10:36,389 --> 00:10:34,399
as as um

262
00:10:38,230 --> 00:10:36,399
it's half twice again the size of the

263
00:10:40,310 --> 00:10:38,240

model in in this auditorium if you're

264
00:10:42,949 --> 00:10:40,320
here but it's absolutely absolutely

265
00:10:44,949 --> 00:10:42,959
splendid just a a built for saturn and

266
00:10:47,990 --> 00:10:44,959
of course that's the iconic

267
00:10:50,470 --> 00:10:48,000
north pole of saturn uh below it now

268
00:10:52,550 --> 00:10:50,480
that is an animation we did not take a

269
00:10:53,430 --> 00:10:52,560
selfie stick with us although those

270
00:10:55,030 --> 00:10:53,440
those

271
00:10:57,350 --> 00:10:55,040
we could have put one on the rpws

272
00:10:58,949 --> 00:10:57,360
antenna in hindsight that again was

273
00:11:01,269 --> 00:10:58,959
something that the 90s didn't know about

274
00:11:04,949 --> 00:11:01,279
so we'll have to have to live walmart

275
00:11:07,269 --> 00:11:04,959
but again it's just been almost flawless

276
00:11:09,509 --> 00:11:07,279
operations in both the instruments

277
00:11:11,190 --> 00:11:09,519
and the spacecraft

278
00:11:13,750 --> 00:11:11,200
engineering systems and then the ground

279
00:11:15,910 --> 00:11:13,760
support itself again has just i think

280
00:11:17,990 --> 00:11:15,920
made this mission not only do we have an

281
00:11:19,590 --> 00:11:18,000
environment that just is

282
00:11:21,509 --> 00:11:19,600
overwhelming with abundance of

283
00:11:22,949 --> 00:11:21,519
scientific mysteries and puzzles we've

284
00:11:25,590 --> 00:11:22,959
had a spacecraft in the team that could

285
00:11:27,590 --> 00:11:25,600
exploit it so again i will probably come

286
00:11:28,389 --> 00:11:27,600
back to that point but it's just been an

287
00:11:32,389 --> 00:11:28,399
amazing

288
00:11:34,069 --> 00:11:32,399

do let's get to

289
00:11:35,350 --> 00:11:34,079
the last few

290
00:11:37,910 --> 00:11:35,360
few hours

291
00:11:41,110 --> 00:11:37,920
could i have the next animation

292
00:11:43,750 --> 00:11:41,120
this is the so-called ball of yarn what

293
00:11:45,670 --> 00:11:43,760
we do as jim pointed out we we have a

294
00:11:48,150 --> 00:11:45,680
main engine and it's a great main engine

295
00:11:50,550 --> 00:11:48,160
but we've got titan and titan is a

296
00:11:52,870 --> 00:11:50,560
phenomenal main engine every time every

297
00:11:54,310 --> 00:11:52,880
time we fly by titan every time we fly

298
00:11:56,550 --> 00:11:54,320
by titan

299
00:11:58,230 --> 00:11:56,560
we get a little bit better view of titan

300
00:12:00,470 --> 00:11:58,240
and we get a little bit better view of

301
00:12:03,190 --> 00:12:00,480
the saturn system every one of those

302
00:12:05,750 --> 00:12:03,200
course changes every orbit change there

303
00:12:09,670 --> 00:12:05,760
is titan's doing it for us and it's done

304
00:12:11,750 --> 00:12:09,680
for us for 294 different orbits 127

305
00:12:14,230 --> 00:12:11,760
times we've made major orbital changes

306
00:12:16,550 --> 00:12:14,240
and titan's been at the center of every

307
00:12:17,990 --> 00:12:16,560
one of them so that's the ball of yarn

308
00:12:19,910 --> 00:12:18,000
and if i could go to the next one let me

309
00:12:21,509 --> 00:12:19,920
just show you what titan did for us this

310
00:12:23,829 --> 00:12:21,519
is april

311
00:12:26,470 --> 00:12:23,839
all the time we've been outside the

312
00:12:28,230 --> 00:12:26,480
rings and being very very careful with

313
00:12:29,990 --> 00:12:28,240

the rings and with the dust because we

314
00:12:32,310 --> 00:12:30,000
really didn't understand the environment

315
00:12:34,230 --> 00:12:32,320
well but for the grand finale in order

316
00:12:35,990 --> 00:12:34,240
to exploit every last ounce of our

317
00:12:37,990 --> 00:12:36,000
propellant and the science that that

318
00:12:39,910 --> 00:12:38,000
saturn offered inside we've been in what

319
00:12:41,990 --> 00:12:39,920
we've been calling the solst the

320
00:12:44,389 --> 00:12:42,000
proximal orbits or the grand finale

321
00:12:46,710 --> 00:12:44,399
titan gave us one last little nudge back

322
00:12:48,949 --> 00:12:46,720
in april and pushed us the cassini

323
00:12:51,910 --> 00:12:48,959
spacecraft between

324
00:12:53,670 --> 00:12:51,920
the rings and the planet itself and

325
00:12:56,550 --> 00:12:53,680
we've been skirting back and forth and

326
00:12:58,150 --> 00:12:56,560
back from that sense for 22 times since

327
00:13:00,629 --> 00:12:58,160
since april

328
00:13:02,870 --> 00:13:00,639
our last one unfortunately was was

329
00:13:04,389 --> 00:13:02,880
saturday morning we had our saturday

330
00:13:05,910 --> 00:13:04,399
evening actually we got the call back on

331
00:13:07,190 --> 00:13:05,920
saturday morning we don't normally

332
00:13:08,870 --> 00:13:07,200
communicate with the spacecraft during

333
00:13:11,110 --> 00:13:08,880
these passages because the science is so

334
00:13:12,790 --> 00:13:11,120
precious we were busy gathering that so

335
00:13:15,430 --> 00:13:12,800
the call home was saturday morning we

336
00:13:17,030 --> 00:13:15,440
were here got the call home spacecraft's

337
00:13:18,470 --> 00:13:17,040
fine it did it again the way it always

338
00:13:20,310 --> 00:13:18,480

has

339
00:13:24,150 --> 00:13:20,320
monday we got the kiss goodbye from

340
00:13:26,870 --> 00:13:24,160
titan 119 000 kilometer altitude flyby

341
00:13:28,069 --> 00:13:26,880
from titan took about 39 meters per

342
00:13:30,629 --> 00:13:28,079
second of velocity away from the

343
00:13:32,470 --> 00:13:30,639
spacecraft slowed it down just enough

344
00:13:34,389 --> 00:13:32,480
that what's going to happen on friday is

345
00:13:36,710 --> 00:13:34,399
absolutely inevitable so if i could go

346
00:13:38,069 --> 00:13:36,720
to that next animation um just to show

347
00:13:40,150 --> 00:13:38,079
this

348
00:13:42,150 --> 00:13:40,160
there is a graphic here see that titan

349
00:13:43,750 --> 00:13:42,160
flyby no i that's behind me i should be

350
00:13:46,870 --> 00:13:43,760
pointing that little titan flyby was

351
00:13:48,629 --> 00:13:46,880
enough to put us into the into saturn it

352
00:13:51,030 --> 00:13:48,639
was just distant enough just close

353
00:13:52,870 --> 00:13:51,040
enough and just the right orientation to

354
00:13:54,550 --> 00:13:52,880
seal cassini's fade

355
00:13:56,629 --> 00:13:54,560
so what's going to happen next if i can

356
00:13:59,110 --> 00:13:56,639
get the next graphic please

357
00:14:00,550 --> 00:13:59,120
we made contact with cassini for the

358
00:14:03,189 --> 00:14:00,560
last time

359
00:14:05,670 --> 00:14:03,199
i mean from the penultimate time we

360
00:14:07,670 --> 00:14:05,680
seized contact about 6 50 this morning

361
00:14:08,949 --> 00:14:07,680
after the titan flyby we got a call home

362
00:14:11,910 --> 00:14:08,959
last night we were all in the mission

363
00:14:14,470 --> 00:14:11,920

support area waiting for telemetry as it

364
00:14:17,269 --> 00:14:14,480
has done over and over again cassini

365
00:14:19,110 --> 00:14:17,279
came in on time and in perfect shape it

366
00:14:21,509 --> 00:14:19,120
got the flyby that it needed it got the

367
00:14:23,829 --> 00:14:21,519
velocity change it needed and it's now

368
00:14:25,110 --> 00:14:23,839
on its way into uh

369
00:14:27,750 --> 00:14:25,120
into

370
00:14:30,310 --> 00:14:27,760
saturn but before it goes

371
00:14:31,350 --> 00:14:30,320
about 6 50 this morning it turned off of

372
00:14:32,310 --> 00:14:31,360
earth

373
00:14:35,110 --> 00:14:32,320
back

374
00:14:37,350 --> 00:14:35,120
to the job it's been at for the last 13

375
00:14:38,949 --> 00:14:37,360
years observing the saturn system it's

376
00:14:41,350 --> 00:14:38,959
going to be taking the last set of

377
00:14:43,670 --> 00:14:41,360
pictures of some of the prime targets

378
00:14:45,110 --> 00:14:43,680
that it's visited over the many

379
00:14:47,430 --> 00:14:45,120
years that has been at saturn and we'll

380
00:14:50,069 --> 00:14:47,440
be able to share those with you sometime

381
00:14:52,470 --> 00:14:50,079
on friday they'll be coming back

382
00:14:54,230 --> 00:14:52,480
tomorrow about 2 45 tomorrow afternoon

383
00:14:57,350 --> 00:14:54,240
cassini is going to turn back

384
00:14:59,750 --> 00:14:57,360
and play back those final sets of images

385
00:15:01,829 --> 00:14:59,760
we figure that to take about 11 hours so

386
00:15:04,710 --> 00:15:01,839
at about one o'clock in the morning of

387
00:15:05,990 --> 00:15:04,720
friday uh september 15th

388
00:15:07,430 --> 00:15:06,000

we will

389
00:15:10,790 --> 00:15:07,440
the solid state recorders onboard

390
00:15:13,110 --> 00:15:10,800
cassini will be empty and we will

391
00:15:14,069 --> 00:15:13,120
then reconfigures cassini for its very

392
00:15:15,350 --> 00:15:14,079
final

393
00:15:18,389 --> 00:15:15,360
transmissions

394
00:15:20,870 --> 00:15:18,399
what we're going to do is uh cassini is

395
00:15:23,350 --> 00:15:20,880
normally a mission that stores things on

396
00:15:25,189 --> 00:15:23,360
data it's like like it's doing right now

397
00:15:26,870 --> 00:15:25,199
we're not in contact we could look all

398
00:15:28,069 --> 00:15:26,880
we wanted and cassini's off busy doing

399
00:15:29,670 --> 00:15:28,079
its own thing

400
00:15:32,230 --> 00:15:29,680
stores it on the recorders and then

401
00:15:33,829 --> 00:15:32,240
plays it back later it's doing that

402
00:15:35,670 --> 00:15:33,839
right now but

403
00:15:37,269 --> 00:15:35,680
next friday morning we're going to turn

404
00:15:39,990 --> 00:15:37,279
cassini into what we call essentially a

405
00:15:41,590 --> 00:15:40,000
bent pipe transmission system everything

406
00:15:42,949 --> 00:15:41,600
that comes from the instruments is going

407
00:15:45,030 --> 00:15:42,959
to go right into the recorder and right

408
00:15:46,550 --> 00:15:45,040
back out so there'll be a few seconds

409
00:15:48,949 --> 00:15:46,560
delay but it's essentially now a

410
00:15:51,670 --> 00:15:48,959
real-time instrument and that's to

411
00:15:53,910 --> 00:15:51,680
enable this the uh sampling instruments

412
00:15:56,550 --> 00:15:53,920
this particular the ion net ion and

413
00:15:58,470 --> 00:15:56,560

neutral mass spectrometer to get data as

414
00:16:00,710 --> 00:15:58,480
deep into the atmosphere as cassini can

415
00:16:02,710 --> 00:16:00,720
permit it we've taken our data rate down

416
00:16:04,310 --> 00:16:02,720
to as low as we can handle so that no

417
00:16:06,150 --> 00:16:04,320
matter what antenna we've got on the

418
00:16:08,230 --> 00:16:06,160
ground we'll be able to receive it so if

419
00:16:10,949 --> 00:16:08,240
it's a rainy day

420
00:16:12,949 --> 00:16:10,959
at the um in canberra in australia where

421
00:16:14,550 --> 00:16:12,959
we'll be tracked then we'll be able to

422
00:16:17,030 --> 00:16:14,560
have a better chance of getting the data

423
00:16:19,189 --> 00:16:17,040
we've also got antennas both at the dsn

424
00:16:21,670 --> 00:16:19,199
tracking plan stations on the east side

425
00:16:23,910 --> 00:16:21,680
of australia but also we've got the new

426
00:16:25,350 --> 00:16:23,920
issa station standing at the ready on

427
00:16:27,350 --> 00:16:25,360
the west side so if we've got a rainy

428
00:16:29,110 --> 00:16:27,360
day over the entire continent well we're

429
00:16:31,829 --> 00:16:29,120
out of luck but as best we can do we've

430
00:16:33,350 --> 00:16:31,839
got ourselves covered

431
00:16:35,829 --> 00:16:33,360
we will torn

432
00:16:38,310 --> 00:16:35,839
at that point also to make sure that the

433
00:16:39,670 --> 00:16:38,320
high gain antenna the

434
00:16:41,430 --> 00:16:39,680
large dish you see there is pointed

435
00:16:43,269 --> 00:16:41,440
directly at the earth and then we've

436
00:16:45,590 --> 00:16:43,279
rotated the spacecraft so the ion

437
00:16:47,749 --> 00:16:45,600
neutral mass spectrometer's aperture is

438
00:16:49,110 --> 00:16:47,759

pointing directly into the oncoming

439
00:16:50,870 --> 00:16:49,120
atmosphere so essentially it's getting

440
00:16:52,230 --> 00:16:50,880
just a full blast of the atmosphere as

441
00:16:53,030 --> 00:16:52,240
it comes in

442
00:16:55,509 --> 00:16:53,040
um

443
00:16:57,749 --> 00:16:55,519
so how are we gonna the last few minutes

444
00:17:00,389 --> 00:16:57,759
cassini is not built for atmosphere as

445
00:17:03,509 --> 00:17:00,399
you might imagine we we were we're we're

446
00:17:04,710 --> 00:17:03,519
a deep deep vaping kind of probe let's

447
00:17:05,909 --> 00:17:04,720
not say we have it hasn't seen

448
00:17:07,669 --> 00:17:05,919
atmosphere we've flown into the

449
00:17:10,630 --> 00:17:07,679
atmosphere of titan we've used the

450
00:17:12,710 --> 00:17:10,640
thrusters to battle that prop uh the the

451
00:17:14,309 --> 00:17:12,720
torques and the drag forces that we've

452
00:17:16,549 --> 00:17:14,319
had to deal with and they've been very

453
00:17:17,990 --> 00:17:16,559
effective at it so we know how to fly

454
00:17:19,270 --> 00:17:18,000
into a little bit of atmosphere and

455
00:17:21,110 --> 00:17:19,280
we've been doing that for the last five

456
00:17:23,110 --> 00:17:21,120
orbits we've actually been dipping our

457
00:17:24,949 --> 00:17:23,120
toes down into saturn's atmosphere for

458
00:17:27,110 --> 00:17:24,959
the last five orbits and the thrusters

459
00:17:28,390 --> 00:17:27,120
have had to fight back at what we call a

460
00:17:30,070 --> 00:17:28,400
duty cycle

461
00:17:31,909 --> 00:17:30,080
at 100 percent they're working as hard

462
00:17:34,230 --> 00:17:31,919
as they possibly can they've been up to

463
00:17:37,110 --> 00:17:34,240

the 40s so we really have been working

464
00:17:38,950 --> 00:17:37,120
the atmospheric effects to some extent

465
00:17:40,789 --> 00:17:38,960
we have a good sense of these but these

466
00:17:43,270 --> 00:17:40,799
are really tiny thrusters they're built

467
00:17:46,310 --> 00:17:43,280
to move a school bus by just kind of

468
00:17:47,590 --> 00:17:46,320
tapping it so they're just not not going

469
00:17:49,430 --> 00:17:47,600
to be able to do that i think i'm

470
00:17:51,750 --> 00:17:49,440
getting a 1 8 pound

471
00:17:53,590 --> 00:17:51,760
so this is just you know you're you you

472
00:17:54,470 --> 00:17:53,600
keep touching something pressing out a

473
00:17:56,470 --> 00:17:54,480
little bit it's about an eighth of a

474
00:17:57,990 --> 00:17:56,480
pound you can imagine what these things

475
00:18:00,549 --> 00:17:58,000
those thrusters have to do in order to

476
00:18:02,230 --> 00:18:00,559
deal with the atmosphere of cassini so

477
00:18:03,190 --> 00:18:02,240
before i go on to the next animation let

478
00:18:05,990 --> 00:18:03,200
me just

479
00:18:09,350 --> 00:18:06,000
point out one final moment

480
00:18:11,029 --> 00:18:09,360
here and at 4 55 a.m pacific daylight

481
00:18:12,870 --> 00:18:11,039
time loss of signal and what's going to

482
00:18:15,270 --> 00:18:12,880
happen is the thrusters will eventually

483
00:18:16,950 --> 00:18:15,280
be overpowered by the atmosphere we

484
00:18:19,029 --> 00:18:16,960
won't watch cassini burn up what we'll

485
00:18:20,470 --> 00:18:19,039
watch it do is slowly turn away from us

486
00:18:22,789 --> 00:18:20,480
and we'll watch the indicator on the

487
00:18:24,310 --> 00:18:22,799
radio science displays that will go down

488
00:18:26,870 --> 00:18:24,320

flat and

489
00:18:28,710 --> 00:18:26,880
essentially loss of signal the mission

490
00:18:30,150 --> 00:18:28,720
will be over within a minute later

491
00:18:33,110 --> 00:18:30,160
there's it's going so fast and the

492
00:18:35,270 --> 00:18:33,120
atmosphere is thickening so quickly that

493
00:18:37,590 --> 00:18:35,280
cassini will be vaporized in

494
00:18:39,669 --> 00:18:37,600
in a few i think maybe 100 maybe two

495
00:18:41,750 --> 00:18:39,679
minutes but i think more like one so

496
00:18:44,310 --> 00:18:41,760
it's really it's just inevitable it's

497
00:18:47,430 --> 00:18:44,320
going in very fast very steep uh let's

498
00:18:50,789 --> 00:18:47,440
go to the next image just for fun to see

499
00:18:53,909 --> 00:18:50,799
there's the timeline of the last 90

500
00:18:55,830 --> 00:18:53,919
seconds of cassini every 10 seconds tick

501
00:18:57,909 --> 00:18:55,840
mark there and that really that tick

502
00:18:58,789 --> 00:18:57,919
mark as you can see the final one on my

503
00:19:01,669 --> 00:18:58,799
right

504
00:19:03,669 --> 00:19:01,679
is um on my left up there i believe uh

505
00:19:06,230 --> 00:19:03,679
is where we will lose signal so you can

506
00:19:07,590 --> 00:19:06,240
see very very tenuous atmosphere where

507
00:19:09,190 --> 00:19:07,600
essentially

508
00:19:10,950 --> 00:19:09,200
the analog of that might be on earth

509
00:19:13,029 --> 00:19:10,960
that's about where the international

510
00:19:15,029 --> 00:19:13,039
space station is relative to internet

511
00:19:16,870 --> 00:19:15,039
density it's very very thin air the

512
00:19:18,870 --> 00:19:16,880
cassini's going so fast and the

513
00:19:20,710 --> 00:19:18,880

thrusters are so

514
00:19:22,630 --> 00:19:20,720
modest for this sort of requirement it's

515
00:19:24,470 --> 00:19:22,640
just not going to last much longer but

516
00:19:25,669 --> 00:19:24,480
you can see that about 70 seconds 60

517
00:19:28,070 --> 00:19:25,679
seconds in the thrusters are going to

518
00:19:29,350 --> 00:19:28,080
start to fight for the last minute or so

519
00:19:31,350 --> 00:19:29,360
they will be fighting the atmosphere

520
00:19:33,510 --> 00:19:31,360
increasingly increasingly as it tries to

521
00:19:36,070 --> 00:19:33,520
turn cassini into a more

522
00:19:36,789 --> 00:19:36,080
aerodynamically compatible shape

523
00:19:38,390 --> 00:19:36,799
and

524
00:19:41,029 --> 00:19:38,400
eventually they will they'll overcome so

525
00:19:42,710 --> 00:19:41,039
if i could see the last graphic please

526
00:19:44,549 --> 00:19:42,720
this is an animation and so there's

527
00:19:46,549 --> 00:19:44,559
cassini coming in this is about that

528
00:19:49,909 --> 00:19:46,559
point you can see we're starting this is

529
00:19:51,190 --> 00:19:49,919
again a bit a bit of a artistic license

530
00:19:53,029 --> 00:19:51,200
here but the thrusters as you can see

531
00:19:55,510 --> 00:19:53,039
down off those extensions on the bottom

532
00:19:57,750 --> 00:19:55,520
are fighting extremely hard to take the

533
00:19:58,870 --> 00:19:57,760
keep the antenna pointed directly at the

534
00:20:00,310 --> 00:19:58,880
earth and you can see it's going to

535
00:20:02,070 --> 00:20:00,320
start to feel the vibration of some of

536
00:20:03,510 --> 00:20:02,080
the atmospheric torques but it will

537
00:20:05,029 --> 00:20:03,520
fight and it will fight and will fight

538
00:20:07,270 --> 00:20:05,039

the mass spectrometer is pointing into

539
00:20:08,950 --> 00:20:07,280
the atmosphere the antenna is pointing

540
00:20:14,149 --> 00:20:08,960
at the earth and it's going to do that

541
00:20:16,390 --> 00:20:15,190
we've

542
00:20:17,990 --> 00:20:16,400
those of you have been following this

543
00:20:19,430 --> 00:20:18,000
story for a little while might have

544
00:20:21,909 --> 00:20:19,440
noticed that we've been a little bit

545
00:20:23,430 --> 00:20:21,919
ambivalent about when cassini's actually

546
00:20:24,549 --> 00:20:23,440
going to lose signal

547
00:20:27,029 --> 00:20:24,559
one of the

548
00:20:28,310 --> 00:20:27,039
wonders and mysteries of saturn is uh

549
00:20:30,630 --> 00:20:28,320
that we

550
00:20:32,310 --> 00:20:30,640
are always surprised and we thought we

551
00:20:35,190 --> 00:20:32,320
knew what the atmosphere was all about

552
00:20:36,470 --> 00:20:35,200
we had models that told us we were not

553
00:20:38,950 --> 00:20:36,480
perhaps not going to get enough

554
00:20:40,230 --> 00:20:38,960
atmosphere to even satisfy the ims

555
00:20:41,909 --> 00:20:40,240
requirements

556
00:20:44,789 --> 00:20:41,919
during the last

557
00:20:46,549 --> 00:20:44,799
five orbits we had plans to pop down

558
00:20:48,470 --> 00:20:46,559
into the atmosphere and if it was too

559
00:20:50,630 --> 00:20:48,480
thick we had plans to pop up

560
00:20:51,909 --> 00:20:50,640
and pop up again and pop down in order

561
00:20:53,669 --> 00:20:51,919
to get this thing fine-tuned well it was

562
00:20:55,830 --> 00:20:53,679
turned out to be absolutely perfect

563
00:20:57,510 --> 00:20:55,840

against all of our predictions we had

564
00:21:00,070 --> 00:20:57,520
all these contingencies planned and we

565
00:21:01,510 --> 00:21:00,080
threw them away but what that tells us

566
00:21:03,350 --> 00:21:01,520
also is not only we do not know the

567
00:21:04,870 --> 00:21:03,360
atmosphere but the atmosphere affects

568
00:21:05,909 --> 00:21:04,880
when you're going to go in every time

569
00:21:07,990 --> 00:21:05,919
you go into the atmosphere and get

570
00:21:12,310 --> 00:21:08,000
slowed down well you go in a little bit

571
00:21:16,230 --> 00:21:12,320
earlier so what started as 508 is now at

572
00:21:17,669 --> 00:21:16,240
4 colon 55 call it 06.

573
00:21:19,750 --> 00:21:17,679
a.m

574
00:21:22,870 --> 00:21:19,760
pacific time and that's our story and

575
00:21:27,669 --> 00:21:25,590
so with that i would like to turn the

576
00:21:29,350 --> 00:21:27,679
mic over to linda spilker to tell you

577
00:21:30,470 --> 00:21:29,360
about some of this amazing science that

578
00:21:31,909 --> 00:21:30,480
we're going to get in these last few

579
00:21:33,830 --> 00:21:31,919
hours

580
00:21:35,830 --> 00:21:33,840
well being thank you very much earl

581
00:21:37,909 --> 00:21:35,840
being part of the cassini mission for

582
00:21:40,470 --> 00:21:37,919
the entire mission has been an

583
00:21:43,190 --> 00:21:40,480
incredible privilege both for me and for

584
00:21:47,110 --> 00:21:43,200
many of the scientists on board cassini

585
00:21:50,230 --> 00:21:47,120
we've had an incredible 13-year journey

586
00:21:52,549 --> 00:21:50,240
around saturn returning data like a

587
00:21:53,510 --> 00:21:52,559
giant fire hose just flooding us with

588
00:21:57,430 --> 00:21:53,520

data

589
00:21:59,510 --> 00:21:57,440
a million piece puzzle

590
00:22:01,830 --> 00:21:59,520
cassini has been slowly putting together

591
00:22:03,590 --> 00:22:01,840
the pieces we have some of the border

592
00:22:05,350 --> 00:22:03,600
some of the regions and we're trying to

593
00:22:07,750 --> 00:22:05,360
put together the picture of the saturn

594
00:22:09,909 --> 00:22:07,760
system but we don't have a picture on

595
00:22:11,270 --> 00:22:09,919
the cover to guide us to tell us what

596
00:22:13,510 --> 00:22:11,280
that final

597
00:22:14,950 --> 00:22:13,520
set of data will finally look like and

598
00:22:18,070 --> 00:22:14,960
what's really great about the grand

599
00:22:19,590 --> 00:22:18,080
finale is it's adding incredible new

600
00:22:21,750 --> 00:22:19,600
puzzle pieces

601
00:22:24,070 --> 00:22:21,760
to help us better understand the saturn

602
00:22:25,750 --> 00:22:24,080
system and as earl said lots of

603
00:22:27,750 --> 00:22:25,760
surprises many of the things we thought

604
00:22:29,990 --> 00:22:27,760
we knew about saturn are more

605
00:22:31,029 --> 00:22:30,000
complicated than we originally had

606
00:22:33,110 --> 00:22:31,039
imagined

607
00:22:35,990 --> 00:22:33,120
if we look at the first graphic

608
00:22:37,909 --> 00:22:36,000
this is an example of looking at saturn

609
00:22:40,149 --> 00:22:37,919
from the outside in that's what we're

610
00:22:41,909 --> 00:22:40,159
doing with the grand finale orbits if

611
00:22:44,390 --> 00:22:41,919
you look at that blue figure on your

612
00:22:47,350 --> 00:22:44,400
right that's the aurora oval at saturn

613
00:22:49,750 --> 00:22:47,360

the particles come in hit the atmosphere

614
00:22:52,549 --> 00:22:49,760
cause this wonderful aurora

615
00:22:54,630 --> 00:22:52,559
just underneath it you have the hexagon

616
00:22:56,390 --> 00:22:54,640
with the hurricane inside it if you look

617
00:22:57,990 --> 00:22:56,400
on the bottom right you can see an image

618
00:22:59,669 --> 00:22:58,000
now in the infrared where you can see

619
00:23:02,789 --> 00:22:59,679
the heat energy

620
00:23:04,630 --> 00:23:02,799
coming out from inside of the planet and

621
00:23:06,950 --> 00:23:04,640
finally that beautiful image with the

622
00:23:08,630 --> 00:23:06,960
hexagons so we're looking at different

623
00:23:11,510 --> 00:23:08,640
levels from saturn almost like we've

624
00:23:13,750 --> 00:23:11,520
taken a magnifying glass to the planet

625
00:23:15,909 --> 00:23:13,760
and the rings we've also been looking at

626
00:23:17,990 --> 00:23:15,919
the interior and in a sense pulling back

627
00:23:20,630 --> 00:23:18,000
the curtain with our gravity and

628
00:23:23,909 --> 00:23:20,640
magnetic field data to see what saturn

629
00:23:25,110 --> 00:23:23,919
is like on the inside as well

630
00:23:26,950 --> 00:23:25,120
well as earl mentioned we're going to be

631
00:23:29,270 --> 00:23:26,960
taking our last images we hope about

632
00:23:31,350 --> 00:23:29,280
eight o'clock tomorrow night to have the

633
00:23:33,110 --> 00:23:31,360
images up on our raw image site if we go

634
00:23:35,510 --> 00:23:33,120
to the next graphic

635
00:23:37,669 --> 00:23:35,520
in that last period of time looking

636
00:23:40,789 --> 00:23:37,679
around saturn what we're doing is we're

637
00:23:42,470 --> 00:23:40,799
taking our final picture postcards of

638
00:23:45,190 --> 00:23:42,480

the saturn system

639
00:23:47,029 --> 00:23:45,200
looking at our favorite targets and to

640
00:23:48,230 --> 00:23:47,039
put these images in our cassini

641
00:23:50,310 --> 00:23:48,240
scrapbook

642
00:23:52,789 --> 00:23:50,320
so we're going to take if you look at

643
00:23:54,710 --> 00:23:52,799
the upper left a mosaic of saturn in the

644
00:23:56,710 --> 00:23:54,720
rings in color

645
00:23:57,990 --> 00:23:56,720
basically our last look at the entire

646
00:24:00,230 --> 00:23:58,000
system

647
00:24:02,230 --> 00:24:00,240
upper right that's titan we're going to

648
00:24:04,230 --> 00:24:02,240
take some goodbye pictures of titan last

649
00:24:06,470 --> 00:24:04,240
look to see if there's any weather or

650
00:24:08,149 --> 00:24:06,480
clouds going on

651
00:24:10,070 --> 00:24:08,159
in the lower left that's the outers of

652
00:24:12,630 --> 00:24:10,080
the a-ring and that bright feature is

653
00:24:14,710 --> 00:24:12,640
created by a grouping of particles that

654
00:24:17,269 --> 00:24:14,720
we've nicknamed peggy we've been

655
00:24:19,350 --> 00:24:17,279
watching since 2012 to see if peggy

656
00:24:21,110 --> 00:24:19,360
might break free of the rings

657
00:24:23,029 --> 00:24:21,120
and become a moon in her own right so

658
00:24:24,390 --> 00:24:23,039
we're going to take a last look see what

659
00:24:25,669 --> 00:24:24,400
peggy's up to

660
00:24:29,029 --> 00:24:25,679
in the center we're going to watch

661
00:24:31,269 --> 00:24:29,039
enceladus set behind the northern limb

662
00:24:33,269 --> 00:24:31,279
of saturn so very appropriate enceladus

663
00:24:35,190 --> 00:24:33,279

setting get a look at the propellers

664
00:24:37,190 --> 00:24:35,200
that's on the lower right these objects

665
00:24:39,750 --> 00:24:37,200
that are trying to open up gaps in

666
00:24:42,630 --> 00:24:39,760
saturn's rings not quite big enough to

667
00:24:44,630 --> 00:24:42,640
do that but you can only see those with

668
00:24:46,630 --> 00:24:44,640
a spacecraft like cassini

669
00:24:48,230 --> 00:24:46,640
and then on our final moments of data

670
00:24:49,269 --> 00:24:48,240
we're going to look on the dark side of

671
00:24:51,830 --> 00:24:49,279
saturn

672
00:24:54,230 --> 00:24:51,840
at that point where cassini will be

673
00:24:56,549 --> 00:24:54,240
plunging into the atmosphere looking in

674
00:24:59,430 --> 00:24:56,559
the near infrared the ultraviolet trying

675
00:25:00,390 --> 00:24:59,440
to get some pictures of cassini's final

676
00:25:03,510 --> 00:25:00,400
home

677
00:25:05,669 --> 00:25:03,520
inside the planet saturn itself now if

678
00:25:07,669 --> 00:25:05,679
we go to the next graphic this just came

679
00:25:09,590 --> 00:25:07,679
down last night

680
00:25:11,190 --> 00:25:09,600
this is one of our looks at titan from

681
00:25:12,870 --> 00:25:11,200
the goodbye kiss

682
00:25:14,470 --> 00:25:12,880
the north pole you can see the lake

683
00:25:15,750 --> 00:25:14,480
region we're looking at the north pole

684
00:25:17,510 --> 00:25:15,760
of titan

685
00:25:20,310 --> 00:25:17,520
looking through the haze the haze has

686
00:25:21,990 --> 00:25:20,320
cleared remarkably as summer solstice

687
00:25:23,909 --> 00:25:22,000
has approached

688
00:25:25,590 --> 00:25:23,919

and then if we go to the final graphic

689
00:25:26,390 --> 00:25:25,600
these are the instruments that will be

690
00:25:28,390 --> 00:25:26,400
on

691
00:25:31,269 --> 00:25:28,400
and sending back data

692
00:25:33,510 --> 00:25:31,279
during those final moments with cassini

693
00:25:35,669 --> 00:25:33,520
and we have eight of them including

694
00:25:37,909 --> 00:25:35,679
the gas chromatograph grass

695
00:25:40,070 --> 00:25:37,919
ion and neutral mass spectrometer the

696
00:25:42,310 --> 00:25:40,080
magnetospheric imaging experiment the

697
00:25:44,789 --> 00:25:42,320
radio science system will be sending

698
00:25:46,950 --> 00:25:44,799
back its last gravity measurements the

699
00:25:49,029 --> 00:25:46,960
radio and plasma wave antennas and then

700
00:25:51,190 --> 00:25:49,039
the ultraviolet and infrared

701
00:25:52,549 --> 00:25:51,200
spectrometers will also be taking data

702
00:25:54,230 --> 00:25:52,559
in that time period

703
00:25:57,190 --> 00:25:54,240
the magnetometer

704
00:25:59,430 --> 00:25:57,200
and the dust analyzer as well

705
00:26:01,590 --> 00:25:59,440
now in these very final seconds we'll be

706
00:26:04,630 --> 00:26:01,600
plunging deeper into the atmosphere of

707
00:26:06,470 --> 00:26:04,640
saturn than we've ever gone before

708
00:26:09,750 --> 00:26:06,480
in fact you can think of cassini as

709
00:26:11,430 --> 00:26:09,760
becoming the first saturn probe

710
00:26:13,750 --> 00:26:11,440
and to tell you more about sniffing the

711
00:26:15,510 --> 00:26:13,760
atmosphere of saturn i turn it over to

712
00:26:17,750 --> 00:26:15,520
hunter weight and he's the principal

713
00:26:19,909 --> 00:26:17,760

investigator for the ion and neutral

714
00:26:21,110 --> 00:26:19,919
mass spectrometer hunter thanks thanks

715
00:26:23,909 --> 00:26:21,120
linda

716
00:26:25,190 --> 00:26:23,919
the ion neutral mass spectrometer is

717
00:26:28,230 --> 00:26:25,200
actually the

718
00:26:32,230 --> 00:26:28,240
sensitive nose of the spacecraft if

719
00:26:36,549 --> 00:26:35,350
and zoom in on ims you can also see it

720
00:26:38,470 --> 00:26:36,559
here

721
00:26:40,870 --> 00:26:38,480
gas enters into this

722
00:26:43,190 --> 00:26:40,880
front portion of the instrument and

723
00:26:44,710 --> 00:26:43,200
inside the molecular composition is

724
00:26:46,789 --> 00:26:44,720
determined

725
00:26:48,710 --> 00:26:46,799
and that's so we have to be pointed in

726
00:26:51,029 --> 00:26:48,720
the forward direction and the direction

727
00:26:52,390 --> 00:26:51,039
motion the spacecraft is earl's already

728
00:26:55,029 --> 00:26:52,400
indicated

729
00:26:57,830 --> 00:26:55,039
we've done this on many occasions we've

730
00:27:00,470 --> 00:26:57,840
explored the atmosphere of titan in the

731
00:27:02,230 --> 00:27:00,480
same manner we've explored the plumes of

732
00:27:04,390 --> 00:27:02,240
enceladus

733
00:27:06,149 --> 00:27:04,400
with the eye neutral mass spectrometer

734
00:27:07,990 --> 00:27:06,159
as well and found out about the

735
00:27:10,950 --> 00:27:08,000
composition there and made some

736
00:27:12,789 --> 00:27:10,960
inferences about the internal ocean and

737
00:27:13,510 --> 00:27:12,799
now we get a chance to actually look at

738
00:27:21,269 --> 00:27:13,520

the

739
00:27:23,350 --> 00:27:21,279
we're sampling both in this last stage

740
00:27:26,149 --> 00:27:23,360
if you go to the next graphic

741
00:27:29,510 --> 00:27:26,159
we'll there's some idea of

742
00:27:32,470 --> 00:27:29,520
the sampling that we're doing so the

743
00:27:33,990 --> 00:27:32,480
the five dots indicate the five

744
00:27:35,909 --> 00:27:34,000
previous orbits where we were at the

745
00:27:38,149 --> 00:27:35,919
lowest point or closest to the

746
00:27:40,870 --> 00:27:38,159
atmosphere so far

747
00:27:43,830 --> 00:27:40,880
earlier we were closer to the rings

748
00:27:45,430 --> 00:27:43,840
and we were uh well we were close to the

749
00:27:48,389 --> 00:27:45,440
rings that there's kind of like three

750
00:27:50,470 --> 00:27:48,399
bands that we actually sample so

751
00:27:51,990 --> 00:27:50,480
we've had a chance to look more at the

752
00:27:54,870 --> 00:27:52,000
ring atmosphere

753
00:27:57,110 --> 00:27:54,880
and to look and progressively

754
00:27:59,430 --> 00:27:57,120
see more and more of the atmosphere of

755
00:28:01,110 --> 00:27:59,440
saturn itself and you can see that line

756
00:28:02,630 --> 00:28:01,120
on the graph that's called well-mixed

757
00:28:04,870 --> 00:28:02,640
atmosphere that's where the atmosphere

758
00:28:06,950 --> 00:28:04,880
becomes kind of homogeneous in terms of

759
00:28:09,750 --> 00:28:06,960
composition and we're not going to quite

760
00:28:12,310 --> 00:28:09,760
make it there but we'll make it close

761
00:28:14,470 --> 00:28:12,320
and in that period of time we'll be able

762
00:28:17,029 --> 00:28:14,480
to make our cleanest sample of the

763
00:28:19,669 --> 00:28:17,039

atmosphere of saturn itself

764
00:28:21,669 --> 00:28:19,679
so if we go to the final graphic

765
00:28:22,630 --> 00:28:21,679
uh this is a very pretty picture of the

766
00:28:24,549 --> 00:28:22,640
rings and

767
00:28:25,590 --> 00:28:24,559
and of the atmosphere you can see kind

768
00:28:29,269 --> 00:28:25,600
of a

769
00:28:31,990 --> 00:28:29,279
a haze which is the atmosphere

770
00:28:33,990 --> 00:28:32,000
just above the edge of the planet and

771
00:28:35,990 --> 00:28:34,000
the one of the most important scientific

772
00:28:38,950 --> 00:28:36,000
things that we're trying to figure out

773
00:28:41,669 --> 00:28:38,960
is a concept called ring rain and this

774
00:28:44,070 --> 00:28:41,679
concept was introduced

775
00:28:45,990 --> 00:28:44,080
in the early 80s to actually explain

776
00:28:49,029 --> 00:28:46,000
some observations that were made by both

777
00:28:51,029 --> 00:28:49,039
pioneer and voyager as they flew by

778
00:28:59,669 --> 00:28:51,039
and

779
00:29:01,510 --> 00:28:59,679
ice strains from the rings falling into

780
00:29:04,230 --> 00:29:01,520
the atmosphere and making modifications

781
00:29:05,350 --> 00:29:04,240
to the atmosphere in ionosphere

782
00:29:06,310 --> 00:29:05,360
well

783
00:29:10,630 --> 00:29:06,320
as

784
00:29:12,710 --> 00:29:10,640
much more extensive than that it's much

785
00:29:14,950 --> 00:29:12,720
more complicated we're getting great new

786
00:29:17,110 --> 00:29:14,960
data we're trying to find out exactly

787
00:29:19,510 --> 00:29:17,120
what is coming from the rings and what

788
00:29:21,669 --> 00:29:19,520

is due to the atmosphere and that final

789
00:29:23,110 --> 00:29:21,679
plunge will allow us to do that the

790
00:29:25,110 --> 00:29:23,120
other thing that we'll do during that

791
00:29:27,830 --> 00:29:25,120
period of time is we move closer to the

792
00:29:30,870 --> 00:29:27,840
mixed atmosphere we'll be able to look

793
00:29:32,070 --> 00:29:30,880
at some important constituents that we

794
00:29:33,590 --> 00:29:32,080
know are there

795
00:29:35,909 --> 00:29:33,600
and we've been measuring them but we'll

796
00:29:38,789 --> 00:29:35,919
get a better idea of the hydrogen to

797
00:29:41,029 --> 00:29:38,799
helium ratio and this is important in

798
00:29:43,590 --> 00:29:41,039
terms of the formation and evolution of

799
00:29:46,230 --> 00:29:43,600
saturn itself so we have an extensive

800
00:29:48,389 --> 00:29:46,240
set of science objectives that we're

801
00:29:49,590 --> 00:29:48,399
going to execute on this final plunge

802
00:29:51,029 --> 00:29:49,600
and we're

803
00:29:52,789 --> 00:29:51,039
looking forward to getting the data in

804
00:29:55,430 --> 00:29:52,799
near real time

805
00:29:57,430 --> 00:29:55,440
thanks i'll pass it back to earl

806
00:30:00,950 --> 00:29:57,440
thanks hunter

807
00:30:04,070 --> 00:30:00,960
after nearly four decades of planning

808
00:30:07,590 --> 00:30:04,080
execution implementation and execution

809
00:30:09,590 --> 00:30:07,600
we are now within 48 hours of the end of

810
00:30:12,549 --> 00:30:09,600
the cassini mission

811
00:30:15,350 --> 00:30:12,559
the work of of three space agencies 17

812
00:30:17,430 --> 00:30:15,360
member nations hundreds of suppliers

813
00:30:18,950 --> 00:30:17,440

thousands of engineers scientists and

814
00:30:21,909 --> 00:30:18,960
support staff

815
00:30:24,549 --> 00:30:21,919
are about to come to a fiery end high

816
00:30:26,310 --> 00:30:24,559
above the clouds of saturn

817
00:30:28,549 --> 00:30:26,320
the current

818
00:30:29,830 --> 00:30:28,559
cassini team or family is as it has

819
00:30:31,510 --> 00:30:29,840
become

820
00:30:33,350 --> 00:30:31,520
comprised of hundreds of engineers

821
00:30:35,430 --> 00:30:33,360
scientists and support staff has worked

822
00:30:37,750 --> 00:30:35,440
for many years to bring us to this point

823
00:30:39,590 --> 00:30:37,760
and it's done a phenomenal job as i

824
00:30:43,590 --> 00:30:39,600
emphasize at the beginning

825
00:30:46,070 --> 00:30:43,600
this is about a spacecraft and a team

826
00:30:48,389 --> 00:30:46,080
that has just been absolutely the best

827
00:30:50,870 --> 00:30:48,399
one it could ever ask for in both cases

828
00:30:52,870 --> 00:30:50,880
and it's coming to an end unfortunately

829
00:30:54,549 --> 00:30:52,880
we'll be saddened oh there's no doubt

830
00:30:57,029 --> 00:30:54,559
about it at the loss of such an

831
00:30:59,509 --> 00:30:57,039
incredible machine but i think all of us

832
00:31:00,630 --> 00:30:59,519
we're going to have a great sense of

833
00:31:02,789 --> 00:31:00,640
pride

834
00:31:04,870 --> 00:31:02,799
in a little bit corny perhaps but

835
00:31:07,269 --> 00:31:04,880
mission accomplished we set out to do

836
00:31:09,509 --> 00:31:07,279
something at saturn we did it we did it

837
00:31:11,190 --> 00:31:09,519
extremely well and we delivered more and

838
00:31:12,230 --> 00:31:11,200

more and we've left

839
00:31:15,190 --> 00:31:12,240
the world

840
00:31:16,710 --> 00:31:15,200
informed but still wondering and that's

841
00:31:18,470 --> 00:31:16,720
i couldn't ask for more we got to go

842
00:31:20,070 --> 00:31:18,480
back we know it

843
00:31:21,990 --> 00:31:20,080
we've been gathering all week we'll be

844
00:31:23,830 --> 00:31:22,000
staffing up the mission control center

845
00:31:25,909 --> 00:31:23,840
tomorrow standing vigil through the

846
00:31:28,549 --> 00:31:25,919
night as we prepare to say goodbye both

847
00:31:31,350 --> 00:31:28,559
from here and a large crowd of team of

848
00:31:33,110 --> 00:31:31,360
our team members at caltech

849
00:31:35,750 --> 00:31:33,120
as our faithful traveler from earth

850
00:31:37,909 --> 00:31:35,760
makes its final goodbye

851
00:31:40,470 --> 00:31:37,919
so thank you cassini

852
00:31:42,389 --> 00:31:40,480
and farewell

853
00:31:44,710 --> 00:31:42,399
all right well thank you very much to

854
00:31:46,070 --> 00:31:44,720
our speakers it's just phenomenal

855
00:31:48,149 --> 00:31:46,080
we're going to go ahead and open it up

856
00:31:50,789 --> 00:31:48,159
for questions uh first of all to

857
00:31:53,669 --> 00:31:50,799
reporters here in the auditorium please

858
00:31:56,230 --> 00:31:53,679
wait for the mic and uh uh give us your

859
00:31:59,350 --> 00:31:56,240
name and affiliation any questions here

860
00:32:03,509 --> 00:32:00,389
thanks

861
00:32:04,789 --> 00:32:03,519
hi irene klotz with aviation week um

862
00:32:06,630 --> 00:32:04,799
the uh

863
00:32:09,350 --> 00:32:06,640

the last image that's going to be taken

864
00:32:10,630 --> 00:32:09,360
from titan is it i mean from cassini is

865
00:32:12,789 --> 00:32:10,640
it the uh

866
00:32:15,750 --> 00:32:12,799
the image of where it's going to impact

867
00:32:18,870 --> 00:32:15,760
and what is the speed that cassini will

868
00:32:21,110 --> 00:32:18,880
be traveling uh relative to saturn in

869
00:32:23,029 --> 00:32:21,120
the final descent

870
00:32:24,870 --> 00:32:23,039
i think the answer is yes to the first

871
00:32:26,870 --> 00:32:24,880
question the final image is the final

872
00:32:29,350 --> 00:32:26,880
image is the place where casino will

873
00:32:31,269 --> 00:32:29,360
plant it'll be dark but that'll be we'll

874
00:32:33,909 --> 00:32:31,279
take an image there yes and in miles per

875
00:32:35,669 --> 00:32:33,919
hour we're going about 76 000 miles per

876
00:32:37,029 --> 00:32:35,679
hour

877
00:32:39,430 --> 00:32:37,039
we'll actually have an image with our

878
00:32:41,430 --> 00:32:39,440
visual and infrared mapping spectrometer

879
00:32:43,909 --> 00:32:41,440
and that image can sense the heat of

880
00:32:46,070 --> 00:32:43,919
saturn as well and so we may

881
00:32:50,230 --> 00:32:46,080
see some details of the atmosphere in

882
00:32:51,029 --> 00:32:50,240
the near infrared thanks and the 455 06

883
00:32:53,190 --> 00:32:51,039
that's

884
00:32:54,230 --> 00:32:53,200
pacific daylight time and what is the

885
00:32:56,230 --> 00:32:54,240
actual

886
00:32:58,470 --> 00:32:56,240
time on with it

887
00:33:01,190 --> 00:32:58,480
it's about an hour and 21 minutes or it

888
00:33:05,830 --> 00:33:01,200

takes the signal an hour and 20 sorry 23

889
00:33:09,669 --> 00:33:05,840
minutes to get from saturn to to earth

890
00:33:11,909 --> 00:33:09,679
but as far as we're concerned that that

891
00:33:14,230 --> 00:33:11,919
what we see is and what we live with

892
00:33:15,909 --> 00:33:14,240
is this is the signal from cassini so

893
00:33:18,549 --> 00:33:15,919
when that last signal comes down that's

894
00:33:19,750 --> 00:33:18,559
when things have happened for us

895
00:33:21,590 --> 00:33:19,760
okay another question here in the

896
00:33:22,710 --> 00:33:21,600
audience down front frederick castell

897
00:33:25,669 --> 00:33:22,720
freelance

898
00:33:27,509 --> 00:33:25,679
journalist uh two questions uh when you

899
00:33:30,630 --> 00:33:27,519
look at the ephemerides

900
00:33:33,990 --> 00:33:30,640
of the different uh moons do we see some

901
00:33:35,029 --> 00:33:34,000
kind of pioneer effect

902
00:33:40,470 --> 00:33:35,039
on the

903
00:33:42,630 --> 00:33:40,480
for

904
00:33:45,830 --> 00:33:42,640
next mission future mission what's the

905
00:33:48,470 --> 00:33:45,840
strategy about plutonium

906
00:33:49,909 --> 00:33:48,480
i i'll start with the pioneer

907
00:33:52,710 --> 00:33:49,919
effect but i'm going to let the gym

908
00:33:55,269 --> 00:33:52,720
handle the next one uh no we have not

909
00:33:57,029 --> 00:33:55,279
the pipe because we have so many

910
00:33:59,669 --> 00:33:57,039
different perturbations in the system

911
00:34:00,950 --> 00:33:59,679
from the moons from our own thrusting

912
00:34:03,029 --> 00:34:00,960
from the

913
00:34:05,110 --> 00:34:03,039

thermal pressures of the rtgs even more

914
00:34:06,789 --> 00:34:05,120
subtle we're just too busy perturbing

915
00:34:09,190 --> 00:34:06,799
that trajectory to actually be able to

916
00:34:11,430 --> 00:34:09,200
see something as subtle as the pioneer

917
00:34:14,069 --> 00:34:11,440
effect it's it's just too much going on

918
00:34:16,629 --> 00:34:14,079
in the saturn system

919
00:34:18,629 --> 00:34:16,639
several years ago we were able to work

920
00:34:21,510 --> 00:34:18,639
with the administration and congress to

921
00:34:24,869 --> 00:34:21,520
get the approval to restart the

922
00:34:25,990 --> 00:34:24,879
production of plutonium-238

923
00:34:28,069 --> 00:34:26,000
we've already

924
00:34:30,710 --> 00:34:28,079
done a number of tests and in

925
00:34:32,389 --> 00:34:30,720
2019 we'll get back into the production

926
00:34:34,550 --> 00:34:32,399
on a regular basis

927
00:34:36,389 --> 00:34:34,560
we also have

928
00:34:39,430 --> 00:34:36,399
approximately

929
00:34:42,310 --> 00:34:39,440
30 kilograms plus of uh plutonium

930
00:34:45,030 --> 00:34:42,320
available to us for future missions

931
00:34:47,589 --> 00:34:45,040
uh the next plutonium mission uh that we

932
00:34:48,950 --> 00:34:47,599
planned is a mars mission it's mars

933
00:34:50,069 --> 00:34:48,960
2020.

934
00:34:52,149 --> 00:34:50,079
but um

935
00:34:55,030 --> 00:34:52,159
i think we're in really good stead for

936
00:34:56,389 --> 00:34:55,040
the next several decades uh our plan is

937
00:34:58,630 --> 00:34:56,399
to uh

938
00:35:02,870 --> 00:34:58,640

keep keep a stock of plutonium and not

939
00:35:04,230 --> 00:35:02,880
let that be a mission limiting factor

940
00:35:06,470 --> 00:35:04,240
okay other questions here in the

941
00:35:07,270 --> 00:35:06,480
audience

942
00:35:09,510 --> 00:35:07,280
uh

943
00:35:12,870 --> 00:35:09,520
right here we'll go inside and then

944
00:35:17,750 --> 00:35:15,670
hi thank you for doing this

945
00:35:19,829 --> 00:35:17,760
will we be able to tell anything from

946
00:35:22,150 --> 00:35:19,839
the live stream data on the way into the

947
00:35:25,109 --> 00:35:22,160
atmosphere right away and if not how

948
00:35:27,750 --> 00:35:25,119
long will it be before we know

949
00:35:29,670 --> 00:35:27,760
a big idea of what it's telling us

950
00:35:30,790 --> 00:35:29,680
that's yours well um

951
00:35:33,430 --> 00:35:30,800
the data

952
00:35:35,430 --> 00:35:33,440
the operations team lead for the ims

953
00:35:37,109 --> 00:35:35,440
tells me that she will display it 20

954
00:35:39,990 --> 00:35:37,119
minutes after

955
00:35:41,750 --> 00:35:40,000
the time we take it so we're going to

956
00:35:42,829 --> 00:35:41,760
get it streamed to us

957
00:35:46,390 --> 00:35:42,839
from

958
00:35:47,990 --> 00:35:46,400
the downlink to jpel be transferred to

959
00:35:48,790 --> 00:35:48,000
southwest research institute and then

960
00:35:51,750 --> 00:35:48,800
we'll

961
00:35:53,589 --> 00:35:51,760
have it on a computer down in caltech

962
00:35:54,870 --> 00:35:53,599
understanding it might take a little bit

963
00:36:00,310 --> 00:35:54,880

longer

964
00:36:05,030 --> 00:36:02,790
wall street journal um you you mentioned

965
00:36:07,750 --> 00:36:05,040
that cassini has uh among its many

966
00:36:09,589 --> 00:36:07,760
accomplishments enabled a series of

967
00:36:12,550 --> 00:36:09,599
missions to come i wonder if you'd

968
00:36:15,510 --> 00:36:12,560
expand on that for a moment well as i

969
00:36:17,270 --> 00:36:15,520
mentioned earlier the concept of

970
00:36:18,550 --> 00:36:17,280
the gravity assist that we were able to

971
00:36:19,670 --> 00:36:18,560
get with

972
00:36:22,069 --> 00:36:19,680
titan

973
00:36:24,950 --> 00:36:22,079
allowed our instruments to get a global

974
00:36:27,270 --> 00:36:24,960
view of that beautiful moon

975
00:36:30,310 --> 00:36:27,280
that's really spectacular because that

976
00:36:32,470 --> 00:36:30,320
means when we take it to uh the jupiter

977
00:36:33,990 --> 00:36:32,480
environment where the radiation belt is

978
00:36:35,990 --> 00:36:34,000
really harsh

979
00:36:38,230 --> 00:36:36,000
all through the area where the galilean

980
00:36:41,270 --> 00:36:38,240
moons are we want to be able to get in

981
00:36:42,390 --> 00:36:41,280
and get out and so then if we orbit

982
00:36:45,109 --> 00:36:42,400
jupiter

983
00:36:47,270 --> 00:36:45,119
we can do multiple flybys of the moons

984
00:36:48,870 --> 00:36:47,280
and the one we're we're planning to do

985
00:36:51,829 --> 00:36:48,880
is europa

986
00:36:54,630 --> 00:36:51,839
and from those multiple flybys

987
00:36:58,630 --> 00:36:54,640
actually create a global view of that

988
00:37:00,470 --> 00:36:58,640

moon as if we were in orbit and so

989
00:37:03,270 --> 00:37:00,480
cassini's really pioneered that whole

990
00:37:05,589 --> 00:37:03,280
concept and that will be our first next

991
00:37:06,829 --> 00:37:05,599
attempt in using that

992
00:37:09,430 --> 00:37:06,839
to great

993
00:37:10,790 --> 00:37:09,440
effect all right actually we're going to

994
00:37:11,910 --> 00:37:10,800
go to the phones now for a couple of

995
00:37:13,910 --> 00:37:11,920
questions but we'll come back to the

996
00:37:16,230 --> 00:37:13,920
auditorium uh i think we have marcia

997
00:37:18,630 --> 00:37:16,240
dunn from the ap marcia

998
00:37:19,910 --> 00:37:18,640
yes can you hear me sure

999
00:37:22,310 --> 00:37:19,920
yes um

1000
00:37:23,910 --> 00:37:22,320
for either jim or earl or both there

1001
00:37:26,710 --> 00:37:23,920
seems to be a

1002
00:37:28,950 --> 00:37:26,720
the outpouring of love for cassini seems

1003
00:37:31,430 --> 00:37:28,960
to be growing in these last

1004
00:37:33,430 --> 00:37:31,440
hours and days i'm wondering if you had

1005
00:37:35,430 --> 00:37:33,440
a chance to hear the cassini opera from

1006
00:37:36,790 --> 00:37:35,440
the planetary society what did you think

1007
00:37:39,349 --> 00:37:36,800
about that

1008
00:37:42,069 --> 00:37:39,359
and and how do you feel hearing from

1009
00:37:43,750 --> 00:37:42,079
the public who's so sorry to see cassini

1010
00:37:45,990 --> 00:37:43,760
go

1011
00:37:48,710 --> 00:37:46,000
i i have heard the opera tribute from

1012
00:37:51,030 --> 00:37:48,720
the planetary society and i loved it um

1013
00:37:52,470 --> 00:37:51,040

it's very heartwarming to us as a matter

1014
00:37:54,069 --> 00:37:52,480
of fact we've

1015
00:37:55,829 --> 00:37:54,079
recently posted a letter from a

1016
00:37:58,950 --> 00:37:55,839
six-year-old boy who invited us to his

1017
00:37:59,829 --> 00:37:58,960
cassini party in florida on the 15th uh

1018
00:38:05,589 --> 00:37:59,839
the

1019
00:38:07,589 --> 00:38:05,599
may be so corny uh is just very

1020
00:38:09,750 --> 00:38:07,599
heartening um

1021
00:38:10,550 --> 00:38:09,760
to because it's part of what we try to

1022
00:38:13,829 --> 00:38:10,560
do

1023
00:38:16,710 --> 00:38:13,839
is to extend everybody out to saturn

1024
00:38:18,470 --> 00:38:16,720
it's not science for you know in in the

1025
00:38:21,190 --> 00:38:18,480
in the ivory tower it's for it's for

1026
00:38:24,310 --> 00:38:21,200
humanity and so that everybody to get on

1027
00:38:27,270 --> 00:38:24,320
ride come with us is just phenomenal so

1028
00:38:28,470 --> 00:38:27,280
i i'm very heartened by that um i wish

1029
00:38:29,829 --> 00:38:28,480
uh

1030
00:38:32,069 --> 00:38:29,839
well never mind i don't even wanna go

1031
00:38:33,750 --> 00:38:32,079
there

1032
00:38:36,550 --> 00:38:33,760
more orbit

1033
00:38:39,109 --> 00:38:36,560
so it's it is it is where it is we've

1034
00:38:41,349 --> 00:38:39,119
we've gone this this train and i again i

1035
00:38:43,190 --> 00:38:41,359
i couldn't be more heartened by the the

1036
00:38:45,270 --> 00:38:43,200
outpouring we've had

1037
00:38:47,510 --> 00:38:45,280
absolutely you know the cassini family

1038
00:38:49,910 --> 00:38:47,520

as earl mentioned is those people that

1039
00:38:53,510 --> 00:38:49,920
have worked many years uh

1040
00:38:55,109 --> 00:38:53,520
decades uh to uh to to get to this point

1041
00:38:57,430 --> 00:38:55,119
and we are absolutely

1042
00:38:59,270 --> 00:38:57,440
delighted to have an extended family to

1043
00:39:01,430 --> 00:38:59,280
share

1044
00:39:02,630 --> 00:39:01,440
the experiences that

1045
00:39:04,630 --> 00:39:02,640
have

1046
00:39:06,950 --> 00:39:04,640
really enabled

1047
00:39:09,109 --> 00:39:06,960
enormous science to be done

1048
00:39:10,950 --> 00:39:09,119
in fact

1049
00:39:12,550 --> 00:39:10,960
you know really the science is not done

1050
00:39:14,310 --> 00:39:12,560
until we share it

1051
00:39:16,150 --> 00:39:14,320
this is really just the beginning of a

1052
00:39:18,310 --> 00:39:16,160
number of discoveries

1053
00:39:20,390 --> 00:39:18,320
that the data will reveal as we try to

1054
00:39:22,310 --> 00:39:20,400
figure out what the physical phenomena

1055
00:39:24,550 --> 00:39:22,320
are that that are being described in

1056
00:39:25,750 --> 00:39:24,560
those observations

1057
00:39:28,630 --> 00:39:25,760
those will

1058
00:39:31,510 --> 00:39:28,640
live on for many decades afterwards and

1059
00:39:33,750 --> 00:39:31,520
and already they're beckoning us to go

1060
00:39:36,630 --> 00:39:33,760
back you know between voyager and

1061
00:39:39,510 --> 00:39:36,640
cassini was 30 years

1062
00:39:42,310 --> 00:39:39,520
and um i i believe that will be much

1063
00:39:43,589 --> 00:39:42,320

shorter the next time around okay we're

1064
00:39:45,349 --> 00:39:43,599
going to take a couple of questions from

1065
00:39:46,950 --> 00:39:45,359
social media we've got jason townsend

1066
00:39:49,109 --> 00:39:46,960
from nasa headquarters jason what's

1067
00:39:51,030 --> 00:39:49,119
going on indeed there's a lot of

1068
00:39:53,270 --> 00:39:51,040
interest online here our first question

1069
00:39:55,670 --> 00:39:53,280
here comes from

1070
00:39:57,510 --> 00:39:55,680
salma on twitter who asks will cassini

1071
00:39:59,030 --> 00:39:57,520
completely evaporate in the atmosphere

1072
00:40:00,790 --> 00:39:59,040
of saturn or will it crash into the

1073
00:40:03,589 --> 00:40:00,800
surface of the planet

1074
00:40:05,190 --> 00:40:03,599
it will be completely vaporized like

1075
00:40:06,710 --> 00:40:05,200
many meteorites at earth that won't

1076
00:40:08,790 --> 00:40:06,720
they're nothing there's if there is a

1077
00:40:11,190 --> 00:40:08,800
surface of saturn it's at a hellishly

1078
00:40:13,030 --> 00:40:11,200
hot and pressure and temperature and

1079
00:40:14,950 --> 00:40:13,040
anything from cassini will vaporize long

1080
00:40:16,710 --> 00:40:14,960
before

1081
00:40:18,870 --> 00:40:16,720
wonderful lots of other questions here

1082
00:40:20,790 --> 00:40:18,880
asking about images here so evelyn on

1083
00:40:23,349 --> 00:40:20,800
twitter asks will cassini be able to

1084
00:40:24,790 --> 00:40:23,359
take a close-up image of saturn as it

1085
00:40:26,950 --> 00:40:24,800
plunges

1086
00:40:29,430 --> 00:40:26,960
no we don't have the data rate to

1087
00:40:31,589 --> 00:40:29,440
support sending back images in real time

1088
00:40:33,990 --> 00:40:31,599

so the instruments that i showed you did

1089
00:40:36,630 --> 00:40:34,000
not include the cameras for those final

1090
00:40:38,150 --> 00:40:36,640
few moments for the plunge so we'll be

1091
00:40:40,710 --> 00:40:38,160
getting those images back the final

1092
00:40:43,030 --> 00:40:40,720
image will be of the place where cassini

1093
00:40:45,030 --> 00:40:43,040
will go but it'll be from about 14 hours

1094
00:40:46,630 --> 00:40:45,040
earlier

1095
00:40:49,109 --> 00:40:46,640
all right next question here comes from

1096
00:40:51,990 --> 00:40:49,119
twitter user billiman who asks would it

1097
00:40:53,670 --> 00:40:52,000
be possible to use a low gain antenna at

1098
00:40:55,589 --> 00:40:53,680
a very low bit rate to monitor a

1099
00:40:59,080 --> 00:40:55,599
heartbeat from cassini just a little

1100
00:41:04,550 --> 00:41:01,750
[Laughter]

1101
00:41:06,790 --> 00:41:04,560
i'll i'll repeat that for the audience

1102
00:41:08,790 --> 00:41:06,800
the spacecraft engineer is on the is in

1103
00:41:10,230 --> 00:41:08,800
the second row and the answer is a

1104
00:41:12,950 --> 00:41:10,240
resounding no

1105
00:41:15,349 --> 00:41:12,960
the uh if we'd done that we would have

1106
00:41:16,069 --> 00:41:15,359
given up some science data and really

1107
00:41:20,630 --> 00:41:16,079
the

1108
00:41:22,550 --> 00:41:20,640
those last packets of

1109
00:41:23,829 --> 00:41:22,560
of spectrometer data was much more

1110
00:41:24,870 --> 00:41:23,839
important

1111
00:41:26,630 --> 00:41:24,880
okay we're going to go back to the

1112
00:41:29,670 --> 00:41:26,640
phones i think we've got leo enright

1113
00:41:31,190 --> 00:41:29,680

from irish television leo can hear us

1114
00:41:33,750 --> 00:41:31,200
yeah thanks very much in fact my

1115
00:41:36,069 --> 00:41:33,760
question isn't entirely unrelated to the

1116
00:41:38,950 --> 00:41:36,079
last one because i i'm wondering there

1117
00:41:40,790 --> 00:41:38,960
has been some speculation that a good

1118
00:41:42,630 --> 00:41:40,800
telescope on earth and i presume a

1119
00:41:45,270 --> 00:41:42,640
really good one would be able to see

1120
00:41:47,349 --> 00:41:45,280
this happen is that the case

1121
00:41:49,030 --> 00:41:47,359
well we're going to try and look from

1122
00:41:50,390 --> 00:41:49,040
with telescopes from the earth we're

1123
00:41:52,150 --> 00:41:50,400
just not sure

1124
00:41:53,750 --> 00:41:52,160
this flash will be occurring on the day

1125
00:41:55,750 --> 00:41:53,760
side of saturn

1126
00:41:58,790 --> 00:41:55,760
and we've done some calculations about

1127
00:42:02,790 --> 00:41:58,800
brightness we think it's not very likely

1128
00:42:05,030 --> 00:42:02,800
but we're sure going to look anyway

1129
00:42:06,150 --> 00:42:05,040
okay one more question on the phones i'm

1130
00:42:08,309 --> 00:42:06,160
going to uh

1131
00:42:10,790 --> 00:42:08,319
i think we've got dave mosher from

1132
00:42:12,390 --> 00:42:10,800
business insider

1133
00:42:13,829 --> 00:42:12,400
dave are you guys hear me yeah we sure

1134
00:42:15,349 --> 00:42:13,839
can

1135
00:42:17,670 --> 00:42:15,359
all right great um actually had a

1136
00:42:19,589 --> 00:42:17,680
follow-up to uh the previous question

1137
00:42:21,910 --> 00:42:19,599
and then one more new one

1138
00:42:23,990 --> 00:42:21,920

do we know which observatories in the

1139
00:42:25,750 --> 00:42:24,000
southern hemisphere or wherever on earth

1140
00:42:27,430 --> 00:42:25,760
are going to be trying to see this thing

1141
00:42:30,390 --> 00:42:27,440
that's my first question

1142
00:42:32,069 --> 00:42:30,400
for whoever can best answer it and then

1143
00:42:34,230 --> 00:42:32,079
sort of related to that but

1144
00:42:36,550 --> 00:42:34,240
about the data that's coming back

1145
00:42:38,230 --> 00:42:36,560
um i just checked the forecast for

1146
00:42:39,910 --> 00:42:38,240
australia and it does look like there's

1147
00:42:42,069 --> 00:42:39,920
a little cloud and

1148
00:42:44,150 --> 00:42:42,079
and rain in the forecast for the next

1149
00:42:45,589 --> 00:42:44,160
few days i'm curious

1150
00:42:47,270 --> 00:42:45,599
if you guys are worried about that at

1151
00:42:48,230 --> 00:42:47,280
all or if it's

1152
00:42:50,870 --> 00:42:48,240
you're confident that you're going to

1153
00:42:52,230 --> 00:42:50,880
get this data back thanks

1154
00:42:53,750 --> 00:42:52,240
well the observatories we're going to be

1155
00:42:55,990 --> 00:42:53,760
using are

1156
00:42:58,710 --> 00:42:56,000
mostly in australia australia of course

1157
00:43:00,150 --> 00:42:58,720
canberra has a great view of cassini

1158
00:43:01,670 --> 00:43:00,160
also we're going to be using some

1159
00:43:03,990 --> 00:43:01,680
smaller telescopes we're going to try

1160
00:43:05,910 --> 00:43:04,000
and look from india from china

1161
00:43:08,230 --> 00:43:05,920
possibly from taiwan we're really

1162
00:43:09,670 --> 00:43:08,240
encouraging our amateurs too

1163
00:43:11,750 --> 00:43:09,680

to get out there and look with their

1164
00:43:14,150 --> 00:43:11,760
telescopes we don't have any giant

1165
00:43:16,069 --> 00:43:14,160
telescopes in that region where we can

1166
00:43:17,990 --> 00:43:16,079
see cassini so we're just saying hey

1167
00:43:20,710 --> 00:43:18,000
everybody go out take a look and we'll

1168
00:43:23,910 --> 00:43:22,470
we have um

1169
00:43:25,910 --> 00:43:23,920
every confidence that we're going to get

1170
00:43:28,309 --> 00:43:25,920
the data back it's going to take a

1171
00:43:29,990 --> 00:43:28,319
pretty hellicious weather rainstorm to

1172
00:43:32,230 --> 00:43:30,000
to take out the data we've got our data

1173
00:43:35,190 --> 00:43:32,240
rates down at a very low level if we can

1174
00:43:37,990 --> 00:43:35,200
maintain the 70 meter antenna we have a

1175
00:43:39,510 --> 00:43:38,000
lot of margin if we do lose the 70 meter

1176
00:43:41,670 --> 00:43:39,520
dish then our margin is a little bit

1177
00:43:42,710 --> 00:43:41,680
lower but we're still i believe

1178
00:43:44,309 --> 00:43:42,720
comfortable

1179
00:43:47,190 --> 00:43:44,319
worst case

1180
00:43:49,109 --> 00:43:47,200
we still have the new norcia complex

1181
00:43:51,510 --> 00:43:49,119
over on the other side of the continent

1182
00:43:54,150 --> 00:43:51,520
that is not really prepared to

1183
00:43:55,589 --> 00:43:54,160
decommutate our telemetry immediately

1184
00:43:57,030 --> 00:43:55,599
but all the data will be on the ground

1185
00:43:59,589 --> 00:43:57,040
and we can build the right system to

1186
00:44:02,150 --> 00:43:59,599
take it back apart so we'll get the data

1187
00:44:03,750 --> 00:44:02,160
it's just a question of how soon

1188
00:44:05,910 --> 00:44:03,760

okay thanks guys we're going to go back

1189
00:44:07,349 --> 00:44:05,920
to social for a couple more questions

1190
00:44:08,870 --> 00:44:07,359
jason

1191
00:44:11,510 --> 00:44:08,880
all right um

1192
00:44:16,950 --> 00:44:11,520
twitter user jason asks when will a

1193
00:44:20,870 --> 00:44:19,109
that's for me

1194
00:44:23,750 --> 00:44:20,880
i i sort of

1195
00:44:26,630 --> 00:44:23,760
begged for that question

1196
00:44:30,069 --> 00:44:26,640
the observations by cassini have been so

1197
00:44:32,550 --> 00:44:30,079
remarkable for enceladus and titan

1198
00:44:35,430 --> 00:44:32,560
that indeed last year we announced the

1199
00:44:37,430 --> 00:44:35,440
inclusion of those two objects in our

1200
00:44:38,710 --> 00:44:37,440
focused science program called new

1201
00:44:40,950 --> 00:44:38,720
frontiers

1202
00:44:43,750 --> 00:44:40,960
those proposals are in and currently

1203
00:44:44,950 --> 00:44:43,760
under evaluation and they do indeed

1204
00:44:48,069 --> 00:44:44,960
include

1205
00:44:51,510 --> 00:44:48,079
proposals to go back to titan and

1206
00:44:54,150 --> 00:44:51,520
enceladus so we'll look through this

1207
00:44:56,309 --> 00:44:54,160
competition and see what happens

1208
00:44:58,870 --> 00:44:56,319
okay uh you got another question there

1209
00:45:01,030 --> 00:44:58,880
jason sure uh this one comes from uh

1210
00:45:02,550 --> 00:45:01,040
pietro who asks if you could go back and

1211
00:45:06,150 --> 00:45:02,560
change something in cassini an

1212
00:45:09,670 --> 00:45:06,160
instrument or skill what would it be

1213
00:45:14,950 --> 00:45:12,230

okay if i could go back and change some

1214
00:45:17,829 --> 00:45:14,960
instruments on cassini i think i'd

1215
00:45:20,550 --> 00:45:17,839
select flying some more capable mass

1216
00:45:23,109 --> 00:45:20,560
spectrometers you know if we had known

1217
00:45:25,430 --> 00:45:23,119
about the geysers on enceladus ahead of

1218
00:45:27,670 --> 00:45:25,440
time that would have perhaps guided us

1219
00:45:31,030 --> 00:45:27,680
something to go back and perhaps look

1220
00:45:32,710 --> 00:45:31,040
for amino acids fatty acids possible

1221
00:45:34,550 --> 00:45:32,720
evidence of life so if i could change

1222
00:45:36,069 --> 00:45:34,560
one thing it'd be to carry some

1223
00:45:37,589 --> 00:45:36,079
spectrometers

1224
00:45:39,109 --> 00:45:37,599
that could do some work for of her

1225
00:45:44,710 --> 00:45:39,119
looking for life

1226
00:45:49,109 --> 00:45:47,030
you know we we went in with everything

1227
00:45:52,230 --> 00:45:49,119
we possibly could we had the swiss army

1228
00:45:55,109 --> 00:45:52,240
knife and now we know so much more now

1229
00:45:56,710 --> 00:45:55,119
we can fine-tune it but this spacecraft

1230
00:45:58,630 --> 00:45:56,720
i i like i said i couldn't have asked

1231
00:46:02,230 --> 00:45:58,640
for anything

1232
00:46:07,589 --> 00:46:02,240
all right we're going to come back to

1233
00:46:11,670 --> 00:46:09,270
i'm emily locawello with the planetary

1234
00:46:13,270 --> 00:46:11,680
society with a couple science questions

1235
00:46:14,790 --> 00:46:13,280
um hunter i'm wondering if you could

1236
00:46:17,109 --> 00:46:14,800
tell us a little bit more about that

1237
00:46:18,950 --> 00:46:17,119
ring rain concept that you're trying to

1238
00:46:20,870 --> 00:46:18,960

test and how what you're learning about

1239
00:46:22,630 --> 00:46:20,880
it and linda i know that there's a

1240
00:46:24,309 --> 00:46:22,640
science team meeting going on this week

1241
00:46:26,309 --> 00:46:24,319
i'm wondering if you can share any of

1242
00:46:28,950 --> 00:46:26,319
the early exciting results from the

1243
00:46:31,430 --> 00:46:28,960
proximal mission

1244
00:46:32,630 --> 00:46:31,440
well the ring rain concept as i

1245
00:46:35,829 --> 00:46:32,640
mentioned was

1246
00:46:37,990 --> 00:46:35,839
first introduced in the 1980s and it was

1247
00:46:40,069 --> 00:46:38,000
a concept of

1248
00:46:42,630 --> 00:46:40,079
material from the rings mainly water

1249
00:46:44,150 --> 00:46:42,640
vapor and ice grains

1250
00:46:46,230 --> 00:46:44,160
descending into the atmosphere and

1251
00:46:48,470 --> 00:46:46,240
causing changes in the atmosphere

1252
00:46:50,790 --> 00:46:48,480
and we have measured that and we've we

1253
00:46:53,510 --> 00:46:50,800
do see the water but we see other

1254
00:46:54,870 --> 00:46:53,520
constituents as well so it's much more

1255
00:46:57,990 --> 00:46:54,880
complex

1256
00:46:59,990 --> 00:46:58,000
than we imagined before and we'll be you

1257
00:47:02,230 --> 00:47:00,000
know we're trying to

1258
00:47:04,069 --> 00:47:02,240
we're traveling at 31 kilometers per

1259
00:47:05,190 --> 00:47:04,079
second and gases coming into our

1260
00:47:06,550 --> 00:47:05,200
instrument

1261
00:47:07,430 --> 00:47:06,560
very fast

1262
00:47:14,470 --> 00:47:07,440
and

1263
00:47:16,470 --> 00:47:14,480

we so we're working very carefully to

1264
00:47:18,230 --> 00:47:16,480
understand that before we

1265
00:47:19,990 --> 00:47:18,240
go out and tell the public what we're

1266
00:47:21,670 --> 00:47:20,000
seeing

1267
00:47:23,510 --> 00:47:21,680
yes emily we're having one of our

1268
00:47:25,910 --> 00:47:23,520
project science group meetings in fact

1269
00:47:28,390 --> 00:47:25,920
it's the 73rd meeting we were having of

1270
00:47:30,950 --> 00:47:28,400
this group since we first got started

1271
00:47:33,349 --> 00:47:30,960
and there have just been some tremendous

1272
00:47:35,910 --> 00:47:33,359
presentations about the grand finale

1273
00:47:38,390 --> 00:47:35,920
science some of it only days old and

1274
00:47:40,630 --> 00:47:38,400
what i can tell you is that many of our

1275
00:47:42,630 --> 00:47:40,640
models we're finding out are too simple

1276
00:47:44,230 --> 00:47:42,640
or just out and out wrong

1277
00:47:46,390 --> 00:47:44,240
and so the scientists are carefully

1278
00:47:48,870 --> 00:47:46,400
looking at and calibrating their data

1279
00:47:50,230 --> 00:47:48,880
and comparing notes and discussing it

1280
00:47:53,030 --> 00:47:50,240
and there's nothing that makes a

1281
00:47:54,790 --> 00:47:53,040
scientist happier than finding out hey

1282
00:47:56,870 --> 00:47:54,800
my model's wrong i have to sort of start

1283
00:47:59,190 --> 00:47:56,880
over and and work it through so we have

1284
00:48:01,589 --> 00:47:59,200
a lot of very very happy scientists

1285
00:48:03,030 --> 00:48:01,599
we're meeting down at caltech and so

1286
00:48:05,270 --> 00:48:03,040
hopefully in the coming months we'll

1287
00:48:07,349 --> 00:48:05,280
have some answers but the in particular

1288
00:48:09,109 --> 00:48:07,359

the interior of the planet is very

1289
00:48:10,790 --> 00:48:09,119
different than we expected its gravity

1290
00:48:12,150 --> 00:48:10,800
field is not at all what we expected

1291
00:48:13,990 --> 00:48:12,160
from our models

1292
00:48:16,870 --> 00:48:14,000
also the magnetic field we're finding

1293
00:48:19,510 --> 00:48:16,880
that the rotation axis of saturn and the

1294
00:48:21,589 --> 00:48:19,520
magnetic field axis are almost perfectly

1295
00:48:22,950 --> 00:48:21,599
aligned and everything we think we know

1296
00:48:25,750 --> 00:48:22,960
tells us that if you don't have at least

1297
00:48:28,470 --> 00:48:25,760
a small tilt you can't maintain those

1298
00:48:30,549 --> 00:48:28,480
currents that sustain a magnetic field

1299
00:48:32,549 --> 00:48:30,559
so we have some more thinking and some

1300
00:48:34,230 --> 00:48:32,559
more work to do

1301
00:48:39,109 --> 00:48:34,240
okay questions here i think there's one

1302
00:48:43,430 --> 00:48:41,829
hi robert perlman with collect space um

1303
00:48:44,630 --> 00:48:43,440
not that there'd be any way of verifying

1304
00:48:46,630 --> 00:48:44,640
this but uh

1305
00:48:48,470 --> 00:48:46,640
has there been any modeling or any even

1306
00:48:50,950 --> 00:48:48,480
best guesses of how cassini's going to

1307
00:48:53,670 --> 00:48:50,960
come apart and what might be the last

1308
00:48:56,150 --> 00:48:53,680
piece to survive

1309
00:48:59,030 --> 00:48:56,160
yes yes there's been very thorough

1310
00:49:01,990 --> 00:48:59,040
analysis of piece by piece

1311
00:49:04,950 --> 00:49:02,000
deconstruction if you will of cassini

1312
00:49:06,069 --> 00:49:04,960
and we believe that the final components

1313
00:49:11,349 --> 00:49:06,079

to

1314
00:49:14,150 --> 00:49:11,359
components that are wrapped around

1315
00:49:16,790 --> 00:49:14,160
the cassinis has these radioactive

1316
00:49:19,270 --> 00:49:16,800
power supplies and each little slug of

1317
00:49:21,430 --> 00:49:19,280
plutonium is wrapped around as wrapped

1318
00:49:23,829 --> 00:49:21,440
with iridium and then they're put inside

1319
00:49:25,670 --> 00:49:23,839
an aeroshell that would in order to

1320
00:49:27,270 --> 00:49:25,680
avoid any possible

1321
00:49:29,750 --> 00:49:27,280
release during a launch accident or

1322
00:49:31,349 --> 00:49:29,760
re-entry and that's just how the iridium

1323
00:49:33,349 --> 00:49:31,359
has a very high melting point and the

1324
00:49:35,670 --> 00:49:33,359
material around them is even higher so

1325
00:49:38,230 --> 00:49:35,680
those will be the last pieces uh other

1326
00:49:39,670 --> 00:49:38,240
than that taking those the the parts of

1327
00:49:40,630 --> 00:49:39,680
the spacecraft that will be shielded

1328
00:49:42,230 --> 00:49:40,640
away

1329
00:49:43,910 --> 00:49:42,240
will last a little bit longer but you

1330
00:49:45,430 --> 00:49:43,920
know a lot of the spacecraft is aluminum

1331
00:49:46,150 --> 00:49:45,440
it's going to melt very quickly a lot of

1332
00:49:47,109 --> 00:49:46,160
its

1333
00:49:49,430 --> 00:49:47,119
carbon

1334
00:49:52,710 --> 00:49:49,440
fiber and mylar and things like that

1335
00:49:57,030 --> 00:49:54,790
okay uh how about some more social media

1336
00:49:58,870 --> 00:49:57,040
questions can you sure here's two good

1337
00:50:01,349 --> 00:49:58,880
ones here uh the first one comes from

1338
00:50:02,950 --> 00:50:01,359

user anshul who asks what is the last

1339
00:50:05,270 --> 00:50:02,960
bit of data that we will receive from

1340
00:50:08,390 --> 00:50:05,280
cassini

1341
00:50:10,309 --> 00:50:08,400
the very last bit of data will include

1342
00:50:12,630 --> 00:50:10,319
the ina neutral mass spectrometer data

1343
00:50:14,309 --> 00:50:12,640
but they come down in packets so we

1344
00:50:16,870 --> 00:50:14,319
don't know if the inms packet will be

1345
00:50:19,030 --> 00:50:16,880
the last one or a magnetometer packet or

1346
00:50:20,870 --> 00:50:19,040
whatever but they'll be coming back as

1347
00:50:23,270 --> 00:50:20,880
quickly as we can send them back so

1348
00:50:27,109 --> 00:50:23,280
we'll find out with that final bit well

1349
00:50:30,150 --> 00:50:27,119
actually to put and we'll see the radio

1350
00:50:31,990 --> 00:50:30,160
signal dissipate so our very last bit of

1351
00:50:33,510 --> 00:50:32,000
science data if we don't get a complete

1352
00:50:35,349 --> 00:50:33,520
packet could very well be the radio

1353
00:50:37,430 --> 00:50:35,359
science

1354
00:50:39,510 --> 00:50:37,440
all right lots of folks are asking about

1355
00:50:41,510 --> 00:50:39,520
what happens next so lisa here says what

1356
00:50:43,430 --> 00:50:41,520
happens to the team working with cassini

1357
00:50:44,950 --> 00:50:43,440
saturn after the missions ends are they

1358
00:50:46,470 --> 00:50:44,960
just reassigned to new projects or

1359
00:50:48,870 --> 00:50:46,480
missions at nasa are they off job

1360
00:50:51,990 --> 00:50:48,880
hunting

1361
00:50:54,309 --> 00:50:52,000
well they're most most of the engineers

1362
00:50:56,309 --> 00:50:54,319
there's there is an active planetary

1363
00:50:58,150 --> 00:50:56,319

program here at jpl and a lot of mission

1364
00:51:00,630 --> 00:50:58,160
of our engineers have already

1365
00:51:03,030 --> 00:51:00,640
uh kind of have semi-migrated over to

1366
00:51:04,950 --> 00:51:03,040
these other opportunities uh we're not

1367
00:51:06,390 --> 00:51:04,960
we're not having a big layoffs or

1368
00:51:08,950 --> 00:51:06,400
anything like that there's lots of work

1369
00:51:10,950 --> 00:51:08,960
for everyone some of us have some

1370
00:51:11,910 --> 00:51:10,960
paperwork to do

1371
00:51:13,349 --> 00:51:11,920
so

1372
00:51:14,300 --> 00:51:13,359
and

1373
00:51:16,309 --> 00:51:14,310
not just me

1374
00:51:18,390 --> 00:51:16,319
[Laughter]

1375
00:51:21,109 --> 00:51:18,400
so there's a lot of documentation and of

1376
00:51:22,630 --> 00:51:21,119
course the science data to the extent

1377
00:51:25,670 --> 00:51:22,640
that it can be funded

1378
00:51:28,470 --> 00:51:25,680
by research grants will continue for

1379
00:51:30,069 --> 00:51:28,480
decades so that that those opportunities

1380
00:51:32,230 --> 00:51:30,079
for both our current and young

1381
00:51:33,750 --> 00:51:32,240
scientists will will be at least for

1382
00:51:35,109 --> 00:51:33,760
another couple of decades got to be

1383
00:51:38,069 --> 00:51:35,119
right and the cassini scientists are

1384
00:51:39,910 --> 00:51:38,079
funded for the next year basically to

1385
00:51:42,390 --> 00:51:39,920
make sure they carefully calibrate and

1386
00:51:44,630 --> 00:51:42,400
understand all of this grand finale data

1387
00:51:46,710 --> 00:51:44,640
to put it in the planetary data system

1388
00:51:48,790 --> 00:51:46,720

and from there it will be accessible to

1389
00:51:51,109 --> 00:51:48,800
future scientists you know who many who

1390
00:51:52,790 --> 00:51:51,119
knows how many phd theses will be

1391
00:51:54,470 --> 00:51:52,800
written in the coming decades with

1392
00:51:56,630 --> 00:51:54,480
cassini data

1393
00:51:59,670 --> 00:51:56,640
so indeed uh you know cassini's really

1394
00:52:02,069 --> 00:51:59,680
given everyone on-the-job training

1395
00:52:03,990 --> 00:52:02,079
uh on operating spacecraft and and

1396
00:52:06,309 --> 00:52:04,000
keeping our instruments healthy and

1397
00:52:11,270 --> 00:52:06,319
analyzing the data and so

1398
00:52:13,829 --> 00:52:11,280
we have a cadre of highly capable

1399
00:52:15,589 --> 00:52:13,839
scientists engineers

1400
00:52:17,750 --> 00:52:15,599
that

1401
00:52:20,150 --> 00:52:17,760
will keep busy

1402
00:52:21,990 --> 00:52:20,160
for many decades our planetary program

1403
00:52:23,990 --> 00:52:22,000
is doing well

1404
00:52:26,630 --> 00:52:24,000
we have tremendous support by the

1405
00:52:28,950 --> 00:52:26,640
administration and congress we have

1406
00:52:32,150 --> 00:52:28,960
missions that we're planning now

1407
00:52:34,069 --> 00:52:32,160
and we really have a very bright future

1408
00:52:36,390 --> 00:52:34,079
all right we've got time for another

1409
00:52:40,390 --> 00:52:36,400
quick follow-up from leo enright from

1410
00:52:44,790 --> 00:52:42,790
i have a question for earl and linda

1411
00:52:47,349 --> 00:52:44,800
about enceladus

1412
00:52:49,910 --> 00:52:47,359
which is a tiny moon not much bigger

1413
00:52:52,470 --> 00:52:49,920

than ireland i have to point out

1414
00:52:55,750 --> 00:52:52,480
and i mean it's just astonishing that

1415
00:52:58,710 --> 00:52:55,760
it's uh it's so active uh earl do you

1416
00:53:01,270 --> 00:52:58,720
know that you have any kant's idea of

1417
00:53:04,870 --> 00:53:01,280
the chances that cassini would have

1418
00:53:06,470 --> 00:53:04,880
actually collided with this tiny moon

1419
00:53:08,630 --> 00:53:06,480
and for linda really if you wouldn't

1420
00:53:11,349 --> 00:53:08,640
mind just telling us

1421
00:53:14,069 --> 00:53:11,359
on the scale of things that you've seen

1422
00:53:16,630 --> 00:53:14,079
in your extraordinary career i mean

1423
00:53:18,309 --> 00:53:16,640
where does enceladus fit in

1424
00:53:22,630 --> 00:53:18,319
as as the

1425
00:53:26,150 --> 00:53:22,640
the amazing surprise as it were

1426
00:53:27,829 --> 00:53:26,160
well we we didn't do the math um

1427
00:53:30,549 --> 00:53:27,839
well actually i take that back we did do

1428
00:53:32,630 --> 00:53:30,559
the math several times for enceladus and

1429
00:53:35,829 --> 00:53:32,640
as long as we control the spacecraft no

1430
00:53:37,910 --> 00:53:35,839
problems but we were had a big challenge

1431
00:53:40,069 --> 00:53:37,920
in an uncontrolled spacecraft not

1432
00:53:42,870 --> 00:53:40,079
hitting within a chance of one in a

1433
00:53:44,470 --> 00:53:42,880
million enceladus in the next 50 years

1434
00:53:46,309 --> 00:53:44,480
the issues are of course that once it's

1435
00:53:47,829 --> 00:53:46,319
uncontrolled you've got titan out there

1436
00:53:49,990 --> 00:53:47,839
pushing it around it could push you just

1437
00:53:51,430 --> 00:53:50,000
about as you saw on those graphics just

1438
00:53:55,109 --> 00:53:51,440

about anywhere you wanted to go and

1439
00:53:58,069 --> 00:53:55,119
encelado celgus was a was a good size

1440
00:54:00,309 --> 00:53:58,079
target so we didn't do the actual math

1441
00:54:01,910 --> 00:54:00,319
for that any of those other than to

1442
00:54:04,630 --> 00:54:01,920
convince ourselves that an uncontrolled

1443
00:54:07,910 --> 00:54:04,640
spacecraft either had to be well outside

1444
00:54:10,309 --> 00:54:07,920
of saturn i mean way way outside or

1445
00:54:11,829 --> 00:54:10,319
inside

1446
00:54:13,829 --> 00:54:11,839
we have time for one last question let

1447
00:54:15,670 --> 00:54:13,839
me ask you the second part for the uh

1448
00:54:17,510 --> 00:54:15,680
for enceladus i would say enceladus

1449
00:54:19,270 --> 00:54:17,520
discoveries made by cassini are

1450
00:54:22,549 --> 00:54:19,280
certainly one of the most astonishing

1451
00:54:25,510 --> 00:54:22,559
set of discoveries for planetary science

1452
00:54:28,630 --> 00:54:25,520
to find that there's an ocean world so

1453
00:54:30,390 --> 00:54:28,640
tiny with the possibility of life so far

1454
00:54:32,630 --> 00:54:30,400
from the sun ten times further from the

1455
00:54:34,790 --> 00:54:32,640
sun than the earth has opened up our

1456
00:54:35,589 --> 00:54:34,800
paradigm of where you might look for

1457
00:54:38,309 --> 00:54:35,599
life

1458
00:54:40,710 --> 00:54:38,319
both within our own solar system and in

1459
00:54:42,789 --> 00:54:40,720
the exoplanet systems beyond so these

1460
00:54:45,270 --> 00:54:42,799
these ocean worlds enceladus titan also

1461
00:54:46,549 --> 00:54:45,280
has a liquid ocean has really changed

1462
00:54:50,230 --> 00:54:46,559
our thinking

1463
00:54:53,829 --> 00:54:51,670

okay well i actually i think that's

1464
00:54:55,430 --> 00:54:53,839
about all the time we have for today for

1465
00:54:56,870 --> 00:54:55,440
our briefing and thanks again to our

1466
00:54:57,990 --> 00:54:56,880
speakers and to all of you for your

1467
00:55:01,109 --> 00:54:58,000
questions

1468
00:55:02,710 --> 00:55:01,119
um here's how you can watch uh cassini

1469
00:55:04,789 --> 00:55:02,720
coverage that nasa television has to

1470
00:55:06,630 --> 00:55:04,799
offer over the next couple of days

1471
00:55:08,950 --> 00:55:06,640
tomorrow september 14th we'll have a

1472
00:55:11,670 --> 00:55:08,960
speaker program as part of our nasa

1473
00:55:15,190 --> 00:55:11,680
social event on cassini from 1 to 2 p.m

1474
00:55:16,630 --> 00:55:15,200
pacific time that's 4 to 5 p.m eastern

1475
00:55:18,789 --> 00:55:16,640
then on friday we'll have live

1476
00:55:21,510 --> 00:55:18,799
commentary from mission control from 4

1477
00:55:22,710 --> 00:55:21,520
to 5 30 a.m pacific that's 7 to 8 30

1478
00:55:24,309 --> 00:55:22,720
eastern

1479
00:55:26,230 --> 00:55:24,319
and following loss of signal we'll have

1480
00:55:28,870 --> 00:55:26,240
a post mission briefing right here

1481
00:55:33,430 --> 00:55:28,880
starting at 6 30 a.m pacific you can

1482
00:55:35,589 --> 00:55:33,440
watch live at nasa.gov live

1483
00:55:37,589 --> 00:55:35,599
more info about cassini is available at

1484
00:55:39,670 --> 00:55:37,599
nasa.gov and you'll find a detailed

1485
00:55:41,589 --> 00:55:39,680
online toolkit about cassini's grand

1486
00:55:43,109 --> 00:55:41,599
finale and end of mission

1487
00:55:46,630 --> 00:55:43,119
on the mission website at

1488
00:55:50,230 --> 00:55:48,470

grant finale

1489
00:55:51,910 --> 00:55:50,240
and uh i think we've got a couple more

1490
00:55:53,990 --> 00:55:51,920
minutes uh before the end of the hour

1491
00:55:55,589 --> 00:55:54,000
we'll end now with a replay of some of

1492
00:55:57,109 --> 00:55:55,599
the images and video we've shared during

1493
00:55:58,980 --> 00:55:57,119
our presentation today thank you so much

1494
00:56:24,309 --> 00:55:58,990
for joining us

1495
00:56:39,990 --> 00:56:26,309
okay everybody uh just an announcement

1496
00:56:58,630 --> 00:56:41,670
a couple of them already have interviews

1497
00:56:58,640 --> 00:57:49,910
okay