
NASA
September 14, 2017

1
00:00:07,670 --> 00:00:05,749
hello and welcome to nasa's jet

2
00:00:10,310 --> 00:00:07,680
propulsion laboratory in pasadena

3
00:00:11,990 --> 00:00:10,320
california my name is stephanie l smith

4
00:00:14,310 --> 00:00:12,000
i'm part of the social media team here

5
00:00:16,950 --> 00:00:14,320
at jpl and it's my pleasure to welcome

6
00:00:19,029 --> 00:00:16,960
you to the cassini nasa social a series

7
00:00:21,349 --> 00:00:19,039
of conversations with scientists and

8
00:00:22,550 --> 00:00:21,359
engineers behind nasa's flagship mission

9
00:00:24,710 --> 00:00:22,560
to saturn

10
00:00:27,349 --> 00:00:24,720
just hours from now we expect the final

11
00:00:28,710 --> 00:00:27,359
transmissions from this intrepid orbiter

12
00:00:30,870 --> 00:00:28,720
but before that

13
00:00:31,750 --> 00:00:30,880

we've got a conversations to have

14
00:00:34,389 --> 00:00:31,760
and

15
00:00:36,150 --> 00:00:34,399
we've got a short video to roll for you

16
00:00:44,069 --> 00:00:36,160
this will show you more of what's in

17
00:00:47,590 --> 00:00:45,490
a lone explorer

18
00:00:49,670 --> 00:00:47,600
[Music]

19
00:00:52,800 --> 00:00:49,680
on a mission to reveal the grandeur of

20
00:00:57,750 --> 00:00:52,810
saturn its rings and moons

21
00:01:05,350 --> 00:01:01,110
after 20 years in space nasa's cassini

22
00:01:06,789 --> 00:01:05,360
spacecraft is running out of fuel

23
00:01:09,270 --> 00:01:06,799
and so

24
00:01:12,149 --> 00:01:09,280
to protect moons of saturn that could

25
00:01:14,149 --> 00:01:12,159
have conditions suitable for life a

26
00:01:20,310 --> 00:01:14,159
spectacular end has been planned for

27
00:01:20,320 --> 00:01:37,190
[Music]

28
00:01:41,830 --> 00:01:40,230
in 2004 following a seven-year journey

29
00:01:44,870 --> 00:01:41,840
through the solar system

30
00:01:46,870 --> 00:01:44,880
cassini arrived at saturn

31
00:01:48,950 --> 00:01:46,880
attitude or pointing position and light

32
00:01:51,670 --> 00:01:48,960
up the rockets

33
00:01:54,710 --> 00:01:51,680
the spacecraft carried a passenger

34
00:01:57,270 --> 00:01:54,720
the european huygens probe the first

35
00:02:00,460 --> 00:01:57,280
human-made object to land on a world in

36
00:02:02,709 --> 00:02:00,470
the distant outer solar system

37
00:02:05,830 --> 00:02:02,719
[Music]

38
00:02:08,550 --> 00:02:05,840

for over a decade cassini has shared the

39
00:02:09,910 --> 00:02:08,560
wonders of saturn and its family of icy

40
00:02:12,470 --> 00:02:09,920
moons

41
00:02:16,070 --> 00:02:12,480
taking us to astounding worlds where

42
00:02:19,110 --> 00:02:16,080
methane rivers run to a methane sea

43
00:02:22,150 --> 00:02:19,120
where jets of ice and gas are blasting

44
00:02:24,869 --> 00:02:22,160
material into space from a liquid water

45
00:02:28,070 --> 00:02:24,879
ocean that might harbor the ingredients

46
00:02:32,710 --> 00:02:29,510
and saturn

47
00:02:38,309 --> 00:02:32,720
a giant world ruled by raging storms and

48
00:02:46,210 --> 00:02:39,270
now

49
00:02:46,220 --> 00:02:51,110
[Music]

50
00:02:58,229 --> 00:02:54,390
cassini's grand finale is a brand new

51
00:03:03,910 --> 00:03:00,790
as it repeatedly braves this unexplored

52
00:03:06,390 --> 00:03:03,920
region cassini seeks new insights about

53
00:03:08,790 --> 00:03:06,400
the origins of the rings and the nature

54
00:03:11,780 --> 00:03:08,800
of the planet's interior

55
00:03:18,229 --> 00:03:11,790
closer to saturn than ever before

56
00:03:20,070 --> 00:03:18,239
[Music]

57
00:03:23,750 --> 00:03:20,080
on the final orbit

58
00:03:26,070 --> 00:03:23,760
cassini will plunge into saturn

59
00:03:28,760 --> 00:03:26,080
fighting to keep its antenna pointed at

60
00:03:31,350 --> 00:03:28,770
earth as it transmits its farewell

61
00:03:34,789 --> 00:03:31,360
[Music]

62
00:03:38,470 --> 00:03:34,799
in the skies of saturn

63
00:03:43,960 --> 00:03:41,110

as cassini becomes part

64
00:03:52,280 --> 00:03:43,970
of the planet itself

65
00:03:52,290 --> 00:04:05,910
[Music]

66
00:04:10,229 --> 00:04:07,990
and there won't be a dry eye in the

67
00:04:12,550 --> 00:04:10,239
house

68
00:04:15,110 --> 00:04:12,560
so to give us a sense of how cassini

69
00:04:16,710 --> 00:04:15,120
fits into nasa's exploration of the

70
00:04:19,509 --> 00:04:16,720
solar system we have a very special

71
00:04:21,830 --> 00:04:19,519
guest all the way from washington dc so

72
00:04:23,830 --> 00:04:21,840
please welcome to the house dr thomas

73
00:04:26,310 --> 00:04:23,840
zurbukin associate administrator for the

74
00:04:33,909 --> 00:04:26,320
science mission directorate at nasa

75
00:04:38,790 --> 00:04:36,469
walking around here

76
00:04:40,629 --> 00:04:38,800
i'm so excited to be here and especially

77
00:04:42,550 --> 00:04:40,639
talking to the social media warriors

78
00:04:44,550 --> 00:04:42,560
here who are really helping us spread

79
00:04:46,310 --> 00:04:44,560
the word so thanks for being here and

80
00:04:48,710 --> 00:04:46,320
thanks for the work you do talking about

81
00:04:50,230 --> 00:04:48,720
science talking about the exploration

82
00:04:52,950 --> 00:04:50,240
stories that are out here which are

83
00:04:54,629 --> 00:04:52,960
ultimately stories about humanity that's

84
00:04:55,749 --> 00:04:54,639
really what this is about

85
00:04:57,110 --> 00:04:55,759
and so

86
00:04:59,909 --> 00:04:57,120
cassini

87
00:05:02,230 --> 00:04:59,919
is a really special mission for nasa i

88
00:05:04,390 --> 00:05:02,240

want to just tell you a few numbers just

89
00:05:06,950 --> 00:05:04,400
so you get a feeling for it

90
00:05:08,790 --> 00:05:06,960
uh at this moment in time we have 106

91
00:05:10,550 --> 00:05:08,800
missions that are either operating or in

92
00:05:12,469 --> 00:05:10,560
development so that's

93
00:05:15,510 --> 00:05:12,479
the nasa portfolio

94
00:05:17,430 --> 00:05:15,520
of these uh if i looked at the last

95
00:05:19,830 --> 00:05:17,440
six eight months or so and i looked at

96
00:05:22,150 --> 00:05:19,840
the top stories that came out by

97
00:05:24,550 --> 00:05:22,160
audience participation you know like how

98
00:05:27,189 --> 00:05:24,560
many eyeballs how many social media

99
00:05:30,230 --> 00:05:27,199
contacts i looked at the top 20 uh

100
00:05:32,150 --> 00:05:30,240
stories or so 17 of them come from the

101
00:05:33,749 --> 00:05:32,160
science mission director there's a lot

102
00:05:35,909 --> 00:05:33,759
of there's other parts to nasa's you

103
00:05:38,550 --> 00:05:35,919
know but some of the just the most

104
00:05:40,390 --> 00:05:38,560
amazing stories come from science out of

105
00:05:43,510 --> 00:05:40,400
the 17 and that's the point where i'm

106
00:05:46,230 --> 00:05:43,520
going eight of them came from cassini

107
00:05:48,710 --> 00:05:46,240
and it's stories that really moved

108
00:05:50,950 --> 00:05:48,720
people and because of the depth of the

109
00:05:53,110 --> 00:05:50,960
type of questions that are being asked

110
00:05:54,469 --> 00:05:53,120
and the questions that are really we

111
00:05:55,830 --> 00:05:54,479
relate to

112
00:05:58,070 --> 00:05:55,840
are we alone

113
00:06:00,150 --> 00:05:58,080

questions about where did we come from

114
00:06:02,390 --> 00:06:00,160
those are the very questions that are at

115
00:06:04,150 --> 00:06:02,400
the center of what planetary science is

116
00:06:05,110 --> 00:06:04,160
all about especially in the outer solar

117
00:06:07,350 --> 00:06:05,120
system

118
00:06:09,430 --> 00:06:07,360
so where are we where is cassini in this

119
00:06:11,749 --> 00:06:09,440
well you remember of course uh just a

120
00:06:13,510 --> 00:06:11,759
couple weeks ago we celebrated the 40th

121
00:06:15,749 --> 00:06:13,520
anniversary of another couple missions

122
00:06:18,950 --> 00:06:15,759
which are voyager they were really the

123
00:06:22,309 --> 00:06:18,960
first ones to zip by at these worlds

124
00:06:24,390 --> 00:06:22,319
giving us a glimpse of what's to come

125
00:06:25,749 --> 00:06:24,400
and that two of these worlds was visited

126
00:06:28,150 --> 00:06:25,759
again

127
00:06:30,790 --> 00:06:28,160
one of them jupiter multiple times over

128
00:06:32,710 --> 00:06:30,800
galileo juno is in orbit right now and

129
00:06:35,909 --> 00:06:32,720
this one we visited with cassini so you

130
00:06:37,990 --> 00:06:35,919
see we flew by with voyager we visited

131
00:06:40,870 --> 00:06:38,000
went into orbit with cassini and spent

132
00:06:42,469 --> 00:06:40,880
you know 13 years or so in orbit so

133
00:06:44,230 --> 00:06:42,479
what's next

134
00:06:46,469 --> 00:06:44,240
well what we're learning and what you

135
00:06:49,749 --> 00:06:46,479
see from other planets is what we really

136
00:06:51,670 --> 00:06:49,759
want to do is peel back

137
00:06:53,670 --> 00:06:51,680
that kind of cloak of ignorance and

138
00:06:55,909 --> 00:06:53,680

really look at the next type of

139
00:06:57,510 --> 00:06:55,919
questions and what will happen here

140
00:06:58,950 --> 00:06:57,520
is the questions that are really at the

141
00:07:00,710 --> 00:06:58,960
center of what excites us and the

142
00:07:04,309 --> 00:07:00,720
science community that's coming here

143
00:07:06,950 --> 00:07:04,319
requires us a next type of step

144
00:07:08,629 --> 00:07:06,960
perhaps landing perhaps a much better

145
00:07:10,710 --> 00:07:08,639
much higher resolution type of

146
00:07:12,469 --> 00:07:10,720
investigation than what we have done

147
00:07:15,990 --> 00:07:12,479
here so think of

148
00:07:18,950 --> 00:07:16,000
of cassini really as a major milestone

149
00:07:21,350 --> 00:07:18,960
on a journey of exploration where some

150
00:07:22,629 --> 00:07:21,360
of the best stuff is yet to come

151
00:07:24,150 --> 00:07:22,639
so for me

152
00:07:26,390 --> 00:07:24,160
this is an ending

153
00:07:29,110 --> 00:07:26,400
but like every ending it's really a

154
00:07:31,430 --> 00:07:29,120
beginning it's the beginning of dreaming

155
00:07:34,230 --> 00:07:31,440
beyond it's the beginning of exploring

156
00:07:36,390 --> 00:07:34,240
beyond and really for us to be excited

157
00:07:38,950 --> 00:07:36,400
and motivated to put together what are

158
00:07:41,510 --> 00:07:38,960
the next uh investigations the next

159
00:07:43,589 --> 00:07:41,520
missions that will come both of nasa

160
00:07:46,469 --> 00:07:43,599
often with contributions from others or

161
00:07:48,230 --> 00:07:46,479
other agencies so for me that's what

162
00:07:50,469 --> 00:07:48,240
cassini means and so what i'm going to

163
00:07:52,230 --> 00:07:50,479

do is just open it up for questions to

164
00:07:53,830 --> 00:07:52,240
see whether you want to shoot some rapid

165
00:08:05,510 --> 00:07:53,840
questions and see if there's anything

166
00:08:08,790 --> 00:08:06,869
you talked about questions that are too

167
00:08:09,990 --> 00:08:08,800
common with the next mission

168
00:08:12,150 --> 00:08:10,000
what are some questions that you would

169
00:08:13,990 --> 00:08:12,160
like to have answered

170
00:08:15,749 --> 00:08:14,000
see the

171
00:08:19,110 --> 00:08:15,759
question that relates to life you know

172
00:08:21,270 --> 00:08:19,120
it's a question that frankly

173
00:08:23,830 --> 00:08:21,280
i don't think many people expected we

174
00:08:26,070 --> 00:08:23,840
would be asking in the context of the

175
00:08:27,189 --> 00:08:26,080
outer solar system see what happens you

176
00:08:29,589 --> 00:08:27,199
know sometimes people talk about

177
00:08:31,749 --> 00:08:29,599
research like peeling the onion i said

178
00:08:33,430 --> 00:08:31,759
that's really wrong because see when you

179
00:08:35,190 --> 00:08:33,440
peel the onion it kind of the next layer

180
00:08:37,509 --> 00:08:35,200
looks a little bit like the layer before

181
00:08:39,909 --> 00:08:37,519
it's just farther in well the way the

182
00:08:41,670 --> 00:08:39,919
nature research kind of works it's like

183
00:08:43,670 --> 00:08:41,680
you peel back an onion what comes

184
00:08:45,829 --> 00:08:43,680
underneath is an apple you peel back an

185
00:08:47,590 --> 00:08:45,839
apple what comes on your knee is a

186
00:08:49,190 --> 00:08:47,600
a monkey

187
00:08:51,829 --> 00:08:49,200
so it's basically what happens is the

188
00:08:54,389 --> 00:08:51,839

type of questions that we unravel our

189
00:08:56,790 --> 00:08:54,399
questions that we don't expect at the

190
00:08:58,389 --> 00:08:56,800
beginning so right now if i had to guess

191
00:09:00,230 --> 00:08:58,399
the questions that we want to look at

192
00:09:02,630 --> 00:09:00,240
are questions both about just the

193
00:09:04,710 --> 00:09:02,640
physics and the environment you know the

194
00:09:07,030 --> 00:09:04,720
history of the solar system but very

195
00:09:09,190 --> 00:09:07,040
much live but once we start looking at

196
00:09:11,750 --> 00:09:09,200
that the whole it's not one question see

197
00:09:13,910 --> 00:09:11,760
it's a whole way of investigating that

198
00:09:16,230 --> 00:09:13,920
if you want to look at that repealing it

199
00:09:18,070 --> 00:09:16,240
away a new question will arise in a way

200
00:09:21,670 --> 00:09:18,080
that will surprise us tremendously just

201
00:09:26,310 --> 00:09:24,070
is very active on twitter we have a

202
00:09:27,910 --> 00:09:26,320
jam-packed rundown today and lots of

203
00:09:30,150 --> 00:09:27,920
folks to get to so if you have other

204
00:09:34,230 --> 00:09:30,160
questions for the good doctor you can

205
00:09:36,790 --> 00:09:34,240
find him at at dr underscore thomas z

206
00:09:41,030 --> 00:09:36,800
so thank you dr thomas z thanks so much

207
00:09:45,190 --> 00:09:43,670
all right so this is a conversation not

208
00:09:47,030 --> 00:09:45,200
a presentation

209
00:09:48,790 --> 00:09:47,040
and we want you to be part of it both

210
00:09:50,949 --> 00:09:48,800
the people who are here in the house at

211
00:09:53,509 --> 00:09:50,959
the nasa social and all of you watching

212
00:09:55,750 --> 00:09:53,519
at home or streaming this live online so

213
00:09:57,110 --> 00:09:55,760

go ahead and either join the

214
00:09:59,110 --> 00:09:57,120
conversation by raising your hand in the

215
00:10:00,949 --> 00:09:59,120
house or tagging your questions on

216
00:10:02,710 --> 00:10:00,959
social media

217
00:10:05,190 --> 00:10:02,720
ask nasa

218
00:10:06,070 --> 00:10:05,200
our first panel up today is our science

219
00:10:08,389 --> 00:10:06,080
panel

220
00:10:10,949 --> 00:10:08,399
and every mission starts with science

221
00:10:12,710 --> 00:10:10,959
science is the pole star that guides us

222
00:10:15,269 --> 00:10:12,720
it's with us every step of the way

223
00:10:17,829 --> 00:10:15,279
science dictates the instrument payload

224
00:10:20,230 --> 00:10:17,839
on a spacecraft and the maneuvers that

225
00:10:21,670 --> 00:10:20,240
it takes during the mission so today

226
00:10:23,750 --> 00:10:21,680
we've got some special guests and let's

227
00:10:25,670 --> 00:10:23,760
welcome them to the stage we've got

228
00:10:27,590 --> 00:10:25,680
linda spilker the cassini project

229
00:10:30,389 --> 00:10:27,600
scientist come on up guys

230
00:10:32,790 --> 00:10:30,399
join our little fireside chat here

231
00:10:35,110 --> 00:10:32,800
jonathan lunine an interdisciplinary

232
00:10:37,590 --> 00:10:35,120
titan scientist from cornell connor

233
00:10:40,710 --> 00:10:37,600
nixon the sears instrument deputy

234
00:10:42,389 --> 00:10:40,720
principal investigator and morgan cable

235
00:10:44,870 --> 00:10:42,399
assistant project science systems

236
00:10:48,790 --> 00:10:44,880
engineer now that's quite a mouthful

237
00:10:51,910 --> 00:10:48,800
and i want them to tell you in

238
00:10:54,470 --> 00:10:51,920

words that non-experts all understand

239
00:10:56,150 --> 00:10:54,480
what it is that those things mean i've

240
00:10:57,030 --> 00:10:56,160
asked them all to prepare and think

241
00:10:58,630 --> 00:10:57,040
about

242
00:11:00,470 --> 00:10:58,640
a few anecdotes from the mission and

243
00:11:02,389 --> 00:11:00,480
images that were very very

244
00:11:04,150 --> 00:11:02,399
special to them but in the interest of

245
00:11:06,230 --> 00:11:04,160
getting to as many of your questions as

246
00:11:08,230 --> 00:11:06,240
possible we're just going to start by

247
00:11:09,590 --> 00:11:08,240
having them say what it is that they do

248
00:11:11,670 --> 00:11:09,600
on the mission

249
00:11:13,750 --> 00:11:11,680
one after the other and then we'll go

250
00:11:15,350 --> 00:11:13,760
into questions and if in the answer of

251
00:11:16,870 --> 00:11:15,360
one of those questions you want to call

252
00:11:19,990 --> 00:11:16,880
for those slides

253
00:11:21,750 --> 00:11:20,000
then we'll pull them up okay so linda

254
00:11:23,670 --> 00:11:21,760
i'm the cassini project scientist and

255
00:11:26,389 --> 00:11:23,680
i've been very fortunate to work on

256
00:11:27,750 --> 00:11:26,399
cassini for almost 30 years and if you

257
00:11:29,910 --> 00:11:27,760
think about that that's the time it

258
00:11:33,110 --> 00:11:29,920
takes saturn to circle the sun once so i

259
00:11:34,790 --> 00:11:33,120
worked on cassini an entire saturn year

260
00:11:36,389 --> 00:11:34,800
and a story that i tell is that my

261
00:11:38,550 --> 00:11:36,399
oldest daughter jennifer had just

262
00:11:41,110 --> 00:11:38,560
started kindergarten when i was work

263
00:11:42,870 --> 00:11:41,120

started working on cassini and now she's

264
00:11:44,949 --> 00:11:42,880
married and she has a daughter of her

265
00:11:47,030 --> 00:11:44,959
own so you these long projects can

266
00:11:49,110 --> 00:11:47,040
actually be multi-generational and it's

267
00:11:51,430 --> 00:11:49,120
a wonderful to work with this incredible

268
00:11:54,829 --> 00:11:51,440
team of international scientists

269
00:11:58,389 --> 00:11:54,839
and it's going to really be sad to say

270
00:12:00,870 --> 00:11:58,399
goodbye i'm jonathan lanine and uh the

271
00:12:01,910 --> 00:12:00,880
the term interdisciplinary scientist

272
00:12:04,310 --> 00:12:01,920
means

273
00:12:06,710 --> 00:12:04,320
that i have responsibility on the

274
00:12:07,829 --> 00:12:06,720
mission for a particular science area in

275
00:12:10,389 --> 00:12:07,839
my case

276
00:12:11,269 --> 00:12:10,399
uh titan surface what is it made of how

277
00:12:14,870 --> 00:12:11,279
does it

278
00:12:16,790 --> 00:12:14,880
put gases in the atmosphere and the

279
00:12:19,110 --> 00:12:16,800
gases come to the surface

280
00:12:20,949 --> 00:12:19,120
and my role has been during development

281
00:12:23,990 --> 00:12:20,959
to make sure that that science would get

282
00:12:26,790 --> 00:12:24,000
done and then during the mission to

283
00:12:28,389 --> 00:12:26,800
help with the deciding which

284
00:12:29,990 --> 00:12:28,399
observations should be done on which

285
00:12:31,110 --> 00:12:30,000
passes of titan

286
00:12:33,110 --> 00:12:31,120
and

287
00:12:35,350 --> 00:12:33,120
thanks to the wonderful discoveries

288
00:12:37,829 --> 00:12:35,360

enceladus i've had a chance to work on

289
00:12:39,829 --> 00:12:37,839
enceladus as well so it's been a

290
00:12:42,550 --> 00:12:39,839
remarkable mission for me the breadth of

291
00:12:45,350 --> 00:12:42,560
science that goes on every day has just

292
00:12:47,430 --> 00:12:45,360
been extraordinary

293
00:12:48,710 --> 00:12:47,440
so i'm conor nixon i work at nasa

294
00:12:50,230 --> 00:12:48,720
goddard space flight center which

295
00:12:52,389 --> 00:12:50,240
provided the composite infrared

296
00:12:53,350 --> 00:12:52,399
spectrometer that's on cassini one of

297
00:12:55,269 --> 00:12:53,360
the core

298
00:12:57,190 --> 00:12:55,279
optical remote sensing instruments

299
00:12:58,470 --> 00:12:57,200
i work now as the deputy

300
00:13:00,629 --> 00:12:58,480
principal investigator of that

301
00:13:02,550 --> 00:13:00,639
instrument and in fact working on

302
00:13:04,310 --> 00:13:02,560
cassini has been my entire

303
00:13:06,150 --> 00:13:04,320
career so i started out in graduate

304
00:13:08,470 --> 00:13:06,160
school before the launch of cassini

305
00:13:10,470 --> 00:13:08,480
helping to build the sears instrument

306
00:13:11,750 --> 00:13:10,480
and then i continued on all the way

307
00:13:13,509 --> 00:13:11,760
through the

308
00:13:16,710 --> 00:13:13,519
launch the jupiter encounter which was a

309
00:13:18,470 --> 00:13:16,720
very exciting tryout period for cassini

310
00:13:20,150 --> 00:13:18,480
all the way through to getting in orbit

311
00:13:21,750 --> 00:13:20,160
and then actually doing the science with

312
00:13:24,150 --> 00:13:21,760
sears which has given us a lot of

313
00:13:26,470 --> 00:13:24,160

remarkable uh discoveries including the

314
00:13:28,150 --> 00:13:26,480
uh infrared signatures on enceladus the

315
00:13:30,470 --> 00:13:28,160
south pole and the discovery view

316
00:13:33,190 --> 00:13:30,480
molecules in titan's atmosphere so very

317
00:13:35,910 --> 00:13:33,200
exciting to be working on this mission

318
00:13:39,110 --> 00:13:35,920
hi i'm morgan cable and i haven't been

319
00:13:40,550 --> 00:13:39,120
working on cassini's for 30 years but a

320
00:13:42,150 --> 00:13:40,560
relatively recent addition but i think

321
00:13:43,750 --> 00:13:42,160
that's one of the wonderful things about

322
00:13:46,629 --> 00:13:43,760
cassini is that

323
00:13:48,150 --> 00:13:46,639
we're able to bring in people closer to

324
00:13:50,310 --> 00:13:48,160
the beginning of our careers and we can

325
00:13:52,389 --> 00:13:50,320
be mentored by some of these amazing

326
00:13:54,550 --> 00:13:52,399
scientists and engineers my role has

327
00:13:56,949 --> 00:13:54,560
been to support linda and the deputy

328
00:13:59,030 --> 00:13:56,959
project scientist as a project science

329
00:14:01,509 --> 00:13:59,040
systems engineer and basically help the

330
00:14:03,430 --> 00:14:01,519
scientists and the engineers communicate

331
00:14:04,710 --> 00:14:03,440
across the cassini mission because

332
00:14:07,430 --> 00:14:04,720
oftentimes they'll speak in different

333
00:14:09,670 --> 00:14:07,440
languages but it's been so much fun

334
00:14:12,230 --> 00:14:09,680
learning and watching this amazing

335
00:14:14,389 --> 00:14:12,240
mission uh grow and i can't wait to see

336
00:14:16,949 --> 00:14:14,399
what's next this is just one chapter of

337
00:14:18,790 --> 00:14:16,959
cassini that this is a start of a new

338
00:14:20,710 --> 00:14:18,800

chapter and i'm excited to see what new

339
00:14:22,790 --> 00:14:20,720
discoveries will find with the data

340
00:14:25,910 --> 00:14:22,800
analysis to come

341
00:14:27,910 --> 00:14:25,920
fantastic okay with that um let's start

342
00:14:30,470 --> 00:14:27,920
the conversation do we have questions

343
00:14:36,790 --> 00:14:30,480
for our science panel just wait for the

344
00:14:41,269 --> 00:14:38,470
hi thank you

345
00:14:43,430 --> 00:14:41,279
technology changes a lot since cassini

346
00:14:45,590 --> 00:14:43,440
was launched in 97

347
00:14:47,189 --> 00:14:45,600
are there tools or instruments that you

348
00:14:49,590 --> 00:14:47,199
wish cassini

349
00:14:51,189 --> 00:14:49,600
had on it that are available today and i

350
00:14:53,350 --> 00:14:51,199
guess in that sense

351
00:14:55,189 --> 00:14:53,360
that if you're able to do a return trip

352
00:14:57,269 --> 00:14:55,199
to investigate the moons what would you

353
00:14:59,590 --> 00:14:57,279
most want to put on it to get more

354
00:15:01,430 --> 00:14:59,600
information

355
00:15:03,990 --> 00:15:01,440
well i'll start

356
00:15:06,150 --> 00:15:04,000
no i don't wish that any instruments we

357
00:15:08,310 --> 00:15:06,160
have today were on cassini because then

358
00:15:10,230 --> 00:15:08,320
we'd end up in this continuous

359
00:15:11,750 --> 00:15:10,240
vicious circle of time travel where

360
00:15:13,829 --> 00:15:11,760
we're waiting for the next terrific

361
00:15:15,750 --> 00:15:13,839
instrument the thing about the cassini

362
00:15:18,389 --> 00:15:15,760
payload is that

363
00:15:21,750 --> 00:15:18,399

it was remarkably broad and deep and yes

364
00:15:24,470 --> 00:15:21,760
today those instruments are obsolete

365
00:15:25,990 --> 00:15:24,480
but the what they were able to do which

366
00:15:27,590 --> 00:15:26,000
i think is one of the most astounding

367
00:15:29,829 --> 00:15:27,600
things about cassini

368
00:15:31,430 --> 00:15:29,839
is that they could actually follow up on

369
00:15:33,269 --> 00:15:31,440
their own discoveries so let me give you

370
00:15:36,230 --> 00:15:33,279
an example quick one

371
00:15:39,110 --> 00:15:36,240
the cassini radar uh and the imaging

372
00:15:41,189 --> 00:15:39,120
experiments discovered lakes and seas on

373
00:15:43,269 --> 00:15:41,199
the surface of titan these beautiful

374
00:15:45,189 --> 00:15:43,279
images but there's a lot of discussion

375
00:15:47,430 --> 00:15:45,199
about were they really liquid how deep

376
00:15:50,150 --> 00:15:47,440
were they what were they made of

377
00:15:52,389 --> 00:15:50,160
the radar system actually

378
00:15:55,110 --> 00:15:52,399
was able to tell us that because instead

379
00:15:57,269 --> 00:15:55,120
of tilting the radar antenna to the side

380
00:15:59,430 --> 00:15:57,279
to make an image it was possible to

381
00:16:01,749 --> 00:15:59,440
point the radar straight down and

382
00:16:03,990 --> 00:16:01,759
actually send signals through these

383
00:16:06,310 --> 00:16:04,000
large seas and some of the lakes and

384
00:16:08,790 --> 00:16:06,320
detect the signal from the bottom of the

385
00:16:10,949 --> 00:16:08,800
seas as well as the top and so we could

386
00:16:12,389 --> 00:16:10,959
learn the depth and then by uh

387
00:16:14,310 --> 00:16:12,399
determining how

388
00:16:16,550 --> 00:16:14,320

much the signal was attenuated or

389
00:16:18,870 --> 00:16:16,560
weakened by its travel we could actually

390
00:16:21,670 --> 00:16:18,880
say something about the composition so

391
00:16:23,269 --> 00:16:21,680
being able to follow up in that way

392
00:16:25,269 --> 00:16:23,279
is really extraordinary now there are

393
00:16:27,110 --> 00:16:25,279
lots of wonderful instruments that we

394
00:16:29,030 --> 00:16:27,120
would all love to fly today back to the

395
00:16:30,949 --> 00:16:29,040
saturn system but there isn't enough

396
00:16:32,230 --> 00:16:30,959
time to tell you about them

397
00:16:34,470 --> 00:16:32,240
i think i want to add another thing

398
00:16:35,670 --> 00:16:34,480
sometimes you get serendipitous kinds of

399
00:16:37,269 --> 00:16:35,680
discoveries

400
00:16:39,430 --> 00:16:37,279
and i think one of them for titan that

401
00:16:41,350 --> 00:16:39,440
helped confirm you had liquid in those

402
00:16:43,509 --> 00:16:41,360
lakes and seas was actually to see a

403
00:16:45,509 --> 00:16:43,519
specular reflection if you look at just

404
00:16:47,670 --> 00:16:45,519
the right angle for the sunlight coming

405
00:16:49,670 --> 00:16:47,680
down hitting the liquid coming back up

406
00:16:52,389 --> 00:16:49,680
the visual infrared mapping spectrometer

407
00:16:54,629 --> 00:16:52,399
saw a beautiful specular reflection once

408
00:16:56,389 --> 00:16:54,639
the sunlight reached the northern lakes

409
00:16:58,389 --> 00:16:56,399
and seas so we could point to that and

410
00:16:59,590 --> 00:16:58,399
say okay that's what you see

411
00:17:02,069 --> 00:16:59,600
with the liquid and then of course

412
00:17:03,749 --> 00:17:02,079
probing the depth is just a further

413
00:17:05,270 --> 00:17:03,759

confirmation of what the composition

414
00:17:07,110 --> 00:17:05,280
might be

415
00:17:09,110 --> 00:17:07,120
i think if i could you know for a future

416
00:17:10,630 --> 00:17:09,120
mission there's so many discoveries

417
00:17:13,189 --> 00:17:10,640
cassini's made to follow up on and

418
00:17:15,189 --> 00:17:13,199
that's what's great about exploration

419
00:17:17,189 --> 00:17:15,199
but certainly to a couple of them to go

420
00:17:19,029 --> 00:17:17,199
back to enceladus with the instruments

421
00:17:21,429 --> 00:17:19,039
possibly to look for life

422
00:17:23,110 --> 00:17:21,439
maybe to land in a lake or sea on titan

423
00:17:25,110 --> 00:17:23,120
and actually sample and see what it's

424
00:17:27,429 --> 00:17:25,120
made of and could you have really

425
00:17:29,110 --> 00:17:27,439
unusual astrobiology

426
00:17:30,789 --> 00:17:29,120
in a methane sea

427
00:17:32,870 --> 00:17:30,799
and of course the rings are incredibly

428
00:17:35,270 --> 00:17:32,880
beautiful and maybe even for me to get

429
00:17:37,830 --> 00:17:35,280
closer to those rings and actually see

430
00:17:39,669 --> 00:17:37,840
how the particles interact and collide i

431
00:17:41,990 --> 00:17:39,679
think that would be a great mission a

432
00:17:44,070 --> 00:17:42,000
probe into saturn's atmosphere to

433
00:17:46,470 --> 00:17:44,080
measure things like nobel gases to you

434
00:17:48,630 --> 00:17:46,480
know to depth so many things we could do

435
00:17:50,390 --> 00:17:48,640
to go back and let's not forget uranus

436
00:17:52,950 --> 00:17:50,400
and neptune maybe we need cassini-like

437
00:17:53,909 --> 00:17:52,960
orbiters around those two worlds too

438
00:17:58,310 --> 00:17:53,919

all right i think we have a question

439
00:18:02,710 --> 00:18:00,549
hi um morgan i think you had a really

440
00:18:05,350 --> 00:18:02,720
good point that this is the first

441
00:18:07,430 --> 00:18:05,360
chapter um of the book

442
00:18:09,990 --> 00:18:07,440
and there's next generation and a lot of

443
00:18:12,470 --> 00:18:10,000
us are involved in education and um

444
00:18:15,430 --> 00:18:12,480
there's a next generation of young

445
00:18:17,350 --> 00:18:15,440
scientists and you know even just kids

446
00:18:20,070 --> 00:18:17,360
that are in school that are

447
00:18:21,909 --> 00:18:20,080
looking to you and and what you're

448
00:18:23,669 --> 00:18:21,919
accomplishing right now and do you have

449
00:18:25,669 --> 00:18:23,679
um something that you might want to say

450
00:18:27,669 --> 00:18:25,679
to them

451
00:18:29,110 --> 00:18:27,679
should i start okay

452
00:18:31,110 --> 00:18:29,120
well i think

453
00:18:33,029 --> 00:18:31,120
the most fun thing about working in

454
00:18:35,110 --> 00:18:33,039
planetary science is that

455
00:18:37,270 --> 00:18:35,120
there is no single path to get there

456
00:18:39,190 --> 00:18:37,280
i've had some some students or some kids

457
00:18:41,669 --> 00:18:39,200
come to me and say okay what what should

458
00:18:43,590 --> 00:18:41,679
i study to come and work at nasa one day

459
00:18:45,590 --> 00:18:43,600
and my answer is your follow your

460
00:18:48,070 --> 00:18:45,600
passion whatever that happens to be it

461
00:18:50,630 --> 00:18:48,080
could be biology it could be chemistry

462
00:18:52,950 --> 00:18:50,640
geology it could be engineering any of

463
00:18:55,590 --> 00:18:52,960

those paths is the correct path so as

464
00:18:57,190 --> 00:18:55,600
long as you love what you're doing

465
00:18:58,789 --> 00:18:57,200
and it happens to have something to do

466
00:19:00,470 --> 00:18:58,799
with space you'll probably end up

467
00:19:02,390 --> 00:19:00,480
finding your way here so that would be

468
00:19:03,830 --> 00:19:02,400
my advice is pursue your passion and

469
00:19:05,110 --> 00:19:03,840
then no matter what

470
00:19:06,390 --> 00:19:05,120
whatever you end up doing you'll be

471
00:19:07,750 --> 00:19:06,400
happy

472
00:19:09,270 --> 00:19:07,760
you know i'd like to add that by saying

473
00:19:11,029 --> 00:19:09,280
that i think that planetary science is

474
00:19:12,950 --> 00:19:11,039
one of the most remarkable fields to be

475
00:19:14,310 --> 00:19:12,960
involved in because really it's got a

476
00:19:17,029 --> 00:19:14,320
place for everyone it's got a place for

477
00:19:18,230 --> 00:19:17,039
chemists biologists physicists unlike

478
00:19:19,909 --> 00:19:18,240
other areas of astronomy where you're

479
00:19:22,549 --> 00:19:19,919
studying stars and galaxies and it

480
00:19:23,909 --> 00:19:22,559
really just takes a lot of physics but

481
00:19:25,830 --> 00:19:23,919
in planetary science there's everything

482
00:19:27,190 --> 00:19:25,840
there there's geology as we've

483
00:19:29,110 --> 00:19:27,200
discovered on titan there's a place for

484
00:19:30,470 --> 00:19:29,120
people who are oceanographers which we

485
00:19:33,350 --> 00:19:30,480
would have never anticipated outside of

486
00:19:35,830 --> 00:19:33,360
the earth so you can really uh

487
00:19:38,070 --> 00:19:35,840
study almost any field and and then wind

488
00:19:39,830 --> 00:19:38,080

up studying our own solar system and i

489
00:19:41,909 --> 00:19:39,840
think that's great yeah i would add one

490
00:19:43,750 --> 00:19:41,919
of the things that i i told my daughters

491
00:19:45,669 --> 00:19:43,760
and and because i heard this from my mom

492
00:19:47,830 --> 00:19:45,679
as well you know don't be afraid to take

493
00:19:49,350 --> 00:19:47,840
lots of math and science and classes

494
00:19:51,110 --> 00:19:49,360
that might be a little bit harder

495
00:19:53,270 --> 00:19:51,120
keep those doors open

496
00:19:55,190 --> 00:19:53,280
you know give yourself as much breath

497
00:19:56,950 --> 00:19:55,200
and opportunity because you may change

498
00:19:58,230 --> 00:19:56,960
your mind along the way when you go to

499
00:20:00,150 --> 00:19:58,240
college and both my daughter said that

500
00:20:01,909 --> 00:20:00,160
they started out one direction and went

501
00:20:06,870 --> 00:20:01,919
a different direction so keep your doors

502
00:20:07,990 --> 00:20:06,880
open you know that would be my advice

503
00:20:09,510 --> 00:20:08,000
we have another question in the front

504
00:20:10,950 --> 00:20:09,520
row

505
00:20:13,029 --> 00:20:10,960
this is a bit of a

506
00:20:14,710 --> 00:20:13,039
career-centric question so i apologize

507
00:20:15,750 --> 00:20:14,720
in advance

508
00:20:18,310 --> 00:20:15,760
as a

509
00:20:21,190 --> 00:20:18,320
concept designer in science fiction

510
00:20:25,029 --> 00:20:21,200
has science fiction

511
00:20:28,710 --> 00:20:25,039
inspired or informed potential usable

512
00:20:32,390 --> 00:20:30,310
ever

513
00:20:34,549 --> 00:20:32,400

good question i love to read science

514
00:20:36,390 --> 00:20:34,559
fiction yeah well that's a great

515
00:20:38,470 --> 00:20:36,400
question i

516
00:20:39,909 --> 00:20:38,480
can't think of an instance where science

517
00:20:41,909 --> 00:20:39,919
i think science fiction has inspired a

518
00:20:44,310 --> 00:20:41,919
lot of us to go into this field

519
00:20:46,310 --> 00:20:44,320
and it's always um it's like two sides

520
00:20:47,669 --> 00:20:46,320
of a coin where we have the science that

521
00:20:49,990 --> 00:20:47,679
we love and then on the other on the

522
00:20:51,590 --> 00:20:50,000
other side we get entertained um by the

523
00:20:52,630 --> 00:20:51,600
science fiction i certainly think that

524
00:20:54,630 --> 00:20:52,640
science fiction has taken this

525
00:20:55,669 --> 00:20:54,640
inspiration from some of the discoveries

526
00:20:57,990 --> 00:20:55,679
that come out of science around the

527
00:20:59,430 --> 00:20:58,000
solar system the uh you know europa

528
00:21:02,549 --> 00:20:59,440
report and

529
00:21:04,549 --> 00:21:02,559
these sorts of things um but i think

530
00:21:07,270 --> 00:21:04,559
that just keeping an open mind and being

531
00:21:08,870 --> 00:21:07,280
curious really is great for for both so

532
00:21:09,830 --> 00:21:08,880
i'm going to date myself

533
00:21:11,830 --> 00:21:09,840
um

534
00:21:14,149 --> 00:21:11,840
one of my inspirations was the other

535
00:21:15,029 --> 00:21:14,159
side of the sky by arthur c clarke which

536
00:21:17,510 --> 00:21:15,039
was a

537
00:21:18,470 --> 00:21:17,520
yes i know his eyebrows went up

538
00:21:19,909 --> 00:21:18,480

um

539
00:21:21,029 --> 00:21:19,919
he wrote it a few years before i

540
00:21:23,669 --> 00:21:21,039
actually read it

541
00:21:27,029 --> 00:21:23,679
the thing about it was that it drew a

542
00:21:29,029 --> 00:21:27,039
picture of a progression of uh space

543
00:21:31,590 --> 00:21:29,039
activities and accomplishments

544
00:21:33,669 --> 00:21:31,600
in a very short number of pages that as

545
00:21:34,950 --> 00:21:33,679
a kid really inspired me because when

546
00:21:37,350 --> 00:21:34,960
you're young you don't get a sense of

547
00:21:40,149 --> 00:21:37,360
how time passes and you know what has to

548
00:21:42,310 --> 00:21:40,159
come before in terms of accomplishments

549
00:21:45,510 --> 00:21:42,320
and it was it was drawing that kind of

550
00:21:47,669 --> 00:21:45,520
step-by-step story in which

551
00:21:49,270 --> 00:21:47,679
this first person sign is talking about

552
00:21:51,510 --> 00:21:49,280
going into space building a space

553
00:21:53,750 --> 00:21:51,520
station and then at the end of the story

554
00:21:54,630 --> 00:21:53,760
his son is about to leave on a trip to

555
00:21:57,350 --> 00:21:54,640
mars

556
00:21:59,270 --> 00:21:57,360
and it it really drew the picture of

557
00:22:00,950 --> 00:21:59,280
that generational approach to space

558
00:22:02,789 --> 00:22:00,960
exploration that

559
00:22:05,830 --> 00:22:02,799
impressed me as a kid and still

560
00:22:08,789 --> 00:22:05,840
impresses me today so read it it's great

561
00:22:10,950 --> 00:22:08,799
yeah i'd say i'm a big fan of star trek

562
00:22:11,830 --> 00:22:10,960
you know i grew up watching the the star

563
00:22:13,510 --> 00:22:11,840

trek

564
00:22:15,510 --> 00:22:13,520
series and i thought wow wouldn't that

565
00:22:17,029 --> 00:22:15,520
be really cool that inspired me to be an

566
00:22:18,149 --> 00:22:17,039
explorer because there were so many

567
00:22:20,950 --> 00:22:18,159
creative

568
00:22:23,029 --> 00:22:20,960
plots and so many creatures and places

569
00:22:25,830 --> 00:22:23,039
that they went that i really enjoyed

570
00:22:28,630 --> 00:22:25,840
star trek yeah the creativity in science

571
00:22:31,029 --> 00:22:28,640
i think is a critical element that uh

572
00:22:32,950 --> 00:22:31,039
people who maybe aren't going to study

573
00:22:34,789 --> 00:22:32,960
to be scientists

574
00:22:36,310 --> 00:22:34,799
tend not to realize that this is

575
00:22:38,390 --> 00:22:36,320
something when we're talking about the

576
00:22:40,070 --> 00:22:38,400
potential for life in a methane or

577
00:22:42,310 --> 00:22:40,080
ethane lake on titan what that might

578
00:22:43,909 --> 00:22:42,320
look like or now we're discovering so

579
00:22:46,390 --> 00:22:43,919
many exoplanets

580
00:22:47,510 --> 00:22:46,400
that i mean the properties there could

581
00:22:48,870 --> 00:22:47,520
pretty much anything that you can

582
00:22:50,390 --> 00:22:48,880
imagine that still fits within the laws

583
00:22:53,270 --> 00:22:50,400
of physics probably exists out there in

584
00:22:55,590 --> 00:22:53,280
the universe somewhere so being able to

585
00:22:58,950 --> 00:22:55,600
use your imagination to try to come up

586
00:23:00,549 --> 00:22:58,960
with as creative of a solution to some

587
00:23:01,990 --> 00:23:00,559
some strange set of conditions that

588
00:23:03,590 --> 00:23:02,000

might exist in the solar system or

589
00:23:05,590 --> 00:23:03,600
beyond is important it's an important

590
00:23:07,350 --> 00:23:05,600
part of our job when we're asking a

591
00:23:09,029 --> 00:23:07,360
question we want to make sure that we're

592
00:23:10,870 --> 00:23:09,039
designing the best experiment to find

593
00:23:12,149 --> 00:23:10,880
the answer and the answer may be

594
00:23:13,510 --> 00:23:12,159
really different from what we might

595
00:23:15,990 --> 00:23:13,520
expect

596
00:23:18,390 --> 00:23:16,000
well as the good mr spock would say

597
00:23:19,750 --> 00:23:18,400
fascinating

598
00:23:22,149 --> 00:23:19,760
are there any other questions for our

599
00:23:23,350 --> 00:23:22,159
science panel here in the house all

600
00:23:25,510 --> 00:23:23,360
right i think we've got time for one

601
00:23:27,590 --> 00:23:25,520
more and then kendra how are we doing on

602
00:23:30,070 --> 00:23:27,600
ask nasa questions online

603
00:23:32,710 --> 00:23:30,080
ooh okay all right we'll do one quick

604
00:23:34,549 --> 00:23:32,720
one and then one from social and uh and

605
00:23:36,470 --> 00:23:34,559
then any other questions that you have

606
00:23:39,029 --> 00:23:36,480
or that you have later you can tweet

607
00:23:42,070 --> 00:23:39,039
those two at nasa jpl or at cassini

608
00:23:44,789 --> 00:23:42,080
saturn and we will get you answers

609
00:23:46,789 --> 00:23:44,799
hi i'm from johns hopkins center for

610
00:23:49,350 --> 00:23:46,799
talented youth and our kids have lots

611
00:23:51,830 --> 00:23:49,360
and lots of questions for you so

612
00:23:53,750 --> 00:23:51,840
one of them is

613
00:23:55,909 --> 00:23:53,760

how would cassini react if it was

614
00:23:57,669 --> 00:23:55,919
contacted by aliens

615
00:23:58,870 --> 00:23:57,679
and how would this be recorded and

616
00:24:01,750 --> 00:23:58,880
transmitted

617
00:24:06,630 --> 00:24:01,760
and was cassini designed to

618
00:24:10,630 --> 00:24:08,390
i'm not sure cassini was designed to

619
00:24:12,070 --> 00:24:10,640
really handle that i i it's a good one

620
00:24:16,660 --> 00:24:12,080
for the engineering panel isn't it

621
00:24:16,670 --> 00:24:24,870
[Laughter]

622
00:24:28,230 --> 00:24:26,390
okay let's go ahead and go to those

623
00:24:30,310 --> 00:24:28,240
social media questions

624
00:24:31,590 --> 00:24:30,320
so uh can we get a microphone for you

625
00:24:33,190 --> 00:24:31,600
kendra

626
00:24:36,950 --> 00:24:33,200
thank you

627
00:24:40,549 --> 00:24:38,950
gil bryce asks what sort of information

628
00:24:42,230 --> 00:24:40,559
do you hope together during the final

629
00:24:46,149 --> 00:24:42,240
plunge

630
00:24:47,830 --> 00:24:46,159
hour instruments on including the

631
00:24:49,750 --> 00:24:47,840
iono-neutral mass spectrometer that's

632
00:24:52,070 --> 00:24:49,760
going to directly sample saturn's

633
00:24:54,149 --> 00:24:52,080
atmosphere so as we're going in till the

634
00:24:56,630 --> 00:24:54,159
very last second we'll be getting

635
00:24:58,149 --> 00:24:56,640
information back about the composition

636
00:25:00,470 --> 00:24:58,159
and the environment around the

637
00:25:02,470 --> 00:25:00,480
spacecraft

638
00:25:04,630 --> 00:25:02,480

anyone have anything else to add well i

639
00:25:06,230 --> 00:25:04,640
would just add that

640
00:25:08,789 --> 00:25:06,240
you know there are some very fundamental

641
00:25:10,710 --> 00:25:08,799
questions about saturn and its evolution

642
00:25:12,390 --> 00:25:10,720
and some of the things that hopefully

643
00:25:14,789 --> 00:25:12,400
cassini will measure during that plunge

644
00:25:16,950 --> 00:25:14,799
will provide some answers like the ratio

645
00:25:18,789 --> 00:25:16,960
of helium to hydrogen which we know for

646
00:25:22,710 --> 00:25:18,799
jupiter and we don't know quite so well

647
00:25:25,669 --> 00:25:24,549
i think we have time for one more social

648
00:25:27,990 --> 00:25:25,679
question

649
00:25:29,909 --> 00:25:28,000
i roll with seoul asked

650
00:25:32,710 --> 00:25:29,919
how far into the atmosphere is cassini

651
00:25:34,789 --> 00:25:32,720
expected to survive before breakup

652
00:25:37,110 --> 00:25:34,799
not very far at all we are just little

653
00:25:39,029 --> 00:25:37,120
tiny thrusters they're about 1 8 pound

654
00:25:41,190 --> 00:25:39,039
each if you look at there's a half scale

655
00:25:43,190 --> 00:25:41,200
model of cassini in the auditorium here

656
00:25:44,789 --> 00:25:43,200
there's one on the table it's it's huge

657
00:25:47,190 --> 00:25:44,799
so we think maybe about the level that

658
00:25:48,630 --> 00:25:47,200
the space station orbits is all before

659
00:25:51,350 --> 00:25:48,640
we hit atmosphere that's thick enough to

660
00:25:53,110 --> 00:25:51,360
turn it away and very shortly thereafter

661
00:25:56,710 --> 00:25:53,120
because he will disintegrate and then

662
00:25:58,310 --> 00:25:56,720
basically melt in saturn's atmosphere

663
00:26:01,660 --> 00:25:58,320

all right and with that

664
00:26:08,630 --> 00:26:06,230
[Applause]

665
00:26:10,470 --> 00:26:08,640
okay you may be wondering what the heck

666
00:26:12,549 --> 00:26:10,480
is up with this monitor that's to my

667
00:26:15,830 --> 00:26:12,559
side or what this gentleman is doing

668
00:26:17,909 --> 00:26:15,840
here you're about to find out okay so 83

669
00:26:20,230 --> 00:26:17,919
minutes one way light time separates us

670
00:26:22,870 --> 00:26:20,240
on earth from cassini at saturn and

671
00:26:24,870 --> 00:26:22,880
there is no chase plane so you might be

672
00:26:26,950 --> 00:26:24,880
wondering how can i see where is the

673
00:26:29,110 --> 00:26:26,960
spacecraft in relationship to the planet

674
00:26:30,870 --> 00:26:29,120
and what is it doing right now

675
00:26:33,190 --> 00:26:30,880
there's a solution for that and it is

676
00:26:34,870 --> 00:26:33,200
called eyes on the solar system and here

677
00:26:36,870 --> 00:26:34,880
to show us more about the new cassini

678
00:26:39,510 --> 00:26:36,880
module is one of the people who made it

679
00:26:41,350 --> 00:26:39,520
jason craig technical producer take it

680
00:26:43,190 --> 00:26:41,360
away jason thank you stephanie

681
00:26:45,110 --> 00:26:43,200
okay so first i want you guys to know

682
00:26:46,710 --> 00:26:45,120
you can download this right now and do

683
00:26:50,149 --> 00:26:46,720
what i'm doing if you have your laptop

684
00:26:54,310 --> 00:26:51,510
and click on the cassini picture

685
00:26:56,310 --> 00:26:54,320
download quick install it takes like 40

686
00:26:58,149 --> 00:26:56,320
seconds and you're good to go exactly

687
00:27:00,390 --> 00:26:58,159
like what you're going to see here

688
00:27:02,710 --> 00:27:00,400

okay so this is a 3d real-time

689
00:27:04,549 --> 00:27:02,720
interactive simulation of the entire

690
00:27:06,310 --> 00:27:04,559
cassini mission and i mean the entire

691
00:27:08,310 --> 00:27:06,320
mission you can watch it in real time

692
00:27:10,390 --> 00:27:08,320
for 20 years

693
00:27:12,549 --> 00:27:10,400
i don't recommend that

694
00:27:13,750 --> 00:27:12,559
but you're in charge of time so if you

695
00:27:16,230 --> 00:27:13,760
want to go backwards you want to go

696
00:27:18,950 --> 00:27:16,240
forwards you can do anything you want so

697
00:27:20,870 --> 00:27:18,960
i can let's rewind a little bit

698
00:27:22,630 --> 00:27:20,880
i can go to any point in the mission the

699
00:27:24,870 --> 00:27:22,640
dates are down here

700
00:27:26,710 --> 00:27:24,880
there's a lot of talk about enceladus on

701
00:27:32,310 --> 00:27:26,720
the stage so let's let's actually go

702
00:27:37,269 --> 00:27:34,549
so look at at the bottom there there's

703
00:27:38,630 --> 00:27:37,279
these fascinating geysers we had no idea

704
00:27:41,029 --> 00:27:38,640
they were there we actually had to send

705
00:27:43,190 --> 00:27:41,039
the mission out there and notice it so

706
00:27:45,190 --> 00:27:43,200
let me light it up for you so it's just

707
00:27:46,950 --> 00:27:45,200
such an incredible thing it's just so

708
00:27:48,549 --> 00:27:46,960
exciting to be part of this you can look

709
00:27:51,350 --> 00:27:48,559
at every single pass i'm going to show

710
00:27:53,990 --> 00:27:51,360
you the cassini car wash right now so we

711
00:27:55,990 --> 00:27:54,000
actually sent cassini through here

712
00:27:57,510 --> 00:27:56,000
on one of our flybys so if you're really

713
00:27:59,029 --> 00:27:57,520

serious about learning about cassini we

714
00:28:02,470 --> 00:27:59,039
have every flyby represented here

715
00:28:05,190 --> 00:28:02,480
including 127 titan flybys so

716
00:28:08,310 --> 00:28:05,200
have at it i'm going to go to enceladus

717
00:28:10,710 --> 00:28:08,320
and let's go down to this one e21 1028

718
00:28:12,230 --> 00:28:10,720
2015 we decided to fly

719
00:28:14,149 --> 00:28:12,240
right through them

720
00:28:15,590 --> 00:28:14,159
go ahead and turn on the ion and neutral

721
00:28:17,590 --> 00:28:15,600
mass spectrometer which you just heard

722
00:28:19,909 --> 00:28:17,600
about angled so that it's right in the

723
00:28:22,149 --> 00:28:19,919
plume want to confirm without any doubt

724
00:28:23,909 --> 00:28:22,159
whatsoever that this plume is made of

725
00:28:25,590 --> 00:28:23,919
water

726
00:28:27,029 --> 00:28:25,600
so we're going to the timeline you can

727
00:28:29,669 --> 00:28:27,039
see the timeline expanding and here we

728
00:28:31,269 --> 00:28:29,679
are back on october 28 2015 where we're

729
00:28:32,230 --> 00:28:31,279
going to kind of shoot the plumes right

730
00:28:33,990 --> 00:28:32,240
here

731
00:28:36,950 --> 00:28:34,000
so

732
00:28:39,590 --> 00:28:36,960
it's going to go right right on through

733
00:28:41,190 --> 00:28:39,600
so this is actually spectacular and most

734
00:28:43,510 --> 00:28:41,200
people want to know

735
00:28:45,190 --> 00:28:43,520
was there a risk was there any kind of

736
00:28:46,710 --> 00:28:45,200
risk whatsoever so yes we there was a

737
00:28:48,549 --> 00:28:46,720
risk analysis and it was determined that

738
00:28:49,830 --> 00:28:48,559

it was sufficiently small that we should

739
00:28:51,669 --> 00:28:49,840
go ahead and do this

740
00:28:53,190 --> 00:28:51,679
and the inum's instrument is on the

741
00:28:55,430 --> 00:28:53,200
corner cassini and it's angled right

742
00:28:57,669 --> 00:28:55,440
into this stuff so it went right through

743
00:29:00,149 --> 00:28:57,679
sniffed it tasted it and confirmed that

744
00:29:02,389 --> 00:29:00,159
it was in fact water so there is a

745
00:29:04,070 --> 00:29:02,399
subsurface ocean at enceladus

746
00:29:05,190 --> 00:29:04,080
and it is full of water

747
00:29:06,870 --> 00:29:05,200
so

748
00:29:08,870 --> 00:29:06,880
you quickly want to see where cassini is

749
00:29:11,750 --> 00:29:08,880
now just right here this is a lot this

750
00:29:13,830 --> 00:29:11,760
is a live simulation shot you've got the

751
00:29:15,590 --> 00:29:13,840
distance to saturn here countdown to the

752
00:29:17,669 --> 00:29:15,600
intermission and the speed it's 17 000

753
00:29:20,070 --> 00:29:17,679
miles an hour oh gosh i should put this

754
00:29:21,750 --> 00:29:20,080
on kilometers

755
00:29:23,590 --> 00:29:21,760
we don't want to cater explicitly to the

756
00:29:25,029 --> 00:29:23,600
american audience so all right now we're

757
00:29:27,029 --> 00:29:25,039
in kilometers

758
00:29:32,310 --> 00:29:27,039
that's better so this is where it is now

759
00:29:36,149 --> 00:29:34,630
this is 30 minutes per second all these

760
00:29:37,909 --> 00:29:36,159
rotations are accurate you can see what

761
00:29:39,190 --> 00:29:37,919
cassini does all the way in let's speed

762
00:29:41,430 --> 00:29:39,200
that up a little more

763
00:29:43,909 --> 00:29:41,440

how much time do i have all right

764
00:29:47,029 --> 00:29:43,919
okay so here we go spoiler this is

765
00:29:50,710 --> 00:29:48,310
now i got to slow down because

766
00:29:52,470 --> 00:29:50,720
spacecraft get faster as they approach

767
00:29:55,269 --> 00:29:52,480
and you can see the speed going way up

768
00:29:57,350 --> 00:29:55,279
and this is the signal that is the speed

769
00:29:58,470 --> 00:29:57,360
of light signal back to earth a data

770
00:30:00,630 --> 00:29:58,480
dump

771
00:30:03,669 --> 00:30:00,640
and it takes 83 minutes to get there so

772
00:30:04,470 --> 00:30:03,679
we don't really know for 83 minutes

773
00:30:05,830 --> 00:30:04,480
so

774
00:30:07,510 --> 00:30:05,840
pointing at earth out that way let me

775
00:30:10,230 --> 00:30:07,520
show you kind of a cool perspective of

776
00:30:12,630 --> 00:30:10,240
this from above

777
00:30:14,389 --> 00:30:12,640
so there's the final transmission

778
00:30:17,029 --> 00:30:14,399
right here i want to show you just how

779
00:30:19,110 --> 00:30:17,039
slow the speed of light is

780
00:30:21,029 --> 00:30:19,120
it's ridiculously slow

781
00:30:23,350 --> 00:30:21,039
so relatively speaking so let's let's

782
00:30:24,630 --> 00:30:23,360
pull out from uh let's pull right on out

783
00:30:26,950 --> 00:30:24,640
from saturn

784
00:30:29,110 --> 00:30:26,960
so there we are this is real time speed

785
00:30:30,630 --> 00:30:29,120
of light and it just crossed the outer

786
00:30:31,990 --> 00:30:30,640
moon iapetus

787
00:30:32,950 --> 00:30:32,000
just think about this this is the speed

788
00:30:35,029 --> 00:30:32,960

of light

789
00:30:37,750 --> 00:30:35,039
now i'll show you really how slow it is

790
00:30:40,149 --> 00:30:37,760
let's go above the solar system

791
00:30:42,870 --> 00:30:40,159
you can't even see the signal that's how

792
00:30:44,389 --> 00:30:42,880
slow the speed of light is going in real

793
00:30:46,230 --> 00:30:44,399
time right here

794
00:30:49,190 --> 00:30:46,240
you can't even see it yet so i actually

795
00:30:51,510 --> 00:30:49,200
have to uh speed up here

796
00:30:54,149 --> 00:30:51,520
this is five minutes per second

797
00:30:55,430 --> 00:30:54,159
so this ts is transmission start

798
00:30:57,750 --> 00:30:55,440
each number means that's how many

799
00:30:59,190 --> 00:30:57,760
minutes you have left of transmission

800
00:31:00,789 --> 00:30:59,200
and now let me go back to real rate so

801
00:31:03,269 --> 00:31:00,799
there we are speed of light it just

802
00:31:05,029 --> 00:31:03,279
crossed jupiter jupiter's orbit and it's

803
00:31:06,310 --> 00:31:05,039
still very far from earth and this is

804
00:31:08,310 --> 00:31:06,320
moving this is the speed of light in

805
00:31:09,750 --> 00:31:08,320
real time so it's kind of cool to see

806
00:31:11,990 --> 00:31:09,760
this so three and a half hour

807
00:31:13,909 --> 00:31:12,000
transmission at the end we get it 83

808
00:31:15,669 --> 00:31:13,919
minutes later and you can watch all of

809
00:31:17,350 --> 00:31:15,679
this in here along with all kinds of

810
00:31:18,950 --> 00:31:17,360
cool things

811
00:31:22,310 --> 00:31:18,960
like the seasons of saturn you've

812
00:31:27,350 --> 00:31:24,710
this is a very very sped up

813
00:31:29,669 --> 00:31:27,360

15-year back and forth cycle of the

814
00:31:31,750 --> 00:31:29,679
shadows on saturn the ring shadows the

815
00:31:38,230 --> 00:31:31,760
rings cast shadows onto the planet

816
00:31:41,590 --> 00:31:39,990
and you see where summer becomes winter

817
00:31:44,310 --> 00:31:41,600
and vice versa

818
00:31:46,230 --> 00:31:44,320
so the the year on saturn is about 29

819
00:31:48,070 --> 00:31:46,240
plus years

820
00:31:49,509 --> 00:31:48,080
it's pretty pretty crazy to see this

821
00:31:51,029 --> 00:31:49,519
sped up so every picture of saturn you

822
00:31:53,590 --> 00:31:51,039
can go back it's all accurate when you

823
00:31:57,710 --> 00:31:55,830
okay let's go back to live

824
00:31:59,350 --> 00:31:57,720
and that's it i'm getting the yank so

825
00:32:00,789 --> 00:31:59,360
eyes.nasa.gov you can do this for

826
00:32:02,310 --> 00:32:00,799
yourself it's a real-time accurate

827
00:32:03,990 --> 00:32:02,320
simulation we work directly with the

828
00:32:05,509 --> 00:32:04,000
scientists some of whom you've talked to

829
00:32:07,350 --> 00:32:05,519
we use all the real data the same thing

830
00:32:09,669 --> 00:32:07,360
the engineers use thanks very much and

831
00:32:12,389 --> 00:32:09,679
give it a shot

832
00:32:15,430 --> 00:32:12,399
thank you jason

833
00:32:18,149 --> 00:32:15,440
and jason before you go uh nasa eyes is

834
00:32:19,669 --> 00:32:18,159
streaming on uh nasa's new twitch

835
00:32:21,269 --> 00:32:19,679
channel right yes that's right go to

836
00:32:26,389 --> 00:32:21,279
twitch

837
00:32:29,190 --> 00:32:26,399
you can watch this view all the way in

838
00:32:30,870 --> 00:32:29,200

thank you all right so

839
00:32:32,389 --> 00:32:30,880
you have heard about the science you

840
00:32:34,149 --> 00:32:32,399
have seen the daring maneuvers that

841
00:32:35,590 --> 00:32:34,159
cassini will take

842
00:32:37,669 --> 00:32:35,600
let's hear from the people who are

843
00:32:40,230 --> 00:32:37,679
helping to make that happen the

844
00:32:42,310 --> 00:32:40,240
engineers so please welcome to the stage

845
00:32:45,269 --> 00:32:42,320
our engineering panel which is made up

846
00:32:47,750 --> 00:32:45,279
of earl mays the cassini project manager

847
00:32:49,110 --> 00:32:47,760
julie webster come on up guys come on up

848
00:32:50,950 --> 00:32:49,120
and join us

849
00:32:53,830 --> 00:32:50,960
the cassini spacecraft operations

850
00:32:56,870 --> 00:32:53,840
manager luis andrade cassini guidance

851
00:32:59,029 --> 00:32:56,880
and control engineer and molly bittner

852
00:33:04,710 --> 00:32:59,039
cassini systems engineer

853
00:33:08,870 --> 00:33:06,710
so just like our science panel i had

854
00:33:10,710 --> 00:33:08,880
them think about some of their favorite

855
00:33:12,549 --> 00:33:10,720
moments from the mission and they have

856
00:33:14,630 --> 00:33:12,559
some anecdotes and they have some images

857
00:33:17,430 --> 00:33:14,640
in their hip pockets but we want to

858
00:33:18,710 --> 00:33:17,440
start with what it is that they do so i

859
00:33:21,110 --> 00:33:18,720
challenge you

860
00:33:25,029 --> 00:33:21,120
to see if you can do this without using

861
00:33:27,430 --> 00:33:25,039
any tlas no three-letter acronyms

862
00:33:29,190 --> 00:33:27,440
yeah okay it's a throw down all right so

863
00:33:30,789 --> 00:33:29,200

we're gonna start take it away earl why

864
00:33:36,310 --> 00:33:30,799
don't you tell us what is what is it you

865
00:33:38,470 --> 00:33:36,320
do on this i'm the kcas proj mgr

866
00:33:39,590 --> 00:33:38,480
i'm the cassini project manager

867
00:33:42,149 --> 00:33:39,600
um

868
00:33:44,630 --> 00:33:42,159
before i toss budgets and schedules

869
00:33:46,389 --> 00:33:44,640
around i actually had some chops in

870
00:33:50,149 --> 00:33:46,399
spacecraft engineering and navigation

871
00:33:51,509 --> 00:33:50,159
but now i'm just the project manager

872
00:33:53,590 --> 00:33:51,519
i don't have any pictures but i thought

873
00:33:55,509 --> 00:33:53,600
maybe i'd share an interesting anecdote

874
00:33:57,830 --> 00:33:55,519
because if you know

875
00:34:00,710 --> 00:33:57,840
in astrodynamics we are just really

876
00:34:02,950 --> 00:34:00,720
prone to killing the holidays

877
00:34:04,389 --> 00:34:02,960
fourth of july labor day anytime we can

878
00:34:06,870 --> 00:34:04,399
make the flight team work on a three-day

879
00:34:10,790 --> 00:34:06,880
weekend we do and so for probe release

880
00:34:12,950 --> 00:34:10,800
huygens probe release christmas eve

881
00:34:14,629 --> 00:34:12,960
and we had a lot of europeans in town

882
00:34:15,750 --> 00:34:14,639
because of course it was their probe and

883
00:34:17,829 --> 00:34:15,760
they want to make sure that we got rid

884
00:34:19,190 --> 00:34:17,839
of it properly

885
00:34:21,909 --> 00:34:19,200
and so that we had a whole bunch of

886
00:34:24,149 --> 00:34:21,919
expats in town and we had christmas

887
00:34:25,829 --> 00:34:24,159
dinner at my home and it was just one of

888
00:34:28,149 --> 00:34:25,839

the nicest christmas meals we've had

889
00:34:29,909 --> 00:34:28,159
very simple but had just international

890
00:34:31,510 --> 00:34:29,919
we had people from france the

891
00:34:34,149 --> 00:34:31,520
netherlands

892
00:34:35,909 --> 00:34:34,159
england and of course a fair contingent

893
00:34:38,470 --> 00:34:35,919
of americans as well it's just a great

894
00:34:43,589 --> 00:34:41,000
all yours that's your story

895
00:34:45,190 --> 00:34:43,599
[Laughter]

896
00:34:48,470 --> 00:34:45,200
okay i'm julie webster i'm the

897
00:34:50,470 --> 00:34:48,480
spacecraft operations manager i first

898
00:34:53,190 --> 00:34:50,480
went to work for earl when he was when

899
00:34:55,589 --> 00:34:53,200
he really had chops when he had uh when

900
00:34:57,670 --> 00:34:55,599
he was the spacecraft operations manager

901
00:35:00,710 --> 00:34:57,680
i actually started with a spacecraft in

902
00:35:01,589 --> 00:35:00,720
1995 so i was there for the first power

903
00:35:06,630 --> 00:35:01,599
on

904
00:35:08,630 --> 00:35:06,640
orchestrated the test as we built up and

905
00:35:10,310 --> 00:35:08,640
went through this is

906
00:35:11,510 --> 00:35:10,320
this is what cassini looked like when i

907
00:35:14,310 --> 00:35:11,520
first saw it

908
00:35:16,710 --> 00:35:14,320
so it's a 12 sided hunk of aluminum

909
00:35:17,430 --> 00:35:16,720
with about 10 miles of wiring inside of

910
00:35:23,190 --> 00:35:17,440
it

911
00:35:28,230 --> 00:35:23,200
that hunk of aluminum

912
00:35:35,270 --> 00:35:31,829
i'm kind of a i guess i i engineer by

913
00:35:36,950 --> 00:35:35,280

touchy feely so um

914
00:35:38,790 --> 00:35:36,960
i actually said inside that as we

915
00:35:41,270 --> 00:35:38,800
powered things on to hear what they

916
00:35:43,030 --> 00:35:41,280
sounded like and what they they go

917
00:35:44,950 --> 00:35:43,040
through and i was telling another news

918
00:35:46,870 --> 00:35:44,960
crew today that

919
00:35:48,630 --> 00:35:46,880
when cassini goes in that's what i'm

920
00:35:51,270 --> 00:35:48,640
going to see if i close my eyes i'm

921
00:35:53,190 --> 00:35:51,280
going to see the inside of that 12-sided

922
00:35:54,790 --> 00:35:53,200
bay got another picture

923
00:35:56,470 --> 00:35:54,800
of it looking a little bit more

924
00:35:58,630 --> 00:35:56,480
professional so this is what it looked

925
00:36:00,790 --> 00:35:58,640
like as we were building it up that's a

926
00:36:04,310 --> 00:36:00,800
probe

927
00:36:06,390 --> 00:36:04,320
other things were on there we'd put the

928
00:36:07,990 --> 00:36:06,400
high gain antenna on we didn't have any

929
00:36:09,190 --> 00:36:08,000
of the thermal blankets on yet i think

930
00:36:11,190 --> 00:36:09,200
this was

931
00:36:13,750 --> 00:36:11,200
right before we were getting ready to go

932
00:36:17,190 --> 00:36:13,760
up to solar thermal vacuum and then the

933
00:36:19,349 --> 00:36:17,200
next picture is of course it's

934
00:36:22,150 --> 00:36:19,359
it's real picture the way it looks to

935
00:36:24,790 --> 00:36:22,160
everybody else today and

936
00:36:27,510 --> 00:36:24,800
in all its glory and all its glory earl

937
00:36:29,349 --> 00:36:27,520
tells me those gold those gold thermal

938
00:36:32,069 --> 00:36:29,359

blankets are not as gold anymore but i

939
00:36:33,270 --> 00:36:32,079
said they're pristine in my mind

940
00:36:35,190 --> 00:36:33,280
so that's

941
00:36:37,030 --> 00:36:35,200
that that's my part

942
00:36:39,589 --> 00:36:37,040
responsible for the health and safety of

943
00:36:40,390 --> 00:36:39,599
the spacecraft and molly is an ex team

944
00:36:43,750 --> 00:36:40,400
member

945
00:36:44,950 --> 00:36:43,760
percent of your time and luis works for

946
00:36:47,030 --> 00:36:44,960
me also

947
00:36:51,910 --> 00:36:47,040
so

948
00:36:54,230 --> 00:36:51,920
the lead guidance and control engineer

949
00:36:56,390 --> 00:36:54,240
for cassini's very final sequence of

950
00:36:58,310 --> 00:36:56,400
commands and as a guidance and control

951
00:37:01,109 --> 00:36:58,320
engineer pretty much my job is to

952
00:37:03,750 --> 00:37:01,119
determine cassini's orientation in space

953
00:37:06,230 --> 00:37:03,760
and also to steer cassini using the

954
00:37:07,829 --> 00:37:06,240
onboard thrusters and reaction wheels in

955
00:37:08,790 --> 00:37:07,839
order to point at different targets of

956
00:37:09,750 --> 00:37:08,800
interest

957
00:37:11,670 --> 00:37:09,760
and

958
00:37:13,829 --> 00:37:11,680
tomorrow during the final plunge i'll be

959
00:37:16,390 --> 00:37:13,839
in the mission control room at the front

960
00:37:18,390 --> 00:37:16,400
console monitoring real-time telemetry

961
00:37:20,710 --> 00:37:18,400
as it comes down from the spacecraft and

962
00:37:23,670 --> 00:37:20,720
i'll be calling out key attitude control

963
00:37:25,510 --> 00:37:23,680

events as they unfold and for my quick

964
00:37:26,870 --> 00:37:25,520
anecdote could you show my first image

965
00:37:29,270 --> 00:37:26,880
please

966
00:37:30,790 --> 00:37:29,280
so i've had a lot of great moments but

967
00:37:33,109 --> 00:37:30,800
i'll tell you about this one

968
00:37:36,150 --> 00:37:33,119
this is an image that cassini took of of

969
00:37:37,510 --> 00:37:36,160
pan and pan is saturn's innermost moon

970
00:37:39,109 --> 00:37:37,520
and

971
00:37:40,950 --> 00:37:39,119
the reason that this is special to me is

972
00:37:43,910 --> 00:37:40,960
because it's the result of an onboard

973
00:37:45,829 --> 00:37:43,920
vector update that yeah that i did

974
00:37:47,990 --> 00:37:45,839
and if we didn't do this vector update

975
00:37:49,670 --> 00:37:48,000
just right pan would have been

976
00:37:51,510 --> 00:37:49,680
completely outside of the camera's field

977
00:37:52,870 --> 00:37:51,520
of view and we would have missed it

978
00:37:54,550 --> 00:37:52,880
and over the years i've done a lot of

979
00:37:56,390 --> 00:37:54,560
these vector updates for titan and

980
00:37:59,030 --> 00:37:56,400
enceladus but this one really stuck in

981
00:38:01,829 --> 00:37:59,040
my mind because i remember when these

982
00:38:03,910 --> 00:38:01,839
images started coming down from cassini

983
00:38:07,109 --> 00:38:03,920
the scientists were just ecstatic they

984
00:38:08,310 --> 00:38:07,119
were so happy at how great these images

985
00:38:10,390 --> 00:38:08,320
came out

986
00:38:12,310 --> 00:38:10,400
and i remember at that moment it really

987
00:38:14,630 --> 00:38:12,320
hit me you know i have directly

988
00:38:17,430 --> 00:38:14,640

contributed to a scientific result of

989
00:38:19,990 --> 00:38:17,440
this magnitude and as a young engineer

990
00:38:22,150 --> 00:38:20,000
it was really inspirational to to know

991
00:38:25,030 --> 00:38:22,160
that you know in some way i'm

992
00:38:27,750 --> 00:38:25,040
contributing to cassini's legacy which

993
00:38:30,150 --> 00:38:27,760
is going to live on long after i'm gone

994
00:38:32,390 --> 00:38:30,160
so can we show the next image

995
00:38:33,589 --> 00:38:32,400
so we got over 50 of these pan images

996
00:38:35,430 --> 00:38:33,599
and when you stitch them all together

997
00:38:36,870 --> 00:38:35,440
you get this really cool video of of

998
00:38:39,109 --> 00:38:36,880
cassini's encounter this is not a

999
00:38:41,750 --> 00:38:39,119
simulation this is what cassini really

1000
00:38:44,390 --> 00:38:41,760
saw and that's pretty much

1001
00:38:46,150 --> 00:38:44,400
it for me so i'll hand it over to molly

1002
00:38:47,910 --> 00:38:46,160
all right hi everyone i'm molly bittner

1003
00:38:50,150 --> 00:38:47,920
i'm on the spacecraft operations team

1004
00:38:51,750 --> 00:38:50,160
i'm on julie's team and i am a systems

1005
00:38:53,990 --> 00:38:51,760
engineer which basically means that i

1006
00:38:55,910 --> 00:38:54,000
oversee the entirety of the spacecraft

1007
00:38:58,069 --> 00:38:55,920
so not just one subsystem but how they

1008
00:39:00,710 --> 00:38:58,079
all work together so i actually have an

1009
00:39:02,550 --> 00:39:00,720
image two from 2015

1010
00:39:04,310 --> 00:39:02,560
so this is enceladus plumes that a lot

1011
00:39:06,630 --> 00:39:04,320
of the science team has talked about but

1012
00:39:08,470 --> 00:39:06,640
to me this picture represents um sort of

1013
00:39:10,390 --> 00:39:08,480

the spacecraft as an orchestra right so

1014
00:39:12,790 --> 00:39:10,400
that's how i view the spacecraft all the

1015
00:39:14,630 --> 00:39:12,800
pieces working together to get us this

1016
00:39:16,470 --> 00:39:14,640
beautiful goal that we have so this was

1017
00:39:19,190 --> 00:39:16,480
in 2015 and one of the sequences that i

1018
00:39:21,430 --> 00:39:19,200
was lead on and i remember designing the

1019
00:39:23,190 --> 00:39:21,440
orbit trim maneuvers or otms if you like

1020
00:39:25,030 --> 00:39:23,200
acronyms

1021
00:39:26,790 --> 00:39:25,040
leading up to this flyby and it was a

1022
00:39:29,109 --> 00:39:26,800
really low altitude where we just

1023
00:39:31,910 --> 00:39:29,119
skimmed over the top of those plumes and

1024
00:39:34,470 --> 00:39:31,920
we had luisa's team guiding the attitude

1025
00:39:36,310 --> 00:39:34,480
of that flyby and the navigation team

1026
00:39:37,910 --> 00:39:36,320
and we had all the subsystems working

1027
00:39:40,790 --> 00:39:37,920
together and that's really

1028
00:39:42,870 --> 00:39:40,800
what i value on this team is every

1029
00:39:44,230 --> 00:39:42,880
different part works so well together

1030
00:39:46,069 --> 00:39:44,240
and really seeing it all come together

1031
00:39:47,670 --> 00:39:46,079
to deliver this great science is really

1032
00:39:49,109 --> 00:39:47,680
amazing

1033
00:39:51,589 --> 00:39:49,119
all right with that we're going to go

1034
00:39:56,470 --> 00:39:51,599
ahead and open it up for questions who's

1035
00:40:00,870 --> 00:39:59,430
pants right here we've had this uh

1036
00:40:02,310 --> 00:40:00,880
question passed off they said we should

1037
00:40:03,510 --> 00:40:02,320
ask the engineers

1038
00:40:06,790 --> 00:40:03,520

um

1039
00:40:07,510 --> 00:40:06,800
not the aliens want to leave that to you

1040
00:40:09,589 --> 00:40:07,520
uh

1041
00:40:11,589 --> 00:40:09,599
what will happen to the spacecraft as it

1042
00:40:14,550 --> 00:40:11,599
enters the top layers of atmosphere what

1043
00:40:16,710 --> 00:40:14,560
uh changes do you predict will happen

1044
00:40:19,990 --> 00:40:16,720
in in terms of

1045
00:40:21,510 --> 00:40:20,000
of the spacecraft well the the thrusters

1046
00:40:23,109 --> 00:40:21,520
the little thrusters

1047
00:40:25,270 --> 00:40:23,119
the little quarter pound thrusters that

1048
00:40:27,030 --> 00:40:25,280
are at each corner they were quarter

1049
00:40:28,870 --> 00:40:27,040
pound to start out with they're about 1

1050
00:40:30,710 --> 00:40:28,880
8 pound now because of the the

1051
00:40:32,630 --> 00:40:30,720
pressurization they'll start fighting

1052
00:40:35,510 --> 00:40:32,640
the atmosphere and luis is going to call

1053
00:40:37,829 --> 00:40:35,520
those steps out as we as we start to

1054
00:40:40,710 --> 00:40:37,839
fight the atmosphere we upped the data

1055
00:40:43,589 --> 00:40:40,720
rate to one per second so that we could

1056
00:40:46,069 --> 00:40:43,599
get the thrusters as fast as we could

1057
00:40:47,349 --> 00:40:46,079
and um eventually that's going to be

1058
00:40:49,670 --> 00:40:47,359
overcome

1059
00:40:51,750 --> 00:40:49,680
and we and we'll lose and we'll lose the

1060
00:40:53,589 --> 00:40:51,760
ability to point the spacecraft because

1061
00:40:56,069 --> 00:40:53,599
it has to be pointed

1062
00:40:57,750 --> 00:40:56,079
these guys convinced me

1063
00:40:59,030 --> 00:40:57,760

that they could they they wanted to go

1064
00:41:01,510 --> 00:40:59,040
to a half

1065
00:41:04,069 --> 00:41:01,520
half half milliradian we usually bang

1066
00:41:05,589 --> 00:41:04,079
bang control at two mil radians but they

1067
00:41:07,829 --> 00:41:05,599
said they could hold on to it for one

1068
00:41:10,790 --> 00:41:07,839
second longer if we stayed at the half

1069
00:41:13,349 --> 00:41:10,800
mil rating you know a miller radian is

1070
00:41:16,630 --> 00:41:13,359
1 17 of a degree

1071
00:41:18,710 --> 00:41:16,640
so we're pointing within 0.01 degrees

1072
00:41:20,390 --> 00:41:18,720
and as soon as we lose the ability to do

1073
00:41:22,710 --> 00:41:20,400
that it will go off

1074
00:41:27,109 --> 00:41:22,720
and then it'll start uh basically

1075
00:41:30,950 --> 00:41:29,430
not really tumbling well i mean yeah

1076
00:41:33,270 --> 00:41:30,960
like what julie said we're going to be

1077
00:41:35,670 --> 00:41:33,280
fighting as long as we can but really

1078
00:41:37,670 --> 00:41:35,680
we expect to to lose

1079
00:41:39,589 --> 00:41:37,680
signal in about one to two minutes if

1080
00:41:40,950 --> 00:41:39,599
we're lucky

1081
00:41:45,109 --> 00:41:40,960
and

1082
00:41:47,030 --> 00:41:45,119
will go on for a few more moments but

1083
00:41:49,349 --> 00:41:47,040
essentially after we lose a signal we we

1084
00:41:51,190 --> 00:41:49,359
don't know it's state

1085
00:41:52,950 --> 00:41:51,200
but you don't expect high rates you're

1086
00:41:54,790 --> 00:41:52,960
not going to really be spinning

1087
00:41:56,950 --> 00:41:54,800
like on top no no no it's not good it's

1088
00:41:59,750 --> 00:41:56,960

going to very gradually drift off point

1089
00:42:01,829 --> 00:41:59,760
find a more stable aerodynamic attitude

1090
00:42:03,109 --> 00:42:01,839
which won't be pointing at the earth and

1091
00:42:05,349 --> 00:42:03,119
in a minute later it'll just be

1092
00:42:07,510 --> 00:42:05,359
vaporized and and and the atmosphere is

1093
00:42:09,589 --> 00:42:07,520
going to make cassini more aerodynamic

1094
00:42:11,910 --> 00:42:09,599
by stripping away

1095
00:42:13,430 --> 00:42:11,920
stripping away parts and re

1096
00:42:15,030 --> 00:42:13,440
yeah re um

1097
00:42:15,990 --> 00:42:15,040
you know setting setting the attitude in

1098
00:42:18,950 --> 00:42:16,000
a more

1099
00:42:21,990 --> 00:42:18,960
aerodynamic fashion yeah

1100
00:42:24,630 --> 00:42:22,000
okay um let's go ahead and take some

1101
00:42:27,109 --> 00:42:24,640
social media questions uh kendra you've

1102
00:42:29,270 --> 00:42:27,119
got some ask nasa questions for us

1103
00:42:31,430 --> 00:42:29,280
mark is asking what improvements in

1104
00:42:33,910 --> 00:42:31,440
cassini were made via software over the

1105
00:42:37,829 --> 00:42:33,920
last 20 years

1106
00:42:39,990 --> 00:42:37,839
earl we'll start there there are a bunch

1107
00:42:41,990 --> 00:42:40,000
first of all cassini when we launched

1108
00:42:44,630 --> 00:42:42,000
didn't have the capability the software

1109
00:42:47,270 --> 00:42:44,640
capability to do orbital operations

1110
00:42:49,349 --> 00:42:47,280
we had the basic structure and we knew

1111
00:42:51,349 --> 00:42:49,359
all the hardware worked but all the

1112
00:42:53,990 --> 00:42:51,359
control laws and everything all of the

1113
00:42:56,390 --> 00:42:54,000

algorithms to actually say there's

1114
00:42:57,829 --> 00:42:56,400
enceladus turn and point and shoot with

1115
00:43:00,870 --> 00:42:57,839
the reaction wheels weren't on board

1116
00:43:02,710 --> 00:43:00,880
those were all developed during cruise

1117
00:43:04,470 --> 00:43:02,720
we couldn't dual record right right we

1118
00:43:06,710 --> 00:43:04,480
could not dual record we knew that we

1119
00:43:08,550 --> 00:43:06,720
had two recorders we knew that all the

1120
00:43:11,109 --> 00:43:08,560
strapping and wiring would work but the

1121
00:43:13,990 --> 00:43:11,119
software and smarts to do that

1122
00:43:15,589 --> 00:43:14,000
would um was not there so there was the

1123
00:43:17,109 --> 00:43:15,599
whole baseline

1124
00:43:19,510 --> 00:43:17,119
set of software and development that we

1125
00:43:22,230 --> 00:43:19,520
did during the cruise but then on top of

1126
00:43:25,190 --> 00:43:22,240
that the flight team

1127
00:43:27,750 --> 00:43:25,200
you know took their own experiences

1128
00:43:29,349 --> 00:43:27,760
and uh did some augmentations with the

1129
00:43:31,589 --> 00:43:29,359
software in order to adapt to some of

1130
00:43:33,109 --> 00:43:31,599
the changes and idiosyncrasy you saw in

1131
00:43:34,470 --> 00:43:33,119
the spacecraft and let you speak to

1132
00:43:35,190 --> 00:43:34,480
those well

1133
00:43:35,990 --> 00:43:35,200
there

1134
00:43:37,910 --> 00:43:36,000
they

1135
00:43:39,589 --> 00:43:37,920
the atlo team

1136
00:43:41,190 --> 00:43:39,599
and the design team actually punted to

1137
00:43:42,470 --> 00:43:41,200
earl's group they said oh you got seven

1138
00:43:44,150 --> 00:43:42,480

years in cruise you're not doing

1139
00:43:45,510 --> 00:43:44,160
anything you might as well rewrite

1140
00:43:48,150 --> 00:43:45,520
flight software while you're going out

1141
00:43:49,430 --> 00:43:48,160
there which was a surprise to the

1142
00:43:53,190 --> 00:43:49,440
scientists who thought we were going to

1143
00:43:57,510 --> 00:43:56,230
so we had three demarcations we had

1144
00:43:59,829 --> 00:43:57,520
three main

1145
00:44:03,910 --> 00:43:59,839
uh areas that we wanted to upload so we

1146
00:44:05,829 --> 00:44:03,920
uploaded in 2000 we uploaded in 2003

1147
00:44:09,430 --> 00:44:05,839
and then as earl said

1148
00:44:12,470 --> 00:44:09,440
we made some corrections in 2007 we made

1149
00:44:14,470 --> 00:44:12,480
some major corrections to fight off a

1150
00:44:16,550 --> 00:44:14,480
couple of the things that the solid

1151
00:44:18,390 --> 00:44:16,560
state power switches would occasionally

1152
00:44:20,150 --> 00:44:18,400
trip off they had a flip-flop circuit in

1153
00:44:22,390 --> 00:44:20,160
there that would occasionally trip off

1154
00:44:24,150 --> 00:44:22,400
and that's it wasn't dangerous to the

1155
00:44:27,270 --> 00:44:24,160
spacecraft but it was annoying and it

1156
00:44:30,150 --> 00:44:27,280
cost science so we we would stop that

1157
00:44:32,710 --> 00:44:30,160
um attitude control continued because

1158
00:44:33,829 --> 00:44:32,720
they had to they had to continue to

1159
00:44:36,150 --> 00:44:33,839
write

1160
00:44:38,150 --> 00:44:36,160
um you know star fields and cassini

1161
00:44:40,069 --> 00:44:38,160
vectors and

1162
00:44:42,950 --> 00:44:40,079
uh

1163
00:44:45,349 --> 00:44:42,960

saturn to sun vector yeah

1164
00:44:47,190 --> 00:44:45,359
so what do you do with that you so so

1165
00:44:48,630 --> 00:44:47,200
there were there were three main

1166
00:44:50,550 --> 00:44:48,640
revisions that were designed

1167
00:44:53,030 --> 00:44:50,560
pre-launched i mean we knew that and

1168
00:44:54,710 --> 00:44:53,040
then there were probably five or six

1169
00:44:57,109 --> 00:44:54,720
iterations along the way the last time

1170
00:44:58,309 --> 00:44:57,119
we did a full flight software was really

1171
00:44:59,510 --> 00:44:58,319
2010.

1172
00:45:01,589 --> 00:44:59,520
but the

1173
00:45:02,550 --> 00:45:01,599
the one you've missed i think maybe the

1174
00:45:04,230 --> 00:45:02,560
most

1175
00:45:05,510 --> 00:45:04,240
telling was that we realized the

1176
00:45:07,589 --> 00:45:05,520
spacecraft

1177
00:45:09,270 --> 00:45:07,599
when it saves when it gets into trouble

1178
00:45:11,670 --> 00:45:09,280
and it's called safing turns off all

1179
00:45:13,589 --> 00:45:11,680
unnecessary loads points to the earth

1180
00:45:15,829 --> 00:45:13,599
says i'm in trouble and calls home well

1181
00:45:19,990 --> 00:45:15,839
the spacecraft was wired to do that at

1182
00:45:21,990 --> 00:45:20,000
five bits per second at a 10 000 bit

1183
00:45:23,349 --> 00:45:22,000
transfer frame you can imagine how long

1184
00:45:25,829 --> 00:45:23,359
it takes us to get one frame of

1185
00:45:27,750 --> 00:45:25,839
telemetry back much less the number of

1186
00:45:29,349 --> 00:45:27,760
frames we need to diagnose the problem

1187
00:45:31,990 --> 00:45:29,359
so these guys figured out pretty quickly

1188
00:45:33,829 --> 00:45:32,000

that only in the most dramatic of safing

1189
00:45:36,790 --> 00:45:33,839
situations do we not know where the

1190
00:45:38,550 --> 00:45:36,800
earth is and so for all those cases they

1191
00:45:41,030 --> 00:45:38,560
rewired fault protection so that we

1192
00:45:43,190 --> 00:45:41,040
would use the highgate antenna at a very

1193
00:45:45,030 --> 00:45:43,200
high data rate to bring the diagnostic

1194
00:45:47,829 --> 00:45:45,040
signals back and it saved us it really

1195
00:45:50,150 --> 00:45:47,839
did that five bits per second is just

1196
00:45:52,870 --> 00:45:50,160
an agony it you can't imagine how small

1197
00:45:55,349 --> 00:45:52,880
that is and so they rewired it so that

1198
00:45:58,150 --> 00:45:55,359
unless attitude control was completely

1199
00:45:59,430 --> 00:45:58,160
lost we were in a manageable state and i

1200
00:46:01,190 --> 00:45:59,440
think that was one of the biggest

1201
00:46:02,870 --> 00:46:01,200
changes

1202
00:46:04,309 --> 00:46:02,880
we knew very very quickly that we just

1203
00:46:06,230 --> 00:46:04,319
weren't going to lock up on the five

1204
00:46:08,069 --> 00:46:06,240
bits even 10 bits at jupiter you know

1205
00:46:09,670 --> 00:46:08,079
that's really hard to do

1206
00:46:11,670 --> 00:46:09,680
and you know so there were a couple

1207
00:46:14,069 --> 00:46:11,680
questions from the media yesterday about

1208
00:46:16,550 --> 00:46:14,079
why don't you go to your low gain and

1209
00:46:18,790 --> 00:46:16,560
get a longer signal and that's exactly

1210
00:46:20,630 --> 00:46:18,800
right you hold the higher signal and you

1211
00:46:23,109 --> 00:46:20,640
can get science data you're getting

1212
00:46:25,510 --> 00:46:23,119
science data to the last second so you

1213
00:46:28,309 --> 00:46:25,520

could stay with the low gain signal for

1214
00:46:30,390 --> 00:46:28,319
15 more seconds but it takes 30 seconds

1215
00:46:32,309 --> 00:46:30,400
for the spacecraft to reconfigure to the

1216
00:46:34,230 --> 00:46:32,319
low gate so you're losing all that

1217
00:46:36,710 --> 00:46:34,240
science while you're reconfiguring to

1218
00:46:38,790 --> 00:46:36,720
hold a maybe signal

1219
00:46:41,510 --> 00:46:38,800
going out

1220
00:46:44,069 --> 00:46:41,520
it was and we've saved twice since we

1221
00:46:46,069 --> 00:46:44,079
built that in 2003 and both times it

1222
00:46:47,510 --> 00:46:46,079
worked like a charm it was it was the

1223
00:46:50,230 --> 00:46:47,520
greatest thing i've ever seen when the

1224
00:46:52,230 --> 00:46:50,240
spacecraft went off sun point

1225
00:46:54,710 --> 00:46:52,240
back to earth point and started dumping

1226
00:46:56,470 --> 00:46:54,720
down 2000 bits per second and we were

1227
00:46:58,710 --> 00:46:56,480
able to diagnose the problems very

1228
00:47:00,230 --> 00:46:58,720
quickly

1229
00:47:01,670 --> 00:47:00,240
all right more questions here in the

1230
00:47:04,630 --> 00:47:01,680
house

1231
00:47:06,870 --> 00:47:04,640
yes uh we have a very important go back

1232
00:47:08,950 --> 00:47:06,880
courtesy jonathan lunin from the science

1233
00:47:11,430 --> 00:47:08,960
panel

1234
00:47:14,470 --> 00:47:11,440
um yeah so i don't did you hear my

1235
00:47:16,550 --> 00:47:14,480
question earlier um

1236
00:47:19,750 --> 00:47:16,560
we were warned

1237
00:47:24,630 --> 00:47:22,069
i know the kids are interested in alien

1238
00:47:27,030 --> 00:47:24,640

life they want to know you know

1239
00:47:30,230 --> 00:47:27,040
so was cassini sort of built with that

1240
00:47:33,190 --> 00:47:30,240
possibility in mind

1241
00:47:35,990 --> 00:47:33,200
i'd say no no no it really wasn't i mean

1242
00:47:38,069 --> 00:47:36,000
cassini is was built to investigate the

1243
00:47:39,990 --> 00:47:38,079
entire electromagnetic spectrum it was

1244
00:47:42,710 --> 00:47:40,000
built to do geology it was built to do

1245
00:47:45,190 --> 00:47:42,720
chemistry but it really wasn't about

1246
00:47:47,910 --> 00:47:45,200
about life it was about maybe perhaps

1247
00:47:49,589 --> 00:47:47,920
the can the basis for for life in a

1248
00:47:52,390 --> 00:47:49,599
sense you know what we've seen at

1249
00:47:53,589 --> 00:47:52,400
enceladus but as a life finder or

1250
00:47:56,069 --> 00:47:53,599
something that could

1251
00:47:58,230 --> 00:47:56,079
discern i mean i'm not an astrobiologist

1252
00:47:59,670 --> 00:47:58,240
but even even asking that question

1253
00:48:01,750 --> 00:47:59,680
trying to find something that could give

1254
00:48:04,230 --> 00:48:01,760
you a definitive answer is extremely

1255
00:48:06,790 --> 00:48:04,240
difficult and cassini was more to just

1256
00:48:10,150 --> 00:48:06,800
do a whole survey of the system

1257
00:48:12,069 --> 00:48:10,160
say that's a that's a long note

1258
00:48:14,390 --> 00:48:12,079
great thank you

1259
00:48:16,790 --> 00:48:14,400
okay um and we didn't carry a golden

1260
00:48:20,950 --> 00:48:16,800
record for uh

1261
00:48:23,270 --> 00:48:20,960
for the star trek team to pick up either

1262
00:48:24,790 --> 00:48:23,280
i do have a dvd though we do have a dvd

1263
00:48:26,710 --> 00:48:24,800

yeah i think we've got one more question

1264
00:48:30,710 --> 00:48:26,720
here in the front row in the house

1265
00:48:33,109 --> 00:48:30,720
it's more of a comment than a question

1266
00:48:35,430 --> 00:48:33,119
in in hollywood it's it's

1267
00:48:36,790 --> 00:48:35,440
offensive to name drop but i'm going to

1268
00:48:38,230 --> 00:48:36,800
do it right now

1269
00:48:40,069 --> 00:48:38,240
i've been very fortunate to work with

1270
00:48:42,309 --> 00:48:40,079
some big name directors james cameron

1271
00:48:43,670 --> 00:48:42,319
j.j abrams steven spielberg

1272
00:48:46,829 --> 00:48:43,680
that's the name dropping part and i

1273
00:48:49,910 --> 00:48:46,839
apologize but i say that because

1274
00:48:52,390 --> 00:48:49,920
i'll dare to speak for them as well

1275
00:48:55,430 --> 00:48:52,400
because i've spoken enough to them

1276
00:49:00,230 --> 00:48:55,440
that you guys are the true inspiration

1277
00:49:02,549 --> 00:49:00,240
and the real stars here it's it's such

1278
00:49:03,589 --> 00:49:02,559
a an absolute privilege to be amongst

1279
00:49:10,150 --> 00:49:03,599
you

1280
00:49:12,390 --> 00:49:10,160
dance around because it's so fantastic

1281
00:49:14,790 --> 00:49:12,400
just experience what you're

1282
00:49:16,710 --> 00:49:14,800
what you're sharing with us so thank you

1283
00:49:18,950 --> 00:49:16,720
well molly you and you and luis should

1284
00:49:20,710 --> 00:49:18,960
tell what inspired you i kind of was

1285
00:49:23,670 --> 00:49:20,720
looking for a job when i found this one

1286
00:49:25,430 --> 00:49:23,680
um sorry really quick before uh to

1287
00:49:27,910 --> 00:49:25,440
answer your comment there actually uh

1288
00:49:30,309 --> 00:49:27,920

last week i was at long beach comic con

1289
00:49:32,870 --> 00:49:30,319
and i did a talk there and it's a sci-fi

1290
00:49:34,790 --> 00:49:32,880
convention and uh those people were

1291
00:49:37,270 --> 00:49:34,800
great they i mean they loved science

1292
00:49:39,270 --> 00:49:37,280
fiction and they loved hearing about

1293
00:49:41,349 --> 00:49:39,280
real science you know space missions

1294
00:49:44,950 --> 00:49:41,359
like cassini and they go very well hand

1295
00:49:46,870 --> 00:49:44,960
in hand you know so um yeah yeah i'm

1296
00:49:48,630 --> 00:49:46,880
with that i grew up watching star wars

1297
00:49:50,470 --> 00:49:48,640
of course and playing with legos and

1298
00:49:53,750 --> 00:49:50,480
playing with all the alien themed legos

1299
00:49:55,589 --> 00:49:53,760
so there's my alien pun for you um

1300
00:49:57,430 --> 00:49:55,599
but i just love space in general you

1301
00:49:59,270 --> 00:49:57,440
know so anything that's space themed i'm

1302
00:50:01,670 --> 00:49:59,280
a huge gamer in my spare time and so

1303
00:50:03,430 --> 00:50:01,680
anything that has space involved i love

1304
00:50:05,430 --> 00:50:03,440
and then then i get to come to work and

1305
00:50:07,030 --> 00:50:05,440
inspire people in the past couple of

1306
00:50:09,109 --> 00:50:07,040
days of talking to the media has just

1307
00:50:10,390 --> 00:50:09,119
been such a privilege right so usually

1308
00:50:12,630 --> 00:50:10,400
i'm working with all these great team

1309
00:50:14,630 --> 00:50:12,640
members and it's amazing but to be able

1310
00:50:16,309 --> 00:50:14,640
to be inspired by you guys too because

1311
00:50:18,790 --> 00:50:16,319
sometimes we get wrapped up in our

1312
00:50:20,870 --> 00:50:18,800
everyday office you know normal work

1313
00:50:22,309 --> 00:50:20,880

that we do but having you guys come here

1314
00:50:25,589 --> 00:50:22,319
and say that you're inspired by us that

1315
00:50:26,710 --> 00:50:25,599
really helps us go forward

1316
00:50:28,069 --> 00:50:26,720
one of the best things that ever

1317
00:50:30,230 --> 00:50:28,079
happened to me

1318
00:50:32,549 --> 00:50:30,240
was on a different spacecraft we had we

1319
00:50:34,950 --> 00:50:32,559
had a lot of problems on on an earlier

1320
00:50:36,309 --> 00:50:34,960
mission that i worked a lot of problems

1321
00:50:39,030 --> 00:50:36,319
and we were all stressed out we were

1322
00:50:41,030 --> 00:50:39,040
working 12 on 12 off i didn't like them

1323
00:50:43,910 --> 00:50:41,040
they didn't like me

1324
00:50:46,150 --> 00:50:43,920
and you know we were all just

1325
00:50:48,230 --> 00:50:46,160
go away i need sleep

1326
00:50:50,150 --> 00:50:48,240
and the project manager at the time

1327
00:50:52,710 --> 00:50:50,160
wrote us some letters thanking us for

1328
00:50:55,910 --> 00:50:52,720
saving the mission and that

1329
00:50:58,549 --> 00:50:55,920
what we did was was a miracle to the

1330
00:51:01,670 --> 00:50:58,559
average person on the street and i have

1331
00:51:02,870 --> 00:51:01,680
never forgotten that never and and gone

1332
00:51:04,870 --> 00:51:02,880
back to

1333
00:51:08,549 --> 00:51:04,880
oh yeah and i like these people too once

1334
00:51:10,950 --> 00:51:08,559
i got a few hours sleep

1335
00:51:13,109 --> 00:51:10,960
yeah just to comment again i we had an

1336
00:51:15,910 --> 00:51:13,119
open house here a few years ago that was

1337
00:51:17,109 --> 00:51:15,920
overwhelmingly crowded overwhelmingly

1338
00:51:18,950 --> 00:51:17,119

hot

1339
00:51:21,190 --> 00:51:18,960
people were parking on the freeways and

1340
00:51:23,270 --> 00:51:21,200
traipsing across arroyo to come on and

1341
00:51:24,630 --> 00:51:23,280
just reminded us again

1342
00:51:26,630 --> 00:51:24,640
of how

1343
00:51:29,270 --> 00:51:26,640
blessed and lucky we are i mean i'm

1344
00:51:30,309 --> 00:51:29,280
walking down the road and it's hot and

1345
00:51:32,309 --> 00:51:30,319
everyone's

1346
00:51:33,750 --> 00:51:32,319
and i hear from the back of my some

1347
00:51:35,270 --> 00:51:33,760
people say what's it like having the

1348
00:51:38,549 --> 00:51:35,280
best job in the world

1349
00:51:41,430 --> 00:51:38,559
you know i oh boy he's right i do

1350
00:51:43,910 --> 00:51:41,440
it's really cool and so thank you so

1351
00:51:45,589 --> 00:51:43,920
we're very lucky

1352
00:51:53,589 --> 00:51:45,599
and with that let's thank our

1353
00:51:58,390 --> 00:51:56,390
okay so on social media it's pix or it

1354
00:52:00,950 --> 00:51:58,400
didn't happen and thanks to cassini

1355
00:52:03,750 --> 00:52:00,960
we've got lots of picks the spacecraft

1356
00:52:06,470 --> 00:52:03,760
has taken nearly half a million of them

1357
00:52:08,790 --> 00:52:06,480
and here to tell us more about the

1358
00:52:10,870 --> 00:52:08,800
awesome images the last images that

1359
00:52:13,109 --> 00:52:10,880
we're expecting to be coming down just

1360
00:52:14,950 --> 00:52:13,119
hours from now from the spacecraft we've

1361
00:52:17,349 --> 00:52:14,960
got one of the people who put together

1362
00:52:19,910 --> 00:52:17,359
the sequence that will take those photos

1363
00:52:22,950 --> 00:52:19,920

so as our engineers leave the stage

1364
00:52:25,030 --> 00:52:22,960
we're gonna uh welcome to it mike evans

1365
00:52:27,829 --> 00:52:25,040
iss team associate from

1366
00:52:29,510 --> 00:52:27,839
cornell university so come on up mike

1367
00:52:31,030 --> 00:52:29,520
right thank you well as i've been

1368
00:52:33,030 --> 00:52:31,040
introduced i don't have to say who i am

1369
00:52:35,270 --> 00:52:33,040
and what i do i suppose i should just

1370
00:52:36,710 --> 00:52:35,280
quickly say you know what i do on

1371
00:52:38,390 --> 00:52:36,720
cassini i

1372
00:52:40,630 --> 00:52:38,400
i led one of the teams that actually

1373
00:52:43,270 --> 00:52:40,640
allocate allocated time to actually do

1374
00:52:44,950 --> 00:52:43,280
the science and that that was not not

1375
00:52:47,829 --> 00:52:44,960
really part of my imaging job and then

1376
00:52:49,990 --> 00:52:47,839
for my energy imaging job i'd identify

1377
00:52:51,670 --> 00:52:50,000
opportunities i'd put requests in you

1378
00:52:53,349 --> 00:52:51,680
know please let us do this and then i'd

1379
00:52:55,589 --> 00:52:53,359
argue for them in the groups that

1380
00:52:57,829 --> 00:52:55,599
actually allocate the time and once once

1381
00:52:59,270 --> 00:52:57,839
we actually get you know succeed i do i

1382
00:53:00,470 --> 00:52:59,280
do all the paperwork well not it's not

1383
00:53:03,109 --> 00:53:00,480
actually paperwork it's all done you

1384
00:53:04,870 --> 00:53:03,119
know online with files but i make sure

1385
00:53:07,030 --> 00:53:04,880
that all the eyes across it or all the

1386
00:53:09,990 --> 00:53:07,040
eyes are dotted all the t's are crossed

1387
00:53:11,589 --> 00:53:10,000
and then i actually help build the

1388
00:53:14,790 --> 00:53:11,599

pointing design which is where to point

1389
00:53:16,230 --> 00:53:14,800
the spacecraft when and in many cases i

1390
00:53:18,069 --> 00:53:16,240
actually will build the camera command

1391
00:53:19,910 --> 00:53:18,079
you know open the shutter at this time

1392
00:53:22,150 --> 00:53:19,920
keep it open for 37 milliseconds use

1393
00:53:24,710 --> 00:53:22,160
this filter use that filter and then in

1394
00:53:25,750 --> 00:53:24,720
many cases when the data comes down i

1395
00:53:28,069 --> 00:53:25,760
actually

1396
00:53:29,030 --> 00:53:28,079
i'm able to i'm involved in the analysis

1397
00:53:32,790 --> 00:53:29,040
of

1398
00:53:34,390 --> 00:53:32,800
and actually if you can bring up my

1399
00:53:37,109 --> 00:53:34,400
first slide absolutely

1400
00:53:38,870 --> 00:53:37,119
let's see okay so

1401
00:53:41,109 --> 00:53:38,880
the other people who've been up on stage

1402
00:53:43,190 --> 00:53:41,119
today have told you know that either

1403
00:53:45,670 --> 00:53:43,200
their their antidote anecdotes or their

1404
00:53:47,910 --> 00:53:45,680
favorite images well this is both my

1405
00:53:49,270 --> 00:53:47,920
favorite image and the anecdotes that

1406
00:53:50,950 --> 00:53:49,280
i'm actually going to tell you this is

1407
00:53:53,349 --> 00:53:50,960
this is the small moon daphnis that

1408
00:53:55,270 --> 00:53:53,359
orbits right at the edge of the a-ring

1409
00:53:56,870 --> 00:53:55,280
of saturn it's only about eight or nine

1410
00:53:58,870 --> 00:53:56,880
kilometers across

1411
00:54:00,630 --> 00:53:58,880
and it sits in this gap called the

1412
00:54:02,950 --> 00:54:00,640
killer gap which radially is only about

1413
00:54:04,790 --> 00:54:02,960

40 kilometers across and it actually

1414
00:54:06,470 --> 00:54:04,800
it's it's not there by accident the gap

1415
00:54:08,230 --> 00:54:06,480
is there because the moon is there the

1416
00:54:09,829 --> 00:54:08,240
moon's gravity actually you know clears

1417
00:54:11,670 --> 00:54:09,839
the gap and if you look just to the

1418
00:54:13,829 --> 00:54:11,680
bottom left of the moon you can see a

1419
00:54:15,510 --> 00:54:13,839
little wisp of material

1420
00:54:17,510 --> 00:54:15,520
and i'm not talking about the edge waves

1421
00:54:19,349 --> 00:54:17,520
i'm talking about the whisper material

1422
00:54:21,349 --> 00:54:19,359
that's all due to the interaction

1423
00:54:23,670 --> 00:54:21,359
between the gravity of this moon and the

1424
00:54:25,190 --> 00:54:23,680
little ring particles that are actually

1425
00:54:27,910 --> 00:54:25,200
just you know part of the ring just just

1426
00:54:29,829 --> 00:54:27,920
outside the gap and my anecdote is

1427
00:54:32,549 --> 00:54:29,839
this moon misbehaves

1428
00:54:35,030 --> 00:54:32,559
it apparently when we look at its orbits

1429
00:54:36,870 --> 00:54:35,040
you know it apparently we don't know why

1430
00:54:38,230 --> 00:54:36,880
yet but it apparently jumps forward a

1431
00:54:39,430 --> 00:54:38,240
little bit and jumps back a little bit

1432
00:54:40,950 --> 00:54:39,440
in its orbit

1433
00:54:42,390 --> 00:54:40,960
but it has the nerve to do it when we're

1434
00:54:44,390 --> 00:54:42,400
not looking

1435
00:54:45,910 --> 00:54:44,400
so when we're down equatorial and you

1436
00:54:47,750 --> 00:54:45,920
know the rings are edge on to us and we

1437
00:54:50,069 --> 00:54:47,760
can't see this moon something has

1438
00:54:51,910 --> 00:54:50,079

happened on the two on the last two

1439
00:54:53,510 --> 00:54:51,920
equatorial periods something's happened

1440
00:54:55,270 --> 00:54:53,520
to this moon and it's jumped a little

1441
00:54:56,790 --> 00:54:55,280
bit forwards in its orbit or it's

1442
00:54:58,549 --> 00:54:56,800
generally in one case it may have jumped

1443
00:55:00,630 --> 00:54:58,559
a little bit back and the problem with

1444
00:55:03,190 --> 00:55:00,640
that is we have to be very close to get

1445
00:55:05,270 --> 00:55:03,200
these high resolution images and

1446
00:55:06,790 --> 00:55:05,280
if it's not exactly where we think it is

1447
00:55:08,790 --> 00:55:06,800
if it's not exactly where we tell the

1448
00:55:11,030 --> 00:55:08,800
cameras to point we miss it completely

1449
00:55:12,390 --> 00:55:11,040
we don't get any any images at all and

1450
00:55:14,230 --> 00:55:12,400
that's what happened to the first

1451
00:55:15,349 --> 00:55:14,240
observation we had about two years ago

1452
00:55:17,270 --> 00:55:15,359
at christmas

1453
00:55:18,950 --> 00:55:17,280
we missed we missed this completely

1454
00:55:20,790 --> 00:55:18,960
because the moon had actually jumped and

1455
00:55:22,630 --> 00:55:20,800
it we were pointing where we thought it

1456
00:55:25,109 --> 00:55:22,640
was not where it actually was

1457
00:55:27,750 --> 00:55:25,119
so when this happened back in january of

1458
00:55:29,349 --> 00:55:27,760
this year we knew well it's a danger so

1459
00:55:30,549 --> 00:55:29,359
let's let's let's hedge your bets

1460
00:55:33,109 --> 00:55:30,559
instead of just pointing where we think

1461
00:55:35,109 --> 00:55:33,119
it's going to be let's at least for the

1462
00:55:36,710 --> 00:55:35,119
for these closest approach images let's

1463
00:55:38,470 --> 00:55:36,720

actually do a mosaic let's point let's

1464
00:55:40,470 --> 00:55:38,480
let's point you know

1465
00:55:41,990 --> 00:55:40,480
one frame slightly ahead one frame a

1466
00:55:43,829 --> 00:55:42,000
little bit you know further ahead where

1467
00:55:45,990 --> 00:55:43,839
we think it is one frame behind and one

1468
00:55:47,430 --> 00:55:46,000
frame a little further behind and as it

1469
00:55:50,470 --> 00:55:47,440
turns out

1470
00:55:52,230 --> 00:55:50,480
this image is from the very first frame

1471
00:55:53,670 --> 00:55:52,240
it's as far away

1472
00:55:54,710 --> 00:55:53,680
if it had been any further away from

1473
00:55:56,630 --> 00:55:54,720
where we thought it was we would have

1474
00:55:58,710 --> 00:55:56,640
missed it completely so we actually only

1475
00:56:00,789 --> 00:55:58,720
have images from this one footprint so

1476
00:56:02,870 --> 00:56:00,799
that we took i i think

1477
00:56:05,190 --> 00:56:02,880
somewhere somewhere between 50 and 60

1478
00:56:07,510 --> 00:56:05,200
images on the way in as the as the

1479
00:56:09,109 --> 00:56:07,520
resolution increased but we only got it

1480
00:56:11,270 --> 00:56:09,119
in three and all three images were

1481
00:56:13,270 --> 00:56:11,280
pointed at exactly the same points so

1482
00:56:14,950 --> 00:56:13,280
even with all the care that we've taken

1483
00:56:16,710 --> 00:56:14,960
we almost missed it

1484
00:56:18,789 --> 00:56:16,720
but the images that we this we did get

1485
00:56:20,390 --> 00:56:18,799
were incredible i mean i i tell people

1486
00:56:22,309 --> 00:56:20,400
you know i look at this and i think it's

1487
00:56:24,150 --> 00:56:22,319
it's some sort of art deco object it's

1488
00:56:26,069 --> 00:56:24,160

it's the it's the hood of a car it's you

1489
00:56:28,390 --> 00:56:26,079
know it's something

1490
00:56:31,190 --> 00:56:28,400
it's it's clearly not the flying saucer

1491
00:56:33,030 --> 00:56:31,200
shape that that pan has that luis was uh

1492
00:56:34,870 --> 00:56:33,040
was talking about earlier and then if

1493
00:56:36,950 --> 00:56:34,880
you could go and show the next image

1494
00:56:38,789 --> 00:56:36,960
this is just an example of the of the of

1495
00:56:40,870 --> 00:56:38,799
the bed of my bread and butter work i

1496
00:56:42,630 --> 00:56:40,880
mean this is the edge of the a ring

1497
00:56:44,549 --> 00:56:42,640
there's there's the f ring you know the

1498
00:56:46,230 --> 00:56:44,559
thin narrow strip and two moon the

1499
00:56:49,349 --> 00:56:46,240
so-called shepherd moons either side of

1500
00:56:50,710 --> 00:56:49,359
it prometheus inside pandora outside and

1501
00:56:53,349 --> 00:56:50,720
the sort of thing i do with this image

1502
00:56:55,270 --> 00:56:53,359
is i do astrometry so basically i figure

1503
00:56:56,789 --> 00:56:55,280
out where all the stars are in the image

1504
00:56:58,870 --> 00:56:56,799
make little corrections so we know

1505
00:57:00,390 --> 00:56:58,880
exactly where the camera was pointed

1506
00:57:02,630 --> 00:57:00,400
because even though we tell the camera

1507
00:57:04,230 --> 00:57:02,640
point in this direction it never

1508
00:57:05,910 --> 00:57:04,240
actually points it exactly in that

1509
00:57:08,390 --> 00:57:05,920
direction it's usually somewhere between

1510
00:57:10,069 --> 00:57:08,400
it's usually about 20 arc seconds off

1511
00:57:12,630 --> 00:57:10,079
and those 20 arc seconds or something

1512
00:57:13,750 --> 00:57:12,640
like 15 or 20 pixels and that makes a

1513
00:57:16,390 --> 00:57:13,760

big difference when you're trying to

1514
00:57:18,069 --> 00:57:16,400
figure out orbits so i i would you know

1515
00:57:20,150 --> 00:57:18,079
figure out where we were pointed then

1516
00:57:21,750 --> 00:57:20,160
right the the moon is in this position

1517
00:57:23,910 --> 00:57:21,760
and that corresponds to this direction

1518
00:57:25,430 --> 00:57:23,920
and then i that data gets sent off to

1519
00:57:27,430 --> 00:57:25,440
the people at jpl and they put it all

1520
00:57:29,349 --> 00:57:27,440
together into numerical simulations and

1521
00:57:31,109 --> 00:57:29,359
then update what we call the fmerids

1522
00:57:32,950 --> 00:57:31,119
which is basically the orbits the

1523
00:57:35,270 --> 00:57:32,960
positions and times

1524
00:57:36,630 --> 00:57:35,280
of of all the objects actually in the

1525
00:57:37,829 --> 00:57:36,640
system and then if you can show the

1526
00:57:41,829 --> 00:57:37,839
final image

1527
00:57:44,069 --> 00:57:41,839
want to take questions

1528
00:57:45,990 --> 00:57:44,079
okay so because we are looking forward

1529
00:57:48,470 --> 00:57:46,000
to those final images we wanted to let

1530
00:57:50,950 --> 00:57:48,480
you know where and when to look for them

1531
00:57:53,430 --> 00:57:50,960
we anticipate the data on the ground and

1532
00:57:56,069 --> 00:57:53,440
on the web around eight o'clock pacific

1533
00:57:58,789 --> 00:57:56,079
11 eastern tonight just go to

1534
00:58:06,950 --> 00:57:58,799
go.nasa.gov

1535
00:58:09,109 --> 00:58:06,960
cassini raw and a big thank you to mike

1536
00:58:11,589 --> 00:58:09,119
and thank you to all of all of you

1537
00:58:13,589 --> 00:58:11,599
joining us here in the house and online

1538
00:58:16,309 --> 00:58:13,599

we hope that you'll be back with us as

1539
00:58:18,390 --> 00:58:16,319
we broadcast live from mission control

1540
00:58:21,109 --> 00:58:18,400
here at jpl as the final data are

1541
00:58:24,309 --> 00:58:21,119
received from the spacecraft the epic

1542
00:58:26,710 --> 00:58:24,319
end of cassini's grand finale

1543
00:58:30,549 --> 00:58:26,720
get your coffee uh we're going live at 4

1544
00:58:32,630 --> 00:58:30,559
a.m pacific 7 a.m eastern 11 o'clock utc

1545
00:58:35,190 --> 00:58:32,640
so europe gets a break you can watch on

1546
00:58:37,030 --> 00:58:35,200
nasa tv or nasa.gov

1547
00:58:41,180 --> 00:58:37,040
live thank you so much for being here

1548
00:58:58,069 --> 00:58:41,190
today and we'll see you online

1549
00:58:58,079 --> 00:59:06,950
and we're out