
VOYAGER ACE

1
00:02:51,440 --> 00:02:35,800
[Music]

2
00:02:55,830 --> 00:02:54,300
hello everyone I'm gay ye Hill and

3
00:02:59,250 --> 00:02:55,840
welcome to NASA's Jet Propulsion

4
00:03:01,680 --> 00:02:59,260
Laboratory after two decades in space

5
00:03:04,500 --> 00:03:01,690
the Cassini spacecraft has reached the

6
00:03:06,330 --> 00:03:04,510
end of its journey at Saturn earlier

7
00:03:08,730 --> 00:03:06,340
this morning the spacecraft made its

8
00:03:11,640 --> 00:03:08,740
final approach to the giant planet and

9
00:03:14,970 --> 00:03:11,650
plunged into Saturn's upper atmosphere

10
00:03:17,040 --> 00:03:14,980
ending this extraordinary mission but

11
00:03:19,980 --> 00:03:17,050
due to the time it takes for radio

12
00:03:22,470 --> 00:03:19,990
signals to travel almost a billion miles

13
00:03:24,720 --> 00:03:22,480

between the ringed planet and Earth the

14
00:03:27,630 --> 00:03:24,730
team won't have confirmation that the

15
00:03:30,900 --> 00:03:27,640
mission has ended until they see Cassini

16
00:03:33,510 --> 00:03:30,910
signal drop away the Deep Space Network

17
00:03:36,690 --> 00:03:33,520
is monitoring Cassini signal as you can

18
00:03:39,770 --> 00:03:36,700
see on this DSN now display it's being

19
00:03:45,330 --> 00:03:39,780
tracked by a 70 meter wide antenna

20
00:03:47,310 --> 00:03:45,340
antenna 43 in Canberra Australia here's

21
00:03:49,860 --> 00:03:47,320
a live picture of the control room on

22
00:03:52,259 --> 00:03:49,870
the other side of the world the DSN team

23
00:03:54,650 --> 00:03:52,269
in Australia is keeping a watchful eye

24
00:03:58,590 --> 00:03:54,660
on Cassini's final transmission

25
00:04:01,290 --> 00:03:58,600
meanwhile it is 4 a.m. here in

26
00:04:04,560 --> 00:04:01,300
California the Sun is not up yet and

27
00:04:07,590 --> 00:04:04,570
more than 1,500 Cassini scientists

28
00:04:10,229 --> 00:04:07,600
engineers alumni friends and family have

29
00:04:12,930 --> 00:04:10,239
gathered for this moment the flight team

30
00:04:15,570 --> 00:04:12,940
is in the Cassini mission control area

31
00:04:18,659 --> 00:04:15,580
others have gathered in von Karman

32
00:04:22,650 --> 00:04:18,669
auditorium here at JPL and still more

33
00:04:24,990 --> 00:04:22,660
are at Caltech in Pasadena folks wanted

34
00:04:28,380 --> 00:04:25,000
to be together to share this final

35
00:04:31,980 --> 00:04:28,390
moment this is a vigil but also a

36
00:04:35,270 --> 00:04:31,990
celebration of a remarkable mission this

37
00:04:39,559 --> 00:04:35,280
is the last hour of the last chapter of

38
00:04:47,039 --> 00:04:47,029

a lone Explorer

39
00:04:57,180 --> 00:04:49,309
on a mission to reveal the grandeur of

40
00:05:05,750 --> 00:05:00,480
after 20 years in space NASA's Cassini

41
00:05:08,790 --> 00:05:05,760
spacecraft is running out of fuel and so

42
00:05:10,830 --> 00:05:08,800
to protect the moons of Saturn that

43
00:05:14,010 --> 00:05:10,840
could have conditions suitable for life

44
00:05:15,030 --> 00:05:14,020
a spectacular end has been planned for

45
00:05:17,290 --> 00:05:15,040
this long-lived

46
00:05:36,049 --> 00:05:17,300
traveler from Earth

47
00:05:41,279 --> 00:05:39,600
in 2004 following a seven-year journey

48
00:05:49,559 --> 00:05:41,289
through the solar system

49
00:05:52,889 --> 00:05:49,569
Cassini arrived at Saturn the spacecraft

50
00:05:55,919 --> 00:05:52,899
carried a passenger the European Huygens

51
00:05:58,019 --> 00:05:55,929
probe the first human-made object to

52
00:06:04,709 --> 00:05:58,029
land on a world in the distant outer

53
00:06:07,049 --> 00:06:04,719
solar system for over a decade Cassini

54
00:06:10,379 --> 00:06:07,059
has shared the wonders of Saturn and its

55
00:06:13,139 --> 00:06:10,389
family of icy moons taking us to

56
00:06:16,859 --> 00:06:13,149
astounding worlds where methane rivers

57
00:06:20,129 --> 00:06:16,869
run to a methane see where Jets of ice

58
00:06:23,279 --> 00:06:20,139
and gas are blasting material into space

59
00:06:27,709 --> 00:06:23,289
from a liquid water ocean that might

60
00:06:31,769 --> 00:06:27,719
Harbor the ingredients for life and

61
00:06:37,490 --> 00:06:31,779
Saturn a giant world ruled by raging

62
00:06:50,560 --> 00:06:41,840
now Cassini has with one last daring

63
00:06:59,780 --> 00:06:54,140

Cassini's grand finale is a brand new

64
00:07:02,780 --> 00:06:59,790
adventure as it repeatedly Braves this

65
00:07:04,879 --> 00:07:02,790
unexplored region Cassini seeks new

66
00:07:07,900 --> 00:07:04,889
insights about the origins of the reigns

67
00:07:12,140 --> 00:07:07,910
and the nature of the planets interior

68
00:07:17,720 --> 00:07:12,150
closer to Saturn than ever before

69
00:07:21,110 --> 00:07:17,730
[Music]

70
00:07:24,980 --> 00:07:21,120
on the final orbit Cassini will plunge

71
00:07:27,890 --> 00:07:24,990
into Saturn fighting to keep its antenna

72
00:07:30,790 --> 00:07:27,900
pointed at earth as a transmits its

73
00:07:37,940 --> 00:07:34,500
in the sky is a Saturn

74
00:07:44,120 --> 00:07:41,810
as Cassini becomes part of the planet

75
00:07:52,870 --> 00:07:44,130
itself

76
00:07:52,880 --> 00:08:06,510
[Music]

77
00:08:12,040 --> 00:08:09,610
okay let's do the numbers the cassini

78
00:08:16,170 --> 00:08:12,050
numbers the mission has traveled nearly

79
00:08:20,440 --> 00:08:16,180
five billion miles since lunch executed

80
00:08:23,340 --> 00:08:20,450
2.5 million commands taken four hundred

81
00:08:26,350 --> 00:08:23,350
and fifty three thousand plus images

82
00:08:29,680 --> 00:08:26,360
discovered six moons published nearly

83
00:08:32,649 --> 00:08:29,690
four thousand science papers and it's

84
00:08:35,860 --> 00:08:32,659
not done Cassini is sending home data

85
00:08:38,230 --> 00:08:35,870
right now right to the end let's take a

86
00:08:40,330 --> 00:08:38,240
look now and talk to Cassini program

87
00:08:43,270 --> 00:08:40,340
enter Earl Mays about this after a

88
00:08:47,470 --> 00:08:43,280

lineup like that you have to be

89
00:08:48,910 --> 00:08:47,480
impressed we are very proud of what

90
00:08:51,400 --> 00:08:48,920
we've been able to accomplish over the

91
00:08:53,740 --> 00:08:51,410
last 13 years at Saturday awesome so a

92
00:08:57,430 --> 00:08:53,750
lot of people are asking then why must

93
00:08:59,020 --> 00:08:57,440
we end this mission this way really if

94
00:09:00,280 --> 00:08:59,030
you think about it a little bit you'll

95
00:09:03,700 --> 00:09:00,290
find out we don't have it didn't have

96
00:09:05,620 --> 00:09:03,710
any choice Cassini must be disposed of

97
00:09:07,180 --> 00:09:05,630
properly at some point there are

98
00:09:08,440 --> 00:09:07,190
international treaties that require that

99
00:09:10,120 --> 00:09:08,450
we can't just leave a derelict

100
00:09:13,540 --> 00:09:10,130
spacecraft in orbit around a planet like

101
00:09:15,100 --> 00:09:13,550
Saturn which has prebiotic moons so

102
00:09:17,140 --> 00:09:15,110
we've got to do something about it we

103
00:09:21,100 --> 00:09:17,150
could have since Cassini away from

104
00:09:23,440 --> 00:09:21,110
Saturn but Saturn was so compelling so

105
00:09:25,990 --> 00:09:23,450
exciting and the mission that we finally

106
00:09:28,870 --> 00:09:26,000
came up with is so rich scientifically

107
00:09:31,990 --> 00:09:28,880
that we just couldn't we had to finish

108
00:09:34,300 --> 00:09:32,000
up at Saturn not someplace else so the

109
00:09:35,950 --> 00:09:34,310
mission really started about seven years

110
00:09:38,110 --> 00:09:35,960
ago we've been on this path to actually

111
00:09:40,690 --> 00:09:38,120
end up right where we are right now in

112
00:09:42,730 --> 00:09:40,700
less than an hour so let's talk about

113
00:09:46,030 --> 00:09:42,740

what's about to happen and kind of walk

114
00:09:48,670 --> 00:09:46,040
viewers through what to expect but let's

115
00:09:51,940 --> 00:09:48,680
start with Monday and the kiss goodbye

116
00:09:55,510 --> 00:09:51,950
okay can you first graphic let's see

117
00:09:57,910 --> 00:09:55,520
what we got here so this is the the last

118
00:09:59,560 --> 00:09:57,920
22 orbits of Saturn and every one of

119
00:10:03,220 --> 00:09:59,570
them is going between the Rings and

120
00:10:06,100 --> 00:10:03,230
Saturn absolutely unexplored territory

121
00:10:08,079 --> 00:10:06,110
fantastic science every time and what's

122
00:10:10,009 --> 00:10:08,089
been also happening is that that out of

123
00:10:12,019 --> 00:10:10,019
there further away is Titan and

124
00:10:14,150 --> 00:10:12,029
right now and then Titan comes by and

125
00:10:17,119 --> 00:10:14,160
you're gonna see it come by for one last

126
00:10:20,119 --> 00:10:17,129
final kiss goodbye that was it it was

127
00:10:22,100 --> 00:10:20,129
very quick you have to go Blake what

128
00:10:24,319 --> 00:10:22,110
happened on Monday was that Titan came

129
00:10:26,720 --> 00:10:24,329
by and gave Cassini one last little

130
00:10:29,210 --> 00:10:26,730
nudge took away a few tens of meters per

131
00:10:31,639 --> 00:10:29,220
second slowed us down just enough so

132
00:10:33,319 --> 00:10:31,649
that our entry into Saturn in just a few

133
00:10:34,929 --> 00:10:33,329
minutes now he's absolutely inevitable

134
00:10:37,960 --> 00:10:34,939
so

135
00:10:40,189 --> 00:10:37,970
Cassini's fate is just filled sealed

136
00:10:41,749 --> 00:10:40,199
absolutely done there was wasn't much we

137
00:10:43,519 --> 00:10:41,759
could have done about it before because

138
00:10:45,410 --> 00:10:43,529

this thing had been so wired in but

139
00:10:47,929 --> 00:10:45,420
after that Titan fly by there was

140
00:10:50,269 --> 00:10:47,939
absolutely nothing we can do so step us

141
00:10:52,910 --> 00:10:50,279
through what has happened over this last

142
00:10:55,100 --> 00:10:52,920
week then getting ready for this moment

143
00:10:57,169 --> 00:10:55,110
okay well because Cassini is still a

144
00:10:58,699 --> 00:10:57,179
science machine really most of what

145
00:11:00,379 --> 00:10:58,709
we've been doing is still gathering more

146
00:11:02,929 --> 00:11:00,389
science and so if you look at this

147
00:11:03,739 --> 00:11:02,939
graphic up here we saw there's the Titan

148
00:11:05,960 --> 00:11:03,749
that just goodbye

149
00:11:08,960 --> 00:11:05,970
on September 11th and then we turn right

150
00:11:10,309 --> 00:11:08,970
back around after flying by Titan

151
00:11:11,929 --> 00:11:10,319
getting a lot of Titan dated we turned

152
00:11:13,429 --> 00:11:11,939
around played all that data back it's on

153
00:11:15,439 --> 00:11:13,439
the monitors all need some of our Jedi

154
00:11:17,509 --> 00:11:15,449
displays you can see those played back

155
00:11:19,220 --> 00:11:17,519
all the data from Titan got good views

156
00:11:21,410 --> 00:11:19,230
of the north of the lakes and the clouds

157
00:11:23,900 --> 00:11:21,420
again turn in because he me turn back

158
00:11:25,910 --> 00:11:23,910
around again for its final set of

159
00:11:28,100 --> 00:11:25,920
science observations and we actually did

160
00:11:30,259 --> 00:11:28,110
a little bit of science and a little bit

161
00:11:31,850 --> 00:11:30,269
of just nostalgia we took a lot of

162
00:11:34,429 --> 00:11:31,860
pictures of him sell this our last

163
00:11:37,189 --> 00:11:34,439

picture of Titan our last picture of the

164
00:11:39,319 --> 00:11:37,199
the rings and planet and we will want

165
00:11:41,359 --> 00:11:39,329
took one more look at the propellers and

166
00:11:42,919 --> 00:11:41,369
Peggy that a little moon we discovered

167
00:11:45,230 --> 00:11:42,929
out in the a ring so there's a little

168
00:11:47,299 --> 00:11:45,240
bit of science a little bit of just kind

169
00:11:49,699 --> 00:11:47,309
of you know last moment memento photos

170
00:11:52,220 --> 00:11:49,709
and those all got played back beginning

171
00:11:53,929 --> 00:11:52,230
yesterday afternoon about 2:45 Cassini

172
00:11:55,879 --> 00:11:53,939
turn back for final calls to earth

173
00:11:58,189 --> 00:11:55,889
played all those data back there also

174
00:12:01,189 --> 00:11:58,199
available in our real-time display about

175
00:12:02,139 --> 00:12:01,199
1 o'clock this morning all that data was

176
00:12:04,850 --> 00:12:02,149
down on the ground

177
00:12:06,470 --> 00:12:04,860
Cassini then rigged yourself up for if

178
00:12:13,039 --> 00:12:06,480
we go back to that timeline just for a

179
00:12:15,409 --> 00:12:13,049
moment so September 15th 137 down there

180
00:12:17,749 --> 00:12:15,419
that last plot we actually configured

181
00:12:19,699 --> 00:12:17,759
ourselves into a real-time Saturn probe

182
00:12:21,650 --> 00:12:19,709
everything that comes into the

183
00:12:23,330 --> 00:12:21,660
spacecraft goes right back out so

184
00:12:24,620 --> 00:12:23,340
there's no delay or a little delay

185
00:12:26,480 --> 00:12:24,630
we could make so that we actually can

186
00:12:28,520 --> 00:12:26,490
become an atmospheric sampling mission

187
00:12:31,700 --> 00:12:28,530
as we go into the planet and then of

188
00:12:34,370 --> 00:12:31,710

course at 4:55 a.m. that's give or take

189
00:12:36,260 --> 00:12:34,380
oh there are a few seconds on that we'll

190
00:12:38,510 --> 00:12:36,270
be entering into Saturn's atmosphere and

191
00:12:40,220 --> 00:12:38,520
let's advance to the next display this

192
00:12:41,780 --> 00:12:40,230
is what's going to be happening within

193
00:12:43,700 --> 00:12:41,790
the last hour

194
00:12:46,520 --> 00:12:43,710
that's exactly right we came in over the

195
00:12:48,800 --> 00:12:46,530
North Pole just a little bit east from

196
00:12:50,510 --> 00:12:48,810
that perspective actually it looks West

197
00:12:52,520 --> 00:12:50,520
here but a little bit over the North

198
00:12:54,170 --> 00:12:52,530
Pole just before four o'clock this

199
00:12:56,900 --> 00:12:54,180
morning we were 60 degrees north and as

200
00:12:58,940 --> 00:12:56,910
you can see that descent is very rapid

201
00:13:01,700 --> 00:12:58,950
in 20 minutes from now or so we'll be at

202
00:13:04,250 --> 00:13:01,710
50 degrees north then a 12 minutes later

203
00:13:06,440 --> 00:13:04,260
40 and we'll be slowly not slowly very

204
00:13:09,770 --> 00:13:06,450
rapidly increasing the 10 degree north

205
00:13:11,990 --> 00:13:09,780
latitude impact point is just about

206
00:13:14,300 --> 00:13:12,000
where we're gonna finish up and it's

207
00:13:16,610 --> 00:13:14,310
going to happen about 5 of 5 this

208
00:13:19,640 --> 00:13:16,620
morning local time and the last 90

209
00:13:20,780 --> 00:13:19,650
seconds the last 90 seconds this is

210
00:13:22,100 --> 00:13:20,790
really where it's all going to be

211
00:13:26,030 --> 00:13:22,110
happening because he's not going to even

212
00:13:27,620 --> 00:13:26,040
really notice Saturn until the last 90

213
00:13:29,390 --> 00:13:27,630

seconds because it's in freefall around

214
00:13:31,430 --> 00:13:29,400
the gravitational body it's just it's

215
00:13:34,610 --> 00:13:31,440
doing its thing and play everything but

216
00:13:36,290 --> 00:13:34,620
between 70 and 60 seconds out from final

217
00:13:37,490 --> 00:13:36,300
impact it will start to notice the

218
00:13:39,080 --> 00:13:37,500
atmosphere and you can see in this

219
00:13:41,720 --> 00:13:39,090
graphic the very tenuous atmosphere

220
00:13:43,790 --> 00:13:41,730
started to experience no because he's

221
00:13:45,710 --> 00:13:43,800
been fighting the atmosphere before as a

222
00:13:49,190 --> 00:13:45,720
matter of fact for the last 5 revs we've

223
00:13:51,110 --> 00:13:49,200
been doing that and it's done very well

224
00:13:53,210 --> 00:13:51,120
but this time because we're going to go

225
00:13:54,890 --> 00:13:53,220
in so deep there's not a chance that it

226
00:13:56,540 --> 00:13:54,900
can fight to hold on to the atmosphere

227
00:13:58,490 --> 00:13:56,550
that atmosphere where we've been

228
00:14:01,460 --> 00:13:58,500
fighting it so far it's about the same

229
00:14:03,470 --> 00:14:01,470
density as the atmosphere that the

230
00:14:06,050 --> 00:14:03,480
International Space Station experiences

231
00:14:09,770 --> 00:14:06,060
here on earth very thin but we're going

232
00:14:15,860 --> 00:14:09,780
very very fast we have the animation

233
00:14:18,260 --> 00:14:15,870
from the video earlier ok painful to

234
00:14:20,150 --> 00:14:18,270
watch well it's actually what you're

235
00:14:21,830 --> 00:14:20,160
watching this value of spacecraft you

236
00:14:23,990 --> 00:14:21,840
can see the thrusters coming out of

237
00:14:25,940 --> 00:14:24,000
active back and as it starts to

238
00:14:28,160 --> 00:14:25,950

encounter the atmosphere those are small

239
00:14:30,020 --> 00:14:28,170
thrusters day.they they just aren't

240
00:14:32,510 --> 00:14:30,030
built to fight the kind of torques and

241
00:14:33,620 --> 00:14:32,520
by the way that's the antenna the chill

242
00:14:35,480 --> 00:14:33,630
trying to point the earth there's

243
00:14:36,540 --> 00:14:35,490
thrusters just aren't built to handle

244
00:14:38,250 --> 00:14:36,550
the kind of

245
00:14:40,889 --> 00:14:38,260
of Japanese rhetoric and Dragons is

246
00:14:43,230 --> 00:14:40,899
conceding experience but for about a

247
00:14:44,790 --> 00:14:43,240
minute Cassini will hang on we'll be

248
00:14:46,829 --> 00:14:44,800
sampling the atmosphere will be sitting

249
00:14:49,170 --> 00:14:46,839
the data back as quickly as we can and

250
00:14:51,720 --> 00:14:49,180
then finally of course it's gonna lose

251
00:14:52,980 --> 00:14:51,730
the battle and well within the next

252
00:14:56,340 --> 00:14:52,990
minute we'll be completely and totally

253
00:14:58,290 --> 00:14:56,350
vaporized becoming part of the planet it

254
00:15:00,180 --> 00:14:58,300
went to explore just as planned as

255
00:15:03,540 --> 00:15:00,190
planned just exactly the way we've

256
00:15:06,150 --> 00:15:03,550
always had to do and so for it for the

257
00:15:09,540 --> 00:15:06,160
team it is bittersweet I mean it is sad

258
00:15:11,690 --> 00:15:09,550
but there is tremendous energy here

259
00:15:14,310 --> 00:15:11,700
there is I think we're excited because

260
00:15:16,319 --> 00:15:14,320
this is exactly the way we always

261
00:15:18,449 --> 00:15:16,329
planned this it's sad that we're losing

262
00:15:21,360 --> 00:15:18,459
you know incredible discovery machine

263
00:15:24,150 --> 00:15:21,370

that's a loss but was always in the

264
00:15:26,040 --> 00:15:24,160
plans and now it's working exactly the

265
00:15:27,990 --> 00:15:26,050
way we set it out the images we've seen

266
00:15:29,819 --> 00:15:28,000
for the last few reps and that's science

267
00:15:31,800 --> 00:15:29,829
we've had for this entire proximal orbit

268
00:15:34,019 --> 00:15:31,810
has just been phenomenal so the real

269
00:15:38,160 --> 00:15:34,029
sense here is just alright we got it

270
00:15:40,079 --> 00:15:38,170
we have what a wonderful tour thank you

271
00:15:42,000 --> 00:15:40,089
well thanks so much for joining us I'll

272
00:15:43,170 --> 00:15:42,010
let you back in the room I know you want

273
00:15:47,310 --> 00:15:43,180
to be back in here

274
00:15:50,130 --> 00:15:47,320
all right thanks Earl meanwhile DSN 43

275
00:15:52,680 --> 00:15:50,140
in Australia is the antenna locked on

276
00:15:55,710 --> 00:15:52,690
Cassini signal and let's check the

277
00:16:02,850 --> 00:15:55,720
update display the expected loss of

278
00:16:09,300 --> 00:16:02,860
signal is 455 a.m. and that is about 41

279
00:16:15,639 --> 00:16:12,490
we've managed to inspire a younger

280
00:16:18,100 --> 00:16:15,649
generation of scientists and they will

281
00:16:20,800 --> 00:16:18,110
continue after this is over and after

282
00:16:23,860 --> 00:16:20,810
the original investigators are gone to

283
00:16:31,960 --> 00:16:23,870
to march on for their own challenges for

284
00:16:34,180 --> 00:16:31,970
future spacecraft exploration let's look

285
00:16:36,670 --> 00:16:34,190
back to what inspired the mission and

286
00:16:39,070 --> 00:16:36,680
the day Cassini arrived at Saturn the

287
00:16:41,380 --> 00:16:39,080
cassini-huygens mission was a joint

288
00:16:44,500 --> 00:16:41,390

effort of NASA the European Space Agency

289
00:16:46,690 --> 00:16:44,510
and the Italian space agency it was

290
00:16:50,400 --> 00:16:46,700
conceived after the Voyager flybys of

291
00:17:01,130 --> 00:16:50,410
Saturn and scientists all over the world

292
00:17:09,949 --> 00:17:04,309
hello this is Arthur Clarke joining you

293
00:17:11,419 --> 00:17:09,959
from my tour in Colombo Sri Lanka thanks

294
00:17:14,120 --> 00:17:11,429
to the World Wide Web

295
00:17:17,299 --> 00:17:14,130
I've been following the purpose of

296
00:17:21,020 --> 00:17:17,309
cassini-huygens from the time it was

297
00:17:23,510 --> 00:17:21,030
launched several years ago as you know I

298
00:17:27,020 --> 00:17:23,520
had more than a passing interest in

299
00:17:27,770 --> 00:17:27,030
Saturn so I'm going to keep my fingers

300
00:17:31,720 --> 00:17:27,780
crossed

301
00:17:35,750 --> 00:17:31,730
with what Cassini discovers who knows

302
00:18:17,570 --> 00:17:35,760
one day our survival on earth they

303
00:18:17,580 --> 00:18:21,740
[Applause]

304
00:18:31,140 --> 00:18:24,779
okay we have burned complete here for

305
00:18:33,600 --> 00:18:31,150
the SLI or insertion burn it for

306
00:18:36,930 --> 00:18:33,610
Saturn's strong gravity pulling us in

307
00:18:39,870 --> 00:18:36,940
SOI burn attitude or pointing direction

308
00:18:48,630 --> 00:18:39,880
and we'll hope to acquire a signal

309
00:18:51,600 --> 00:18:48,640
before that turn actually completes 30th

310
00:18:54,210 --> 00:18:51,610
2004 was the voice of Cassini propulsion

311
00:18:56,220 --> 00:18:54,220
engineer Todd barber Todd served as the

312
00:18:59,130 --> 00:18:56,230
team's commentator and Todd is back

313
00:19:01,409 --> 00:18:59,140

today once again serving as our team

314
00:19:04,440 --> 00:19:01,419
commentator in the same Mission Control

315
00:19:06,000 --> 00:19:04,450
Room for a much different event how does

316
00:19:08,669 --> 00:19:06,010
it feel taught to be here

317
00:19:11,490 --> 00:19:08,679
I gave well it's great to be back it's

318
00:19:13,590 --> 00:19:11,500
kind of cruel to age 13 years in two

319
00:19:16,740 --> 00:19:13,600
seconds and have to watch that but what

320
00:19:19,440 --> 00:19:16,750
a demonstration of the longevity of this

321
00:19:22,799 --> 00:19:19,450
mission as you and I sat there in 2004

322
00:19:24,810 --> 00:19:22,809
we never dreamt we'd be here in 2017

323
00:19:27,029 --> 00:19:24,820
still talking about Cassini and

324
00:19:29,940 --> 00:19:27,039
collecting science data so I'm just

325
00:19:31,830 --> 00:19:29,950
thrilled to be here even even having

326
00:19:34,350 --> 00:19:31,840
aged some years since that's life

327
00:19:36,899 --> 00:19:34,360
Oh Todd very quickly we're a couple of

328
00:19:39,120 --> 00:19:36,909
minutes behind here explain to us why

329
00:19:43,049 --> 00:19:39,130
the team has gathered here even though

330
00:19:47,370 --> 00:19:43,059
you told me that the spacecraft met its

331
00:19:50,159 --> 00:19:47,380
fate probably about 3:30 about 3:30

332
00:19:53,220 --> 00:19:50,169
Pacific time out at Saturn but yet the

333
00:19:55,500 --> 00:19:53,230
team is waiting here now and holding

334
00:19:57,330 --> 00:19:55,510
vigil why is that well it's that pesky

335
00:20:00,029 --> 00:19:57,340
Albert Einstein in his speed of light

336
00:20:02,070 --> 00:20:00,039
speed limit at 186,000 miles per second

337
00:20:04,590 --> 00:20:02,080
or 300,000 kilometers per second so

338
00:20:06,779 --> 00:20:04,600

Saturn is about an hour and 23 minutes

339
00:20:09,000 --> 00:20:06,789
away from us right now one-way light

340
00:20:11,159 --> 00:20:09,010
time I'm a big sports nut I tape a lot

341
00:20:12,360 --> 00:20:11,169
of games and DVR em and the game is

342
00:20:14,220 --> 00:20:12,370
still exciting if you don't know the

343
00:20:16,409 --> 00:20:14,230
result you haven't seen it and no one's

344
00:20:18,810 --> 00:20:16,419
seen the cassini last bits of science

345
00:20:20,520 --> 00:20:18,820
come back from Saturn yet it's just

346
00:20:22,560 --> 00:20:20,530
about to cross the orbit of Jupiter

347
00:20:25,380 --> 00:20:22,570
there's our graphic

348
00:20:28,770 --> 00:20:25,390
so and of course Jupiter's a little

349
00:20:30,330 --> 00:20:28,780
different position so any denizens of

350
00:20:31,650 --> 00:20:30,340
the solar system at Jupiter or Mars

351
00:20:34,350 --> 00:20:31,660
they'll know

352
00:20:36,210 --> 00:20:34,360
Cassini's fate and last bit of data

353
00:20:38,280 --> 00:20:36,220
before we will on earth so we're holding

354
00:20:42,299 --> 00:20:38,290
vigil here we also have that this

355
00:20:45,390 --> 00:20:42,309
display kind of like a gauges in your

356
00:20:47,610 --> 00:20:45,400
car this is the speed notice it's 63,000

357
00:20:50,070 --> 00:20:47,620
miles per hour and climbing as we

358
00:20:52,200 --> 00:20:50,080
descend into Saturn's gravity well and

359
00:20:54,180 --> 00:20:52,210
on the right side is the distance from

360
00:20:57,270 --> 00:20:54,190
the cloud tops and that's just shrinking

361
00:21:00,000 --> 00:20:57,280
it's gonna head down over the next 37

362
00:21:01,350 --> 00:21:00,010
minutes until we reach those cloud tops

363
00:21:03,180 --> 00:21:01,360

and say goodbye to our beautiful

364
00:21:05,640 --> 00:21:03,190
spacecraft down at Saturn and Todd

365
00:21:08,940 --> 00:21:05,650
helped us understand how the team will

366
00:21:12,090 --> 00:21:08,950
be monitoring this yes we've got a few

367
00:21:16,080 --> 00:21:12,100
ways there's a display from well here's

368
00:21:18,450 --> 00:21:16,090
our radio signals so this is the carrier

369
00:21:21,419 --> 00:21:18,460
frequency and what I'd like to point out

370
00:21:24,720 --> 00:21:21,429
here the peak in the middle this is like

371
00:21:27,330 --> 00:21:24,730
the loudness or the signal strength and

372
00:21:29,070 --> 00:21:27,340
at the Cassini frequency that it's

373
00:21:31,020 --> 00:21:29,080
talking we have two displays by the way

374
00:21:33,210 --> 00:21:31,030
X band and s band those are just two

375
00:21:34,950 --> 00:21:33,220
different radio frequencies so if you

376
00:21:36,419 --> 00:21:34,960
think in your car radio of tuning to

377
00:21:38,610 --> 00:21:36,429
different frequencies that's like moving

378
00:21:40,620 --> 00:21:38,620
along the x axis there are the

379
00:21:43,530 --> 00:21:40,630
horizontal axis and we're getting a nice

380
00:21:46,799 --> 00:21:43,540
big strong booming signal from Cassini

381
00:21:48,900 --> 00:21:46,809
on both those axes but as we come into

382
00:21:51,510 --> 00:21:48,910
the atmosphere and turn away from Earth

383
00:21:52,140 --> 00:21:51,520
our thrusters can't keep up anymore with

384
00:21:55,350 --> 00:21:52,150
the torques

385
00:21:58,680 --> 00:21:55,360
those will flatline and that's when we

386
00:22:01,470 --> 00:21:58,690
say goodbye to Cassini however the key

387
00:22:04,620 --> 00:22:01,480
is to keep the data coming down to earth

388
00:22:07,500 --> 00:22:04,630

and get those precious last few bits of

389
00:22:09,990 --> 00:22:07,510
science data from Saturn our first sniff

390
00:22:11,880 --> 00:22:10,000
of the upper Saturn of the atmosphere

391
00:22:14,669 --> 00:22:11,890
and boy we're excited for that all right

392
00:22:15,270 --> 00:22:14,679
well thanks Todd we will check back with

393
00:22:17,880 --> 00:22:15,280
you later

394
00:22:21,480 --> 00:22:17,890
and one of the signals Todd showed you

395
00:22:23,480 --> 00:22:21,490
is part of a computer visualization tool

396
00:22:26,370 --> 00:22:23,490
we call eyes on the solar system this

397
00:22:28,470 --> 00:22:26,380
JPL computer simulation software is

398
00:22:30,450 --> 00:22:28,480
based on real data from missions and

399
00:22:32,820 --> 00:22:30,460
it's something you can download onto

400
00:22:34,530 --> 00:22:32,830
your own computer and use to follow

401
00:22:38,610 --> 00:22:34,540
along this morning just

402
00:22:43,740 --> 00:22:38,620
goto eyes nasa.gov download the app and

403
00:22:46,470 --> 00:22:43,750
click on Cassini store here are two

404
00:22:50,130 --> 00:22:46,480
family photos we'd like to share the top

405
00:22:53,250 --> 00:22:50,140
one was taken on June 21st 2017 it's the

406
00:22:55,770 --> 00:22:53,260
Cassini team and alumni and they filled

407
00:22:58,440 --> 00:22:55,780
the staircase on the mall here most of

408
00:23:01,170 --> 00:22:58,450
them are engineers on the bottom photo

409
00:23:03,270 --> 00:23:01,180
was and this one was just taking just a

410
00:23:05,820 --> 00:23:03,280
few days ago it's the science team and

411
00:23:08,180 --> 00:23:05,830
they were at Caltech the team includes

412
00:23:10,710 --> 00:23:08,190
scientists from all over the world over

413
00:23:12,780 --> 00:23:10,720

the years thousands of people have

414
00:23:15,660 --> 00:23:12,790
worked on this mission in fact there are

415
00:23:17,970 --> 00:23:15,670
so many members of the Cassini family we

416
00:23:20,610 --> 00:23:17,980
couldn't fit all of them here at JPL

417
00:23:23,010 --> 00:23:20,620
it's why there's a big crowd at Beckman

418
00:23:25,320 --> 00:23:23,020
auditorium at Caltech in Pasadena and

419
00:23:27,870 --> 00:23:25,330
that is where Cassini science team

420
00:23:31,790 --> 00:23:27,880
member morgan Cable is right now Morgan

421
00:23:39,300 --> 00:23:36,840
hi gay well here at Caltech the you can

422
00:23:41,790 --> 00:23:39,310
hear behind me right this is a historic

423
00:23:44,520 --> 00:23:41,800
moment and I think the mood reflects

424
00:23:46,710 --> 00:23:44,530
that but it's also like a family reunion

425
00:23:50,010 --> 00:23:46,720
so we're here with our other fellow

426
00:23:51,630 --> 00:23:50,020
Cassini family members we're seeing

427
00:23:54,480 --> 00:23:51,640
people we haven't seen in a long time

428
00:23:56,640 --> 00:23:54,490
for some cases and it's just been

429
00:23:59,130 --> 00:23:56,650
wonderful to share these memories to

430
00:24:01,740 --> 00:23:59,140
revel in the excitement this is the

431
00:24:05,520 --> 00:24:01,750
celebration of an amazing mission and an

432
00:24:08,250 --> 00:24:05,530
incredible legacy Morgan you're one of

433
00:24:10,800 --> 00:24:08,260
the scientists here one of the

434
00:24:13,470 --> 00:24:10,810
scientists out there I mean for you

435
00:24:15,900 --> 00:24:13,480
you're probably being very reflective

436
00:24:20,610 --> 00:24:15,910
what was one of the highlights for you

437
00:24:22,860 --> 00:24:20,620
of this mission for me personally the

438
00:24:26,070 --> 00:24:22,870

discoveries at Enceladus have really

439
00:24:27,540 --> 00:24:26,080
revolutionized our view of where we

440
00:24:29,970 --> 00:24:27,550
might find life or at least the

441
00:24:32,700 --> 00:24:29,980
conditions suitable for life in not only

442
00:24:34,440 --> 00:24:32,710
our solar system but the universe we've

443
00:24:37,080 --> 00:24:34,450
learned now that there are places where

444
00:24:38,940 --> 00:24:37,090
liquid water and the other ingredients

445
00:24:41,760 --> 00:24:38,950
for life as we know it to exist

446
00:24:43,800 --> 00:24:41,770
chemistry and energy exists in places

447
00:24:45,780 --> 00:24:43,810
like Enceladus and that's thanks to the

448
00:24:47,910 --> 00:24:45,790
Cassini mission which flew

449
00:24:51,570 --> 00:24:47,920
the plume of Enceladus multiple times

450
00:24:53,490 --> 00:24:51,580
this means that life may not only exist

451
00:24:56,520 --> 00:24:53,500
in the habitable zone around other stars

452
00:24:59,010 --> 00:24:56,530
but now we can start to look for places

453
00:25:01,380 --> 00:24:59,020
like Enceladus or Europa elsewhere in

454
00:25:04,050 --> 00:25:01,390
the universe and extend our search to

455
00:25:06,720 --> 00:25:04,060
try to find that amazing discovery of

456
00:25:08,430 --> 00:25:06,730
life somewhere else all right well we

457
00:25:11,430 --> 00:25:08,440
will be checking back with you Morgan

458
00:25:14,370 --> 00:25:11,440
later on the show thanks for that report

459
00:25:16,350 --> 00:25:14,380
it is about 23 minutes past the hour

460
00:25:19,260 --> 00:25:16,360
you're watching live coverage marking

461
00:25:21,990 --> 00:25:19,270
the final moments of Cassini on NASA TV

462
00:25:23,940 --> 00:25:22,000
the Deep Space Network is awaiting the

463
00:25:27,450 --> 00:25:23,950

loss of signal from the spacecraft from

464
00:25:30,660 --> 00:25:27,460
DSN antenna 43 in Australia and let's go

465
00:25:33,590 --> 00:25:30,670
to Cassini's final hour display at this

466
00:25:36,780 --> 00:25:33,600
point the spacecraft has sent us data

467
00:25:40,590 --> 00:25:36,790
from about the 50 degree north latitude

468
00:25:49,110 --> 00:25:40,600
mark and loss of signal should be coming

469
00:25:55,010 --> 00:25:51,160
[Music]

470
00:26:14,900 --> 00:25:56,820
you

471
00:26:46,480 --> 00:26:22,630
[Music]

472
00:26:51,770 --> 00:26:49,669
beautiful images from Cassini the

473
00:26:53,840 --> 00:26:51,780
cassini-huygens mission made so many

474
00:26:56,029 --> 00:26:53,850
historic discoveries think about it the

475
00:26:58,220 --> 00:26:56,039
Huygens probe sent back details of an

476
00:27:00,770 --> 00:26:58,230
alien world on Titan a world that

477
00:27:03,409 --> 00:27:00,780
appears to be very similar to earth it

478
00:27:05,029 --> 00:27:03,419
found jet spraying water ice and

479
00:27:08,150 --> 00:27:05,039
organics from the South Pole of

480
00:27:11,299 --> 00:27:08,160
Enceladus revealing an interior ocean

481
00:27:13,310 --> 00:27:11,309
where there could be life over and over

482
00:27:15,980 --> 00:27:13,320
again the mission revealed scientific

483
00:27:19,700 --> 00:27:15,990
wonders about Saturn its rings and moons

484
00:27:22,370 --> 00:27:19,710
and it hasn't stopped at least not yet

485
00:27:25,700 --> 00:27:22,380
with me now is Cassini project scientist

486
00:27:28,460 --> 00:27:25,710
Linda Stoker this mission was determined

487
00:27:30,850 --> 00:27:28,470
to send down science right down to the

488
00:27:33,590 --> 00:27:30,860

very hats right gay till the very last

489
00:27:36,460 --> 00:27:33,600
second so we're all told us just a

490
00:27:41,330 --> 00:27:36,470
little while ago that overnight the

491
00:27:43,159 --> 00:27:41,340
spacecraft sent back the last picture

492
00:27:45,560 --> 00:27:43,169
show it's been called can you describe

493
00:27:48,260 --> 00:27:45,570
what those are okay well let's go to the

494
00:27:49,970 --> 00:27:48,270
very first image image a as part of the

495
00:27:52,460 --> 00:27:49,980
last picture show the first thing we did

496
00:27:54,320 --> 00:27:52,470
is we made a color mosaic and these are

497
00:27:56,419 --> 00:27:54,330
just a couple of pictures from that

498
00:27:59,360 --> 00:27:56,429
mosaic we'll stitch those together and

499
00:28:01,640 --> 00:27:59,370
have a beautiful image of Saturn plus

500
00:28:04,760 --> 00:28:01,650
the Rings for the last time we go to

501
00:28:08,060 --> 00:28:04,770
image a see that's a movie of Enceladus

502
00:28:11,210 --> 00:28:08,070
actually setting behind the limb of

503
00:28:13,909 --> 00:28:11,220
Saturn and explain to me how the team

504
00:28:16,460 --> 00:28:13,919
decided to come up with this imagery in

505
00:28:18,380 --> 00:28:16,470
this selection well there's a lot of

506
00:28:20,720 --> 00:28:18,390
science in these images so we wanted to

507
00:28:22,730 --> 00:28:20,730
do science oh there's Enceladus setting

508
00:28:25,610 --> 00:28:22,740
behind the limit of Saturn so we're

509
00:28:28,399 --> 00:28:25,620
saying goodbye to Enceladus and taking a

510
00:28:30,560 --> 00:28:28,409
last look at that particular world and

511
00:28:32,840 --> 00:28:30,570
so we wanted to sort of do a survey look

512
00:28:34,610 --> 00:28:32,850
at each of these key targets collect

513
00:28:36,260 --> 00:28:34,620

picture postcards for our Cassini

514
00:28:38,480 --> 00:28:36,270
scrapbook so these will be the last

515
00:28:41,360 --> 00:28:38,490
pictures that we'll put in our scrapbook

516
00:28:44,210 --> 00:28:41,370
if we look at image D that's a true

517
00:28:47,810 --> 00:28:44,220
color image of Titan and you can see the

518
00:28:50,030 --> 00:28:47,820
lakes up in the North image F shows this

519
00:28:51,840 --> 00:28:50,040
in false color there's a UV filter as

520
00:28:54,060 --> 00:28:51,850
part of image F and the lakes

521
00:28:56,909 --> 00:28:54,070
really pop out and you can also see that

522
00:28:58,860 --> 00:28:56,919
bluish haze at the edge of Titan you

523
00:29:01,380 --> 00:28:58,870
know Titan has this thick nitrogen

524
00:29:04,740 --> 00:29:01,390
atmosphere we also took some pictures of

525
00:29:06,450 --> 00:29:04,750
the Rings gay if we go to image G we're

526
00:29:08,669 --> 00:29:06,460
looking for propellers in this

527
00:29:11,549 --> 00:29:08,679
particular image and you can just see a

528
00:29:14,250 --> 00:29:11,559
hint of it above that dark gap if we go

529
00:29:16,529 --> 00:29:14,260
to image H that's a blow-up and see that

530
00:29:18,180 --> 00:29:16,539
little two arm propeller it's that

531
00:29:20,880 --> 00:29:18,190
little bright feature just above the

532
00:29:22,140 --> 00:29:20,890
dark gap there's a collection of ring

533
00:29:24,539 --> 00:29:22,150
particles that are large enough they're

534
00:29:26,640 --> 00:29:24,549
trying to open their own gap and they

535
00:29:29,430 --> 00:29:26,650
create what looks like an airplane

536
00:29:33,419 --> 00:29:29,440
propeller and they have fun names names

537
00:29:36,060 --> 00:29:33,429
of aviators if we go to image I as part

538
00:29:38,250 --> 00:29:36,070

of the sequence we're looking at the

539
00:29:40,830 --> 00:29:38,260
tiny moon deafness that's the Keeler gap

540
00:29:43,620 --> 00:29:40,840
you can see those crinkly edges along

541
00:29:46,230 --> 00:29:43,630
the gap that's created by Daphna s--

542
00:29:48,539 --> 00:29:46,240
awake as it goes through that system and

543
00:29:50,279 --> 00:29:48,549
you can see the beautiful density waves

544
00:29:52,860 --> 00:29:50,289
the interaction between the Rings and

545
00:29:55,260 --> 00:29:52,870
the satellites also as those bright

546
00:29:59,279 --> 00:29:55,270
features in our last look at the

547
00:30:01,289 --> 00:29:59,289
propellers and finally image J this is

548
00:30:03,779 --> 00:30:01,299
an image looking at Saturn in a place

549
00:30:07,409 --> 00:30:03,789
where a Cassini will be entering so one

550
00:30:10,049 --> 00:30:07,419
of our last views our very last pictures

551
00:30:12,899 --> 00:30:10,059
of Saturn and you can think of Cassini

552
00:30:15,020 --> 00:30:12,909
as basically running a marathon for 13

553
00:30:18,000 --> 00:30:15,030
years we've been running a marathon of

554
00:30:21,330 --> 00:30:18,010
scientific discovery and were on the

555
00:30:24,810 --> 00:30:21,340
last lap and so we're here today to

556
00:30:28,289 --> 00:30:24,820
cheer as Cassini finishes that race now

557
00:30:30,840 --> 00:30:28,299
many many of these images and what the

558
00:30:33,480 --> 00:30:30,850
spacecraft will be doing right now all

559
00:30:35,130 --> 00:30:33,490
of this is unknown territory the

560
00:30:37,890 --> 00:30:35,140
spacecraft has never been here before

561
00:30:40,140 --> 00:30:37,900
that's right we're flying into Saturn

562
00:30:42,090 --> 00:30:40,150
more deeply than we've ever flown before

563
00:30:44,580 --> 00:30:42,100

we have eight of our scientific

564
00:30:47,279 --> 00:30:44,590
instruments on the key instrument is the

565
00:30:48,840 --> 00:30:47,289
aina neutral mass spectrometer basically

566
00:30:51,210 --> 00:30:48,850
coming in we've oriented the instrument

567
00:30:53,970 --> 00:30:51,220
to sample the atmosphere of Saturn which

568
00:30:56,070 --> 00:30:53,980
it's doing right now deeper and deeper

569
00:30:58,740 --> 00:30:56,080
until on the very final second as

570
00:31:01,260 --> 00:30:58,750
Cassini fights to hold attitude it'll

571
00:31:03,720 --> 00:31:01,270
send back those last very valuable

572
00:31:06,420 --> 00:31:03,730
packets of data and

573
00:31:09,090 --> 00:31:06,430
who knows how many PhD theses might be

574
00:31:12,330 --> 00:31:09,100
in just those final seconds of data

575
00:31:14,880 --> 00:31:12,340
right we will have scientists and

576
00:31:16,920 --> 00:31:14,890
students poring over this data for

577
00:31:19,320 --> 00:31:16,930
decades to come probably right and look

578
00:31:21,900 --> 00:31:19,330
at the hydrogen to helium ratio to help

579
00:31:24,240 --> 00:31:21,910
us understand how Saturn formed how

580
00:31:25,860 --> 00:31:24,250
Saturn's evolving and who knows what

581
00:31:26,400 --> 00:31:25,870
else we'll see as we go into the

582
00:31:29,130 --> 00:31:26,410
atmosphere

583
00:31:29,790 --> 00:31:29,140
what great science means you know still

584
00:31:31,800 --> 00:31:29,800
ahead

585
00:31:34,290 --> 00:31:31,810
all right well Linda thanks for joining

586
00:31:36,780 --> 00:31:34,300
us yes glad to be here you're watching

587
00:31:38,790 --> 00:31:36,790
live coverage of Cassini's final hour

588
00:31:41,730 --> 00:31:38,800

from the Jet Propulsion Laboratory JPL

589
00:31:44,280 --> 00:31:41,740
is a NASA Center in LA cañada Flintridge

590
00:31:46,620 --> 00:31:44,290
and Pasadena California and managed by

591
00:31:49,830 --> 00:31:46,630
the California Institute of Technology

592
00:31:53,910 --> 00:31:49,840
let's check out our display we are now

593
00:31:58,350 --> 00:31:53,920
about just a little under 26 minutes

594
00:32:23,009 --> 00:32:13,340
[Music]

595
00:32:25,859 --> 00:32:23,019
well the Cassini team considers itself a

596
00:32:29,639 --> 00:32:25,869
family a team that works together and

597
00:32:32,549 --> 00:32:29,649
plays together and here is one example

598
00:32:36,450 --> 00:32:32,559
the Cassini virtual singers they have a

599
00:32:41,460 --> 00:32:36,460
knack for putting a Cassini spin on just

600
00:32:44,669 --> 00:32:41,470
about any show to me and I saw Todd

601
00:32:46,440 --> 00:32:44,679
barber in that group Todd it is a very

602
00:32:49,379 --> 00:32:46,450
close-knit group and a

603
00:32:51,629 --> 00:32:49,389
multi-generational group I mean some

604
00:32:53,580 --> 00:32:51,639
people have spent their entire careers

605
00:32:57,029 --> 00:32:53,590
on this mission and others are just

606
00:32:58,830 --> 00:32:57,039
starting their careers on Cassini Todd

607
00:33:01,080 --> 00:32:58,840
barber is standing by with one of the

608
00:33:04,349 --> 00:33:01,090
younger members of the team guidance and

609
00:33:07,590 --> 00:33:04,359
control engineer Joni stupic who started

610
00:33:08,970 --> 00:33:07,600
her career with Cassini right yes that's

611
00:33:10,889 --> 00:33:08,980
right and I've been on since before

612
00:33:12,960 --> 00:33:10,899
launch but it's so wonderful to have

613
00:33:16,440 --> 00:33:12,970

young engineers join the project welcome

614
00:33:18,090 --> 00:33:16,450
Joni and Joni is an attitude control

615
00:33:20,039 --> 00:33:18,100
engineer on the project and can you

616
00:33:23,909 --> 00:33:20,049
explain what that means to our viewers

617
00:33:26,159 --> 00:33:23,919
sure absolutely so I and my team are in

618
00:33:27,690 --> 00:33:26,169
charge of the orientation of the

619
00:33:30,389 --> 00:33:27,700
spacecraft so we point all of the

620
00:33:32,609 --> 00:33:30,399
cameras and the antennae that's great

621
00:33:35,070 --> 00:33:32,619
and you have a particularly important

622
00:33:36,899 --> 00:33:35,080
role this evening right or this morning

623
00:33:39,090 --> 00:33:36,909
I guess I should say absolutely so as

624
00:33:41,820 --> 00:33:39,100
Earl and Linda have both alluded to we

625
00:33:43,919 --> 00:33:41,830
want to get every last possible second

626
00:33:46,259 --> 00:33:43,929
of information which means our antenna

627
00:33:48,060 --> 00:33:46,269
needs to be pointed towards Earth for as

628
00:33:49,680 --> 00:33:48,070
long as we possibly can as we enter into

629
00:33:51,899 --> 00:33:49,690
the atmosphere so I'm just gonna start

630
00:33:53,940 --> 00:33:51,909
trying to tug us away so we want to hold

631
00:33:55,499 --> 00:33:53,950
the antenna studies we possibly can for

632
00:33:57,960 --> 00:33:55,509
that whole time and how do you do that

633
00:34:00,869 --> 00:33:57,970
we have little engines or thrusters that

634
00:34:03,779 --> 00:34:00,879
we use to hold us very wonderful so

635
00:34:05,489 --> 00:34:03,789
that's and basically we will lose the

636
00:34:07,560 --> 00:34:05,499
battle with Saturn's atmosphere we will

637
00:34:11,369 --> 00:34:07,570
and if we go to the graphic here we see

638
00:34:13,289 --> 00:34:11,379

the thrusters firing as we try and hold

639
00:34:15,119 --> 00:34:13,299
that antenna for as long as we can and

640
00:34:16,799 --> 00:34:15,129
that will last for only about a minute

641
00:34:18,480 --> 00:34:16,809
until the trusters are finally

642
00:34:21,359 --> 00:34:18,490
overwhelmed and we can no longer point

643
00:34:23,520 --> 00:34:21,369
man wow that's amazing

644
00:34:26,909 --> 00:34:23,530
but those precious seconds of science

645
00:34:29,880 --> 00:34:26,919
data are are worth every thruster pulse

646
00:34:31,860 --> 00:34:29,890
we put on the every every

647
00:34:33,780 --> 00:34:31,870
yeah we're learning all about Saturn's

648
00:34:36,150 --> 00:34:33,790
atmosphere with all the instruments we

649
00:34:38,520 --> 00:34:36,160
can as we go in yeah we want to point as

650
00:34:39,690 --> 00:34:38,530
long as we can so you started your

651
00:34:41,430 --> 00:34:39,700
career on this mission how are you

652
00:34:43,020 --> 00:34:41,440
feeling tonight knowing it's we have to

653
00:34:44,820 --> 00:34:43,030
say goodbye to our beautiful spacecraft

654
00:34:46,320 --> 00:34:44,830
is definitely better sweetie I started

655
00:34:50,370 --> 00:34:46,330
my career I was in high school when

656
00:34:51,810 --> 00:34:50,380
Cassini arrived at Saturn so it's you

657
00:34:53,580 --> 00:34:51,820
know it's really exciting and I'm really

658
00:34:55,050 --> 00:34:53,590
proud to have worked on such you know

659
00:34:57,030 --> 00:34:55,060
incredible mission and be part of such a

660
00:34:58,650 --> 00:34:57,040
wonderful family but it's gonna be sad

661
00:35:00,510 --> 00:34:58,660
you know I'm used to checking how the

662
00:35:02,010 --> 00:35:00,520
spacecraft is feeling every morning and

663
00:35:04,410 --> 00:35:02,020

things like that so it'll be a little

664
00:35:06,300 --> 00:35:04,420
sad to not have that anymore I

665
00:35:07,980 --> 00:35:06,310
definitely agree there and and we're so

666
00:35:10,080 --> 00:35:07,990
grateful for your contributions and all

667
00:35:11,310 --> 00:35:10,090
the young engineers on the project as

668
00:35:15,150 --> 00:35:11,320
well as the veterans that have been

669
00:35:18,060 --> 00:35:15,160
around since launch thank you Joe we got

670
00:35:20,700 --> 00:35:18,070
a few tricks up our sleeve so if we can

671
00:35:25,110 --> 00:35:20,710
head back to the radio science display

672
00:35:28,500 --> 00:35:25,120
and check and see still looking good so

673
00:35:31,410 --> 00:35:28,510
we have a strong X and s band signal so

674
00:35:33,600 --> 00:35:31,420
our as Earl mentioned our fate is sealed

675
00:35:35,220 --> 00:35:33,610
we we've met our planetary protection

676
00:35:37,380 --> 00:35:35,230
requirement we know we're going to

677
00:35:38,700 --> 00:35:37,390
impact Saturn and take care of that the

678
00:35:41,250 --> 00:35:38,710
next thing that's important is to hold

679
00:35:44,220 --> 00:35:41,260
that signal as long as possible and get

680
00:35:46,910 --> 00:35:44,230
every last precious bit of science data

681
00:35:50,250 --> 00:35:46,920
so so far so good Gaye back to you

682
00:35:52,650 --> 00:35:50,260
thanks Joanie it is about 33 minutes

683
00:36:01,810 --> 00:35:52,660
past the hour and the estimated time of

684
00:36:01,820 --> 00:36:07,720
[Music]

685
00:36:27,590 --> 00:36:09,520
you

686
00:36:58,600 --> 00:36:35,330
[Music]

687
00:37:04,010 --> 00:37:01,940
the cassini-huygens mission has been an

688
00:37:07,160 --> 00:37:04,020

epic adventure around the Saturn system

689
00:37:10,250 --> 00:37:07,170
it has sent home mountains of science

690
00:37:12,710 --> 00:37:10,260
data stunning images the spacecraft

691
00:37:16,100 --> 00:37:12,720
performed beautifully the mission

692
00:37:18,260 --> 00:37:16,110
fulfilled its goals and vensim members

693
00:37:21,700 --> 00:37:18,270
say they couldn't have asked for

694
00:37:21,710 --> 00:37:27,310
[Music]

695
00:37:43,010 --> 00:37:30,890
this is tight mana control

696
00:37:45,500 --> 00:37:43,020
all the systems are go I worked on the

697
00:37:51,079 --> 00:37:45,510
Cassini project for almost 30 years and

698
00:37:53,089 --> 00:37:51,089
that's an entire Saturn orbit the beauty

699
00:37:55,430 --> 00:37:53,099
of Cassini is the design

700
00:37:57,740 --> 00:37:55,440
it's the largest outer planetary

701
00:38:00,559 --> 00:37:57,750
spacecraft ever built twelve different

702
00:38:03,650 --> 00:38:00,569
instruments the Huygens probe built by

703
00:38:10,049 --> 00:38:03,660
the European Space Agency it's just a

704
00:38:10,059 --> 00:38:18,790
three-two-one

705
00:38:38,940 --> 00:38:33,030
[Music]

706
00:38:41,160 --> 00:38:38,950
we turned the cassini cameras down to

707
00:38:43,079 --> 00:38:41,170
look at the Rings revealing them in a

708
00:38:45,630 --> 00:38:43,089
way we had never seen them before

709
00:38:50,580 --> 00:38:45,640
I remember coming back to JPL early in

710
00:38:55,890 --> 00:38:53,100
and watch those pictures one by one come

711
00:38:58,260 --> 00:38:55,900
down and I felt I could almost reach out

712
00:39:00,010 --> 00:38:58,270
and touch the rings that were right

713
00:39:05,910 --> 00:39:00,020

there

714
00:39:08,740 --> 00:39:08,049
we have been collaborating with the

715
00:39:11,079 --> 00:39:08,750
Europeans

716
00:39:16,450 --> 00:39:11,089
ever since launched to make sure that we

717
00:39:18,400 --> 00:39:16,460
had everything right for wagons the

718
00:39:21,720 --> 00:39:18,410
Huygens probe has dropped onto Titan

719
00:39:25,870 --> 00:39:21,730
these are images from billion miles away

720
00:39:27,130 --> 00:39:25,880
on the surface of Titan they're boulders

721
00:39:29,650 --> 00:39:27,140
there were pebbles we're in a dry

722
00:39:34,200 --> 00:39:29,660
lakebed and I still get goose bumps this

723
00:39:38,530 --> 00:39:36,700
looking back at what we were planning to

724
00:39:42,300 --> 00:39:38,540
do in those first four years we've gone

725
00:39:44,590 --> 00:39:42,310
so far beyond that we remapped our

726
00:39:49,450 --> 00:39:44,600
investigations to concentrate on the

727
00:39:51,700 --> 00:39:49,460
questions the cassini raised two of our

728
00:39:55,060 --> 00:39:51,710
instruments actually sampled the plume

729
00:39:57,520 --> 00:39:55,070
of Enceladus as we flew through tasting

730
00:40:00,640 --> 00:39:57,530
the gas measuring the particles in a way

731
00:40:02,950 --> 00:40:00,650
that we hadn't planned Cassini has

732
00:40:05,470 --> 00:40:02,960
changed the paradigm of where we might

733
00:40:11,650 --> 00:40:05,480
look for life that will be one of her

734
00:40:17,110 --> 00:40:11,660
legacies 13 years of exploring Saturn it

735
00:40:28,230 --> 00:40:25,460
[Music]

736
00:40:30,950 --> 00:40:28,240
all right well joining me now is NASA

737
00:40:34,170 --> 00:40:30,960
director of planetary science Jim Green

738
00:40:37,080 --> 00:40:34,180

some of Cassini's greatest

739
00:40:39,840 --> 00:40:37,090
accomplishments came as big surprises

740
00:40:41,190 --> 00:40:39,850
didn't it they did absolutely you know

741
00:40:44,640 --> 00:40:41,200
one of the ones that's pretty

742
00:40:46,650 --> 00:40:44,650
spectacular obviously is Enceladus now

743
00:40:48,690 --> 00:40:46,660
you may not really understand the

744
00:40:52,410 --> 00:40:48,700
importance of having a spacecraft with

745
00:40:54,120 --> 00:40:52,420
all kinds of instruments including

746
00:40:56,160 --> 00:40:54,130
magnetometers and plasma wave

747
00:40:59,520 --> 00:40:56,170
instruments but it was really discovered

748
00:41:03,030 --> 00:40:59,530
the plumes by a magnetometer and so as

749
00:41:06,060 --> 00:41:03,040
the spacecraft was doing a flyby what

750
00:41:08,910 --> 00:41:06,070
was happening is the plumes were being

751
00:41:10,590 --> 00:41:08,920
blasted out of the tiger stripes they

752
00:41:13,290 --> 00:41:10,600
were being ionized and they're loading

753
00:41:15,630 --> 00:41:13,300
down the field dragging it by and so the

754
00:41:17,630 --> 00:41:15,640
magnetometer saw the wave of the field

755
00:41:19,980 --> 00:41:17,640
in a place that they hadn't expected

756
00:41:21,780 --> 00:41:19,990
that gave a hint that something was

757
00:41:24,660 --> 00:41:21,790
going on and it needed to be looked at

758
00:41:26,460 --> 00:41:24,670
and so then the next pass they came up

759
00:41:28,890 --> 00:41:26,470
with the idea well let's look at it in

760
00:41:32,880 --> 00:41:28,900
backlight and wow there were the plumes

761
00:41:35,220 --> 00:41:32,890
and that started then a series of new

762
00:41:37,470 --> 00:41:35,230
orbits and new trajectories to try to go

763
00:41:39,690 --> 00:41:37,480

through and taste the plumes and get

764
00:41:42,690 --> 00:41:39,700
even more details about what's happening

765
00:41:46,320 --> 00:41:42,700
at Enceladus and how does this discovery

766
00:41:50,190 --> 00:41:46,330
sort of change the way we look for life

767
00:41:53,910 --> 00:41:50,200
in the solar system well this is really

768
00:41:57,270 --> 00:41:53,920
a calling if you will of hey you're

769
00:41:59,730 --> 00:41:57,280
gonna have to come back because there's

770
00:42:01,680 --> 00:41:59,740
several things we know about life one it

771
00:42:05,010 --> 00:42:01,690
metabolizes that means it takes in a

772
00:42:06,810 --> 00:42:05,020
liquid it then uses that to extract

773
00:42:09,540 --> 00:42:06,820
energy and then the liquid issues to

774
00:42:12,600 --> 00:42:09,550
extract the waste but then it evolves

775
00:42:14,430 --> 00:42:12,610
and then it also reproduces well I can't

776
00:42:17,760 --> 00:42:14,440
measure any of those from our spacecraft

777
00:42:20,970 --> 00:42:17,770
other than going after the water so once

778
00:42:23,490 --> 00:42:20,980
we see an area that has water then we

779
00:42:26,160 --> 00:42:23,500
know that is a possibility of being a

780
00:42:29,760 --> 00:42:26,170
habitable environment and transitioning

781
00:42:31,710 --> 00:42:29,770
to the other big story also from Cassini

782
00:42:34,680 --> 00:42:31,720
is another moon

783
00:42:36,690 --> 00:42:34,690
oh yeah Titan what a beautiful moon this

784
00:42:39,200 --> 00:42:36,700
is you know it's bigger than the planet

785
00:42:41,609 --> 00:42:39,210
Mercury its atmosphere is actually a

786
00:42:43,980 --> 00:42:41,619
significant one it's twice the pressure

787
00:42:45,480 --> 00:42:43,990
that we have here on earth it's similar

788
00:42:47,460 --> 00:42:45,490

in the sense that it has a lot of

789
00:42:50,790 --> 00:42:47,470
nitrogen effect it's dominated by

790
00:42:53,280 --> 00:42:50,800
nitrogen but it also has liquid on its

791
00:42:56,150 --> 00:42:53,290
surface which we know now is methane and

792
00:43:00,300 --> 00:42:56,160
there's a hydrological cycle of

793
00:43:02,520 --> 00:43:00,310
evaporation transport rain and then new

794
00:43:04,440 --> 00:43:02,530
Lakes are forming in other locations on

795
00:43:07,320 --> 00:43:04,450
the moon and that's an incredible

796
00:43:09,960 --> 00:43:07,330
science legacy but Titan also helped us

797
00:43:13,320 --> 00:43:09,970
with an engineering legacy as well oh

798
00:43:16,770 --> 00:43:13,330
absolutely the concept of using Titan to

799
00:43:19,230 --> 00:43:16,780
do lunar or to do a gravity assist swing

800
00:43:21,450 --> 00:43:19,240
buys that then enable those spacecraft

801
00:43:24,480 --> 00:43:21,460
to get into dipper different orbits is a

802
00:43:26,820 --> 00:43:24,490
fabulous concept because while we're

803
00:43:28,940 --> 00:43:26,830
doing that you know and here's the Koosh

804
00:43:32,040 --> 00:43:28,950
ball as we say all these spectacular

805
00:43:35,250 --> 00:43:32,050
flybys allow us to look at Titan in

806
00:43:38,640 --> 00:43:35,260
detail so from multiple flybys we can

807
00:43:42,510 --> 00:43:38,650
get a global view of that moon and we're

808
00:43:47,130 --> 00:43:42,520
using that same concept at Jupiter with

809
00:43:50,400 --> 00:43:47,140
another moon called Europa before we go

810
00:43:53,550 --> 00:43:50,410
I wanted to bring up the e-book because

811
00:43:55,740 --> 00:43:53,560
the most fantastic things about this

812
00:43:57,990 --> 00:43:55,750
mission has been the imagery could you

813
00:44:00,990 --> 00:43:58,000

tell us a little bit about that well you

814
00:44:04,650 --> 00:44:01,000
know we really needed to make sure that

815
00:44:08,849 --> 00:44:04,660
we had wonderfully described and and and

816
00:44:11,970 --> 00:44:08,859
beautifully set images that were

817
00:44:13,770 --> 00:44:11,980
accessible to everyone and after you

818
00:44:16,260 --> 00:44:13,780
know four hundred fifty thousand plus

819
00:44:19,109 --> 00:44:16,270
images it's so hard to pick but you know

820
00:44:23,010 --> 00:44:19,119
we were able to go back in get a hundred

821
00:44:26,579 --> 00:44:23,020
beautiful images or more and videos and

822
00:44:29,220 --> 00:44:26,589
all kinds of yeah where if you want to

823
00:44:32,970 --> 00:44:29,230
get it you can down look it off the

824
00:44:35,280 --> 00:44:32,980
internet nasa.gov slice ebooks alright

825
00:44:37,470 --> 00:44:35,290
well Jim thanks for joining us thanks

826
00:44:40,620 --> 00:44:37,480
for taking time for us and I know you

827
00:44:45,560 --> 00:44:40,630
want to get back into that control thank

828
00:46:48,020 --> 00:45:11,350
[Music]

829
00:46:54,000 --> 00:46:51,359
while we are a little over ten minutes

830
00:46:56,700 --> 00:46:54,010
away from the loss of signal so we will

831
00:46:58,560 --> 00:46:56,710
be focusing our attention to the control

832
00:47:01,290 --> 00:46:58,570
room very soon now but before we do

833
00:47:04,140 --> 00:47:01,300
let's take a moment to chat with JPL

834
00:47:05,130 --> 00:47:04,150
director Mike Watkins so Mike how are

835
00:47:09,150 --> 00:47:05,140
you feeling

836
00:47:10,500 --> 00:47:09,160
well first good morning we always tend

837
00:47:13,800 --> 00:47:10,510
to do these events somehow at 3:00 in

838
00:47:14,960 --> 00:47:13,810

the morning or 5:00 in the morning but

839
00:47:17,580 --> 00:47:14,970
you know it's kind of a bittersweet

840
00:47:18,839 --> 00:47:17,590
event for all of us I think for me

841
00:47:20,820 --> 00:47:18,849
personally it's more sweet than bitter

842
00:47:23,130 --> 00:47:20,830
because the Cassini's been such a

843
00:47:24,300 --> 00:47:23,140
fantastic mission but I think you know

844
00:47:26,640 --> 00:47:24,310
one of the important things about these

845
00:47:28,530 --> 00:47:26,650
events is to celebrate the incredible

846
00:47:30,630 --> 00:47:28,540
hard work that decades of hard work of

847
00:47:32,670 --> 00:47:30,640
the team that designed built and

848
00:47:34,140 --> 00:47:32,680
operated Cassini and that's really at

849
00:47:35,880 --> 00:47:34,150
the heart of the spacecraft is really

850
00:47:37,380 --> 00:47:35,890
the people that worked on it and the

851
00:47:39,240 --> 00:47:37,390
people that have been operating it and

852
00:47:41,160 --> 00:47:39,250
this is a great time to celebrate those

853
00:47:43,140 --> 00:47:41,170
those that a level of dedication that

854
00:47:45,630 --> 00:47:43,150
devotion you know to work on something

855
00:47:47,760 --> 00:47:45,640
for 10 20 30 years that that's that's

856
00:47:50,430 --> 00:47:47,770
sort of unparalleled in in human history

857
00:47:53,970 --> 00:47:50,440
so how do you think Cassini will be

858
00:47:55,500 --> 00:47:53,980
remembered in the science books well I'd

859
00:47:57,060 --> 00:47:55,510
say most of the science books most of

860
00:47:59,579 --> 00:47:57,070
most what we have in science books about

861
00:48:01,380 --> 00:47:59,589
Saturn come from Cassini right so we

862
00:48:02,760 --> 00:48:01,390
will be long remembered I mean you look

863
00:48:05,400 --> 00:48:02,770

at almost everything we know came from

864
00:48:06,960 --> 00:48:05,410
Cassini about Saturn but you know I

865
00:48:08,700 --> 00:48:06,970
think one of the greatest legacies of a

866
00:48:09,810 --> 00:48:08,710
mission is is not just a scientific

867
00:48:11,760 --> 00:48:09,820
discoveries that makes it what you'll

868
00:48:13,290 --> 00:48:11,770
learn about but the fact that you you

869
00:48:15,660 --> 00:48:13,300
make discoveries that are so compelling

870
00:48:17,339 --> 00:48:15,670
that you have to go back and that's

871
00:48:18,930 --> 00:48:17,349
really the part of what makes the end of

872
00:48:20,490 --> 00:48:18,940
Cassini sweet is that it's the

873
00:48:23,070 --> 00:48:20,500
discoveries are so compelling that we

874
00:48:24,900 --> 00:48:23,080
have to go back we will go back and fly

875
00:48:26,609 --> 00:48:24,910
through the geysers of Enceladus and

876
00:48:28,890 --> 00:48:26,619
we'll go back and look at Titan because

877
00:48:31,650 --> 00:48:28,900
it's just the Cassini findings are just

878
00:48:35,130 --> 00:48:31,660
they're just groundbreaking but the way

879
00:48:37,650 --> 00:48:35,140
missions are one missions sort of sets

880
00:48:42,030 --> 00:48:37,660
the foot steps for the next mission so

881
00:48:43,829 --> 00:48:42,040
what's coming up next after Cassini so

882
00:48:45,690 --> 00:48:43,839
one of things we've learned about the

883
00:48:47,550 --> 00:48:45,700
outer solar system is how much water is

884
00:48:48,990 --> 00:48:47,560
there so we used to think that most of

885
00:48:51,030 --> 00:48:49,000
the water was here in the inner solar

886
00:48:52,680 --> 00:48:51,040
system here on earth for example the

887
00:48:53,170 --> 00:48:52,690
habitable zone Goldilocks zone between

888
00:48:55,690 --> 00:48:53,180

more

889
00:48:57,519 --> 00:48:55,700
between Venus and Mars where we are we

890
00:48:59,769 --> 00:48:57,529
now realize that there's a lot of water

891
00:49:02,410 --> 00:48:59,779
in the outer solar system so Europa for

892
00:49:04,029 --> 00:49:02,420
example the moon of Jupiter Enceladus

893
00:49:05,380 --> 00:49:04,039
and I think what you see compelling

894
00:49:07,359 --> 00:49:05,390
about the outer planets is to go back

895
00:49:09,460 --> 00:49:07,369
and look at those ocean worlds in great

896
00:49:10,960 --> 00:49:09,470
detail fly through the geysers try to

897
00:49:12,519 --> 00:49:10,970
get drilled down through the ice take a

898
00:49:14,890 --> 00:49:12,529
look at the composition of the ice and

899
00:49:16,510 --> 00:49:14,900
as Jim Green noted you know are these

900
00:49:18,730 --> 00:49:16,520
habitable places or these places where

901
00:49:20,620 --> 00:49:18,740
there could be life and so we here at

902
00:49:22,150 --> 00:49:20,630
JPL and and NASA we have plans to go

903
00:49:24,940 --> 00:49:22,160
back to many of these ocean worlds as

904
00:49:27,099 --> 00:49:24,950
many as we can the next one up is a

905
00:49:29,079 --> 00:49:27,109
flyby of multiple flybys of Europa we

906
00:49:31,059 --> 00:49:29,089
call Europa clipper where I'll be in

907
00:49:33,039 --> 00:49:31,069
orbit around Jupiter and flyby europa 40

908
00:49:36,430 --> 00:49:33,049
or 50 times and taking a very close look

909
00:49:38,410 --> 00:49:36,440
at at that ocean and from above the eyes

910
00:49:40,510 --> 00:49:38,420
of course and the composition of the ice

911
00:49:43,299 --> 00:49:40,520
and then later we'll will make our way

912
00:49:45,370 --> 00:49:43,309
to the other ocean world's oceans are

913
00:49:47,500 --> 00:49:45,380

the things to look at right now it's

914
00:49:49,089 --> 00:49:47,510
absolutely you know as the search for

915
00:49:51,370 --> 00:49:49,099
life is one of the is one of the

916
00:49:52,779 --> 00:49:51,380
compelling threads for for a NASA for

917
00:49:54,970 --> 00:49:52,789
the science mission directorate and for

918
00:49:56,140 --> 00:49:54,980
JPL we're looking for for life in our

919
00:49:57,789 --> 00:49:56,150
solar system and of course we're looking

920
00:49:59,470 --> 00:49:57,799
for life outside the solar system we're

921
00:50:01,210 --> 00:49:59,480
looking for exoplanets and other Earth's

922
00:50:04,809 --> 00:50:01,220
but the ocean worlds look like an

923
00:50:07,120 --> 00:50:04,819
incredibly compelling target well thank

924
00:50:09,460 --> 00:50:07,130
you so much Mike for coming by and

925
00:50:12,250 --> 00:50:09,470
joining us I know all the guys want to

926
00:50:14,079 --> 00:50:12,260
get back in there in the storm and be

927
00:50:16,210 --> 00:50:14,089
there for the militiaman all right

928
00:50:18,400 --> 00:50:16,220
thanks thank you so much you're watching

929
00:50:20,200 --> 00:50:18,410
live coverage of Cassini's final hour

930
00:50:22,779 --> 00:50:20,210
from NASA's Jet Propulsion Laboratory

931
00:50:24,640 --> 00:50:22,789
JPL is located in lucky outer Flintridge

932
00:50:27,430 --> 00:50:24,650
in Pasadena and managed by the

933
00:50:30,400 --> 00:50:27,440
California Institute of Technology let's

934
00:50:33,880 --> 00:50:30,410
take a look at our last our display or

935
00:50:36,760 --> 00:50:33,890
display shows that we are just over

936
00:50:41,609 --> 00:50:36,770
seven minutes away from the end of

937
00:50:46,000 --> 00:50:41,619
mission and it's now traveling about

938
00:50:49,420 --> 00:50:46,010

seventy five thousand miles per hour so

939
00:50:55,660 --> 00:50:49,430
Cassini is traveling rapidly towards

940
00:51:01,310 --> 00:50:58,550
for all the beauty and the exotic

941
00:51:04,010 --> 00:51:01,320
features that we found those are places

942
00:51:06,500 --> 00:51:04,020
that startled and amazed but not a place

943
00:51:09,680 --> 00:51:06,510
where you can live and I think it gives

944
00:51:13,010 --> 00:51:09,690
you a perspective on the earth and what

945
00:51:19,340 --> 00:51:13,020
a wonderful place it is and more impetus

946
00:51:22,370 --> 00:51:19,350
to perhaps take care of it we are

947
00:51:24,590 --> 00:51:22,380
getting close to time and time where we

948
00:51:27,050 --> 00:51:24,600
should lose that signal folks are

949
00:51:29,660 --> 00:51:27,060
watching the radio science the display

950
00:51:32,840 --> 00:51:29,670
right now so let's go to Todd and Joanie

951
00:51:34,550 --> 00:51:32,850
and Mission Control hi gay well six

952
00:51:37,970 --> 00:51:34,560
minutes to go till we're six feet under

953
00:51:39,890 --> 00:51:37,980
so it's it's gonna be hard to say

954
00:51:42,800 --> 00:51:39,900
goodbye here radio display still looks

955
00:51:45,560 --> 00:51:42,810
great as we just saw on screen Mission

956
00:51:48,530 --> 00:51:45,570
Control we're I hear a lot of buzz in

957
00:51:50,750 --> 00:51:48,540
the room about the thruster cycles

958
00:51:52,730 --> 00:51:50,760
because the thrusters are firing we're

959
00:51:54,620 --> 00:51:52,740
still outside the atmosphere and they're

960
00:51:58,310 --> 00:51:54,630
just keeping dead bats keeping that

961
00:52:01,250 --> 00:51:58,320
pointing on earth as long as possible so

962
00:52:46,580 --> 00:52:01,260
things aren't too crazy yet but once we

963
00:52:52,840 --> 00:52:46,590

hit that atmosphere super fast we have

964
00:53:05,000 --> 00:52:52,850
two frames thank you telecom systems Lee

965
00:53:13,770 --> 00:53:09,620
frequencies to increase copy thank you

966
00:53:15,570 --> 00:53:13,780
propulsion systems Lee pressures and

967
00:53:17,570 --> 00:53:15,580
temperatures are nominal propulsion is

968
00:53:21,000 --> 00:53:17,580
nominal happy thank you

969
00:53:23,000 --> 00:53:21,010
missions lighting systems Lee mission

970
00:53:25,349 --> 00:53:23,010
planning is nominal Chucky thank you

971
00:53:25,950 --> 00:53:25,359
flight director system stage everything

972
00:53:32,810 --> 00:53:25,960
is normal

973
00:53:36,510 --> 00:53:32,820
copy thank you

974
00:53:38,130 --> 00:53:36,520
so what we just heard was the room going

975
00:53:41,339 --> 00:53:38,140
around and checking all of the the

976
00:53:43,520 --> 00:53:41,349
subsystem so so far all of the sub

977
00:53:45,450 --> 00:53:43,530
systems are nominal about four minutes

978
00:53:49,140 --> 00:53:45,460
three and a half to four minutes away

979
00:53:51,089 --> 00:53:49,150
from the end we went for a blow rate to

980
00:53:54,540 --> 00:53:51,099
high rate control can you comment on

981
00:53:56,339 --> 00:53:54,550
that sure so we have our computer that's

982
00:53:57,960 --> 00:53:56,349
controlling our pointing has different

983
00:53:59,400 --> 00:53:57,970
modes and it's smart enough to know when

984
00:54:02,490 --> 00:53:59,410
we start having to fight a little harder

985
00:54:03,540 --> 00:54:02,500
so we heard that the computer

986
00:54:10,290 --> 00:54:03,550
acknowledged that we start having to

987
00:54:11,940 --> 00:54:10,300
fight a little bit okay thanks we were

988
00:54:14,640 --> 00:54:11,950

marking earlier it's incredible this

989
00:54:16,650 --> 00:54:14,650
entire spacecraft runs on 600 watts of

990
00:54:19,020 --> 00:54:16,660
power how much power is that yeah that'd

991
00:54:22,440 --> 00:54:19,030
have a hairdryer it's all we got right

992
00:54:24,570 --> 00:54:22,450
now I wouldn't talk about how little

993
00:54:26,910 --> 00:54:24,580
fuel we have left it's about one percent

994
00:54:28,710 --> 00:54:26,920
plus or minus two percent that's one

995
00:54:33,720 --> 00:54:28,720
reason we're had men the satyrs

996
00:54:50,590 --> 00:54:33,730
atmosphere tonight under three minutes

997
00:54:53,860 --> 00:54:52,420
we should definitely emphasize we don't

998
00:54:55,990 --> 00:54:53,870
know exactly when we'll lose signal

999
00:55:01,350 --> 00:54:56,000
depends on the Saturn atmosphere and how

1000
00:55:08,200 --> 00:55:06,130
radio signal looks wonderful X band and

1001
00:55:10,030 --> 00:55:08,210
s van two different radio bands still

1002
00:55:11,470 --> 00:55:10,040
getting the signal from Cassini we're

1003
00:55:18,810 --> 00:55:11,480
approaching about 10 degrees north

1004
00:55:24,609 --> 00:55:21,580
3,000 miles from the from the cloud top

1005
00:55:26,410 --> 00:55:24,619
I remember seeing we were gonna hit the

1006
00:55:34,780 --> 00:55:26,420
atmosphere about 77,000 miles an hour I

1007
00:55:45,170 --> 00:55:34,790
see we're close so two minutes and

1008
00:55:53,569 --> 00:55:51,440
we're starting to this is a cs1 yes

1009
00:55:54,799 --> 00:55:53,579
we're still waiting for transition to

1010
00:55:56,059 --> 00:55:54,809
hire it mode but it looks like we're

1011
00:55:59,839 --> 00:55:56,069
going to start accumulating thruster on

1012
00:56:03,410 --> 00:55:59,849
time at a higher rate now and our

1013
00:56:08,150 --> 00:56:03,420

attitude control error is starting to to

1014
00:56:09,980 --> 00:56:08,160
be more active we're just starting to

1015
00:56:12,529 --> 00:56:09,990
sense yeah right yeah yeah we can start

1016
00:56:13,789 --> 00:56:12,539
seeing the spacecraft starting to lose

1017
00:56:17,150 --> 00:56:13,799
the battle with the atmosphere this is

1018
00:56:18,950 --> 00:56:17,160
ACS one we just had the transition to

1019
00:56:20,359 --> 00:56:18,960
high rate mode and with this we're going

1020
00:56:23,120 --> 00:56:20,369
to start seeing restaurant I'm

1021
00:56:25,430 --> 00:56:23,130
accumulating very quickly and the dead

1022
00:56:28,880 --> 00:56:25,440
band is going to clamp down to 0.5 0.5

1023
00:56:38,480 --> 00:56:28,890
to Miller ad and we are in the

1024
00:56:45,559 --> 00:56:38,490
atmosphere we can confirm what ACS have

1025
00:56:47,120 --> 00:56:45,569
told you copy thank you I'm just

1026
00:56:53,650 --> 00:56:47,130
starting to see the thrusters fire more

1027
00:56:53,660 --> 00:56:58,310
yeah

1028
00:56:58,320 --> 00:57:05,060
radio signals still holding 30 seconds

1029
00:57:10,350 --> 00:57:07,590
systems lead mission planning your

1030
00:57:11,670 --> 00:57:10,360
admission plenty spacecraft has just

1031
00:57:18,350 --> 00:57:11,680
crossed ten degrees north latitude

1032
00:57:24,780 --> 00:57:21,950
systems ACS one

1033
00:57:26,220 --> 00:57:24,790
with the additional thruster on time

1034
00:57:40,279 --> 00:57:26,230
we're going to also see the dead dance

1035
00:57:40,289 --> 00:58:05,720
across there zero time

1036
00:58:05,730 --> 00:58:40,200
go ahead price lecture

1037
00:58:46,680 --> 00:58:43,349
project manager flight director go ahead

1038
00:58:58,370 --> 00:58:46,690

okay we call loss of signal loss of next

1039
00:59:06,430 --> 00:59:04,069
Casso signal at 1 1 5 5 4 6 4 the SDN so

1040
00:59:12,140 --> 00:59:06,440
that would be the end of the spacecraft

1041
00:59:15,319 --> 00:59:12,150
at Project Manager on FSO court maybe a

1042
00:59:18,079 --> 00:59:15,329
trickle of telemetry left but just heard

1043
00:59:21,259 --> 00:59:18,089
the signal from the spacecraft is gone

1044
00:59:25,900 --> 00:59:21,269
and within the next 45 seconds so will

1045
00:59:28,939 --> 00:59:25,910
be the spacecraft I hope you're all as

1046
00:59:31,189 --> 00:59:28,949
deeply proud of this amazing

1047
00:59:33,439 --> 00:59:31,199
accomplishment congratulations to you

1048
00:59:36,229 --> 00:59:33,449
all this has been an incredible mission

1049
00:59:39,589 --> 00:59:36,239
an incredible spacecraft and you're all

1050
00:59:42,650 --> 00:59:39,599
an incredible team I'm going to call

1051
00:59:45,540 --> 00:59:42,660
this the end of mission project manager

1052
00:59:45,550 --> 01:01:00,560
[Applause]

1053
01:03:30,810 --> 01:01:11,780
[Music]

1054
01:03:36,550 --> 01:03:33,670
so just a short time ago

1055
01:03:40,210 --> 01:03:36,560
Julie Webster the space operations team

1056
01:03:42,880 --> 01:03:40,220
manager and program manager Earl Mays

1057
01:03:47,710 --> 01:03:42,890
called it the end of mission for Cassini

1058
01:03:50,680 --> 01:03:47,720
it came at about 455 as predicted let's

1059
01:03:53,850 --> 01:03:50,690
go now to Beckman auditorium and check

1060
01:03:56,200 --> 01:03:53,860
in with Morgan Cable she is with Cassini

1061
01:03:58,690 --> 01:03:56,210
interdisciplinary scientist Jonathan

1062
01:04:00,490 --> 01:03:58,700
Lumine to find out how the scientists

1063
01:04:01,000 --> 01:04:00,500

are doing and the team is doing down

1064
01:04:03,610 --> 01:04:01,010
there

1065
01:04:06,490 --> 01:04:03,620
the mission is certainly not over for

1066
01:04:13,050 --> 01:04:06,500
them because now there will be tons of

1067
01:04:18,010 --> 01:04:15,580
that's a very good point gain there's

1068
01:04:21,160 --> 01:04:18,020
gonna be lots of data to analyze for

1069
01:04:24,310 --> 01:04:21,170
years to come Jonathan how are you

1070
01:04:28,690 --> 01:04:24,320
feeling right now I'm actually breathing

1071
01:04:30,310 --> 01:04:28,700
again and I feel sad but we felt sad the

1072
01:04:33,100 --> 01:04:30,320
whole week we knew this was going to

1073
01:04:34,720 --> 01:04:33,110
happen and Cassini performed exactly as

1074
01:04:36,640 --> 01:04:34,730
she was supposed to and I'll bet there's

1075
01:04:39,580 --> 01:04:36,650
some terrific data on the ground now

1076
01:04:43,120 --> 01:04:39,590
about Saturn's atmosphere I'll bet

1077
01:04:46,660 --> 01:04:43,130
you're right what was your favorite

1078
01:04:48,240 --> 01:04:46,670
memory of Cassini well sure a story just

1079
01:04:52,720 --> 01:04:48,250
anything that comes to mind

1080
01:04:55,240 --> 01:04:52,730
my two favorite moments were both having

1081
01:04:57,070 --> 01:04:55,250
to do with Titan one was seeing the Seas

1082
01:05:00,130 --> 01:04:57,080
of Titan for the first time from the

1083
01:05:01,990 --> 01:05:00,140
radar on Cassini and the other was

1084
01:05:04,720 --> 01:05:02,000
seeing the surface of Titan from the

1085
01:05:07,570 --> 01:05:04,730
Huygens probe sitting with 30 other

1086
01:05:09,280 --> 01:05:07,580
people and a trailer in the middle of

1087
01:05:11,770 --> 01:05:09,290
Germany in the middle of winter it was

1088
01:05:14,440 --> 01:05:11,780

cold and dark and there were the first

1089
01:05:17,860 --> 01:05:14,450
pictures of gullies on the surface of an

1090
01:05:20,560 --> 01:05:17,870
alien world that had to just blow your

1091
01:05:21,890 --> 01:05:20,570
mind it did I was screaming so was

1092
01:05:23,840 --> 01:05:21,900
everyone else

1093
01:05:25,610 --> 01:05:23,850
well I think the moods been a little bit

1094
01:05:28,880 --> 01:05:25,620
more somber now but there was applause

1095
01:05:31,250 --> 01:05:28,890
right near the ends I think this is this

1096
01:05:34,820 --> 01:05:31,260
is the celebration of Cassini's life and

1097
01:05:36,200 --> 01:05:34,830
Cassini's legacy and we should talk a

1098
01:05:41,480 --> 01:05:36,210
little bit about the future what do you

1099
01:05:43,130 --> 01:05:41,490
see next for the Saturn system well what

1100
01:05:45,170 --> 01:05:43,140
I would like to see next for the Saturn

1101
01:05:47,120 --> 01:05:45,180
system is that we go back there and

1102
01:05:50,180 --> 01:05:47,130
there's so many things that Cassini has

1103
01:05:52,310 --> 01:05:50,190
given us in terms of a legacy to explore

1104
01:05:55,280 --> 01:05:52,320
and sell it us and the possibility of

1105
01:05:57,760 --> 01:05:55,290
life Titan in its amazing atmosphere in

1106
01:06:00,770 --> 01:05:57,770
lakes and seas and hydrologic cycle

1107
01:06:03,050 --> 01:06:00,780
Saturn and the Rings and the mysteries

1108
01:06:06,170 --> 01:06:03,060
of what lies beneath the clouds there's

1109
01:06:09,320 --> 01:06:06,180
an awful lot that Cassini has said to us

1110
01:06:10,820 --> 01:06:09,330
we must go back and explore yeah there's

1111
01:06:13,460 --> 01:06:10,830
a lot left to do in the Saturn system

1112
01:06:16,960 --> 01:06:13,470
and and elsewhere in the solar system as

1113
01:06:18,890 --> 01:06:16,970

well well this has been a an

1114
01:06:21,050 --> 01:06:18,900
international mission and an

1115
01:06:23,270 --> 01:06:21,060
intergenerational mission right it's

1116
01:06:25,430 --> 01:06:23,280
been such a joy for someone like me to

1117
01:06:29,990 --> 01:06:25,440
be able to be mentored by veterans like

1118
01:06:31,610 --> 01:06:30,000
you in terms of following on Cassini's

1119
01:06:34,880 --> 01:06:31,620
legacy and and mentoring the next

1120
01:06:36,830 --> 01:06:34,890
generation what do you see in terms of

1121
01:06:38,810 --> 01:06:36,840
next missions coming up being able to

1122
01:06:41,480 --> 01:06:38,820
bring in the next generation of

1123
01:06:44,690 --> 01:06:41,490
scientists and engineers first of all

1124
01:06:47,300 --> 01:06:44,700
I'm very very confident and optimistic

1125
01:06:49,760 --> 01:06:47,310
about the next generation because I can

1126
01:06:52,010 --> 01:06:49,770
see that the experts are here already so

1127
01:06:56,210 --> 01:06:52,020
we will be well served in the future of

1128
01:06:57,710 --> 01:06:56,220
course NASA is going back to Europa with

1129
01:06:59,240 --> 01:06:57,720
the Europa clipper which is very

1130
01:07:01,520 --> 01:06:59,250
exciting and the Europeans are doing

1131
01:07:04,030 --> 01:07:01,530
juice to the other Galilean moons and

1132
01:07:07,400 --> 01:07:04,040
there are a number of concepts out there

1133
01:07:10,190 --> 01:07:07,410
for going back to Enceladus and Titan

1134
01:07:12,500 --> 01:07:10,200
and to Saturn we don't know if any of

1135
01:07:14,510 --> 01:07:12,510
those are going to happen in the next

1136
01:07:16,360 --> 01:07:14,520
few years but we'll see there are lots

1137
01:07:18,740 --> 01:07:16,370
of ideas the important point is that

1138
01:07:23,000 --> 01:07:18,750

Cassini has got to be a jumping-off

1139
01:07:25,010 --> 01:07:23,010
point - even more exciting exploratory

1140
01:07:27,020 --> 01:07:25,020
missions we can't let it stop at this

1141
01:07:29,090 --> 01:07:27,030
point we have to keep going on we will

1142
01:07:31,040 --> 01:07:29,100
in the Jupiter system we need to go back

1143
01:07:31,540 --> 01:07:31,050
to Saturn we need to go to Uranus and

1144
01:07:33,220 --> 01:07:31,550
Neptune

1145
01:07:35,950 --> 01:07:33,230
we need to do the whole outer solar

1146
01:07:37,600 --> 01:07:35,960
system we need to the outer planets I

1147
01:07:40,060 --> 01:07:37,610
think one of the amazing things that

1148
01:07:43,870 --> 01:07:40,070
Cassini has shown us is that it's not a

1149
01:07:46,270 --> 01:07:43,880
boring cold place it's dynamic it's so

1150
01:07:49,300 --> 01:07:46,280
incredibly varied just the differences

1151
01:07:51,630 --> 01:07:49,310
in the moons of Saturn alone it inspires

1152
01:07:55,300 --> 01:07:51,640
us to want to go back and to learn more

1153
01:07:58,570 --> 01:07:55,310
yeah you know 40 40 years ago Voyager 1

1154
01:08:00,160 --> 01:07:58,580
was launched and it was Voyager 1 and 2

1155
01:08:03,220 --> 01:08:00,170
that broke open the outer solar system

1156
01:08:07,030 --> 01:08:03,230
for us told us that this was not a cold

1157
01:08:09,220 --> 01:08:07,040
dead grey place and then Galileo and

1158
01:08:12,040 --> 01:08:09,230
Cassini followed on and showed us what

1159
01:08:13,720 --> 01:08:12,050
really amazing things are going on in

1160
01:08:16,630 --> 01:08:13,730
those systems and that there might in

1161
01:08:19,660 --> 01:08:16,640
fact be places for life to exist in

1162
01:08:21,309 --> 01:08:19,670
Europa and Enceladus and Titan and I

1163
01:08:23,590 --> 01:08:21,319

have a poem I want to read to you as

1164
01:08:25,870 --> 01:08:23,600
well at some point is this a good time I

1165
01:08:27,900 --> 01:08:25,880
think it's a great time okay you know a

1166
01:08:30,730 --> 01:08:27,910
lot has been said about Cassini already

1167
01:08:34,840 --> 01:08:30,740
and the end of the mission but I think

1168
01:08:37,059 --> 01:08:34,850
that the best I can do to leave for me

1169
01:08:39,579 --> 01:08:37,069
leave the celebration of Cassini's and

1170
01:08:42,370 --> 01:08:39,589
is to read a bit of a poem by Swinburne

1171
01:08:45,640 --> 01:08:42,380
on the verge which was a nautical poem

1172
01:08:48,490 --> 01:08:45,650
about death and dying death sailing on

1173
01:08:50,860 --> 01:08:48,500
the sea as a metaphor for death and so

1174
01:08:52,510 --> 01:08:50,870
I'm gonna read the last few lines of it

1175
01:08:56,769 --> 01:08:52,520
and I've changed one of the words it'll

1176
01:08:59,500 --> 01:08:56,779
be obvious ah but here Cassini's heart

1177
01:09:02,620 --> 01:08:59,510
leaps yearning toward the gloom with

1178
01:09:06,789 --> 01:09:02,630
venturous glee though her pilot I behold

1179
01:09:09,400 --> 01:09:06,799
nor BAE nor Harbor rock nor Sheol from

1180
01:09:13,240 --> 01:09:09,410
the shore that hath no Shore beyond it

1181
01:09:15,269 --> 01:09:13,250
said in all the sea that's beautiful you

1182
01:09:18,309 --> 01:09:15,279
had to do that didn't you

1183
01:09:21,010 --> 01:09:18,319
Thank You Jonathan for everything well

1184
01:09:23,769 --> 01:09:21,020
Morgan the future is in your hands and

1185
01:09:25,720 --> 01:09:23,779
the hands of your generation and this

1186
01:09:28,150 --> 01:09:25,730
was a moment of transition it was not

1187
01:09:30,130 --> 01:09:28,160
the end and so let's go forth and

1188
01:09:31,110 --> 01:09:30,140

explore the solar system together all

1189
01:09:34,150 --> 01:09:31,120
right

1190
01:09:36,010 --> 01:09:34,160
that's a beautiful sentiment well with

1191
01:09:39,849 --> 01:09:36,020
me now is NASA associate administrator

1192
01:09:41,740 --> 01:09:39,859
for science Thomas sir Lucan doctors are

1193
01:09:42,910 --> 01:09:41,750
broken what was your reaction being in

1194
01:09:46,200 --> 01:09:42,920
that

1195
01:09:48,459 --> 01:09:46,210
I was just overwhelmed with just

1196
01:09:50,320 --> 01:09:48,469
understanding how professional this team

1197
01:09:52,240 --> 01:09:50,330
is you know like during the entire time

1198
01:09:54,310 --> 01:09:52,250
this was clearly emotional for everybody

1199
01:09:56,320 --> 01:09:54,320
the lucky peanuts were there but there

1200
01:09:58,750 --> 01:09:56,330
are a lot of Kleenex and there's a lot

1201
01:10:00,550 --> 01:09:58,760
of use of Kleenex but everybody was so

1202
01:10:02,500 --> 01:10:00,560
professional to the very end and I just

1203
01:10:04,959 --> 01:10:02,510
saw it happening you know it went so

1204
01:10:07,390 --> 01:10:04,969
fast you know somebody was shouting out

1205
01:10:10,120 --> 01:10:07,400
wow we're struggling with c-axis and oh

1206
01:10:12,040 --> 01:10:10,130
it's gone and I just saw that team

1207
01:10:13,899 --> 01:10:12,050
holding together till the very end just

1208
01:10:15,370 --> 01:10:13,909
really it's all about teamwork with this

1209
01:10:18,729 --> 01:10:15,380
mission and it showed in the last

1210
01:10:20,830 --> 01:10:18,739
seconds it truly did and your feelings

1211
01:10:23,560 --> 01:10:20,840
about this what sort of legacy do you

1212
01:10:25,899 --> 01:10:23,570
think this mission leaves you know I

1213
01:10:28,450 --> 01:10:25,909

really do think that rewrote not only

1214
01:10:30,760 --> 01:10:28,460
what we know about the other sources but

1215
01:10:33,580 --> 01:10:30,770
how we think as humans about ourselves

1216
01:10:36,820 --> 01:10:33,590
you know these worlds that had found we

1217
01:10:39,520 --> 01:10:36,830
never knew were there are changing how

1218
01:10:42,280 --> 01:10:39,530
we think about life itself and so for me

1219
01:10:44,439 --> 01:10:42,290
that's why it's truly a civilization

1220
01:10:47,500 --> 01:10:44,449
scale mission one that will stand out

1221
01:10:51,430 --> 01:10:47,510
among other missions anywhere and how

1222
01:10:54,790 --> 01:10:51,440
will it impact future ideas and future

1223
01:10:56,379 --> 01:10:54,800
missions as we plan new things you know

1224
01:10:59,260 --> 01:10:56,389
some of the hardest questions to answer

1225
01:11:01,890 --> 01:10:59,270
our questions like it's their life out

1226
01:11:04,149 --> 01:11:01,900
there and this mission really has

1227
01:11:05,950 --> 01:11:04,159
redefined that it will affect how we

1228
01:11:07,780 --> 01:11:05,960
think about that question so of course

1229
01:11:09,669 --> 01:11:07,790
we're tackling that at NASA with a

1230
01:11:11,379 --> 01:11:09,679
multitude of missions looking at Mars

1231
01:11:13,840 --> 01:11:11,389
trying to bring samples back but also

1232
01:11:16,600 --> 01:11:13,850
looking at Europe by looking at these

1233
01:11:19,060 --> 01:11:16,610
outer ocean worlds and finding these

1234
01:11:21,970 --> 01:11:19,070
worlds all over the universe our lower

1235
01:11:24,910 --> 01:11:21,980
our galaxy every you know there's

1236
01:11:27,609 --> 01:11:24,920
thousands of these exoplanets and you

1237
01:11:29,770 --> 01:11:27,619
know Saturn like Jupiter like and of

1238
01:11:31,330 --> 01:11:29,780

exoplanets that were discovering and

1239
01:11:35,590 --> 01:11:31,340
we're thinking about I didn't totally

1240
01:11:37,930 --> 01:11:35,600
new way and so the thought is people are

1241
01:11:41,379 --> 01:11:37,940
clamoring to go back will that be

1242
01:11:42,220 --> 01:11:41,389
difficult to do to be able to envision

1243
01:11:45,640 --> 01:11:42,230
another

1244
01:11:47,350 --> 01:11:45,650
mission to these places soon it's almost

1245
01:11:49,000 --> 01:11:47,360
very difficult right to do this because

1246
01:11:51,490 --> 01:11:49,010
these machines are so hard

1247
01:11:53,500 --> 01:11:51,500
don't monthly to go back and for example

1248
01:11:56,650 --> 01:11:53,510
take the next step on Enceladus we want

1249
01:11:58,600 --> 01:11:56,660
to really think what that will take now

1250
01:12:00,460 --> 01:11:58,610
there's great ideas already out there

1251
01:12:02,050 --> 01:12:00,470
and perhaps some of these ideas will

1252
01:12:04,090 --> 01:12:02,060
come to first and relatively early I

1253
01:12:06,010 --> 01:12:04,100
don't know but but you know and we'll

1254
01:12:08,020 --> 01:12:06,020
really start thinking about this and and

1255
01:12:10,300 --> 01:12:08,030
start talking about it in the science

1256
01:12:12,729 --> 01:12:10,310
community oh we're all going for courage

1257
01:12:15,910 --> 01:12:12,739
them to to really start you know making

1258
01:12:17,920 --> 01:12:15,920
plans so we can create a consensus as to

1259
01:12:20,020 --> 01:12:17,930
what direction we want to go and yes we

1260
01:12:22,030 --> 01:12:20,030
want to really go back this is such a

1261
01:12:24,490 --> 01:12:22,040
wonderful system we don't want to leave

1262
01:12:26,920 --> 01:12:24,500
it alone it's such a beautiful one and

1263
01:12:29,200 --> 01:12:26,930

it's affected so many people dr. Zhu

1264
01:12:31,060 --> 01:12:29,210
Bookman thank you so much for sharing

1265
01:12:32,770 --> 01:12:31,070
this moment with us a very special

1266
01:12:36,040 --> 01:12:32,780
thanks to the team

1267
01:12:39,040 --> 01:12:36,050
well the cassini-huygens team was a

1268
01:12:41,470 --> 01:12:39,050
multi international team and you know

1269
01:12:45,040 --> 01:12:41,480
just a few moments from now we will be

1270
01:12:52,100 --> 01:12:45,050
speaking to members of ISA and aussi

1271
01:14:53,800 --> 01:13:17,880
[Music]

1272
01:14:59,600 --> 01:14:56,900
as we told you earlier Cocina Huygens

1273
01:15:01,790 --> 01:14:59,610
was a multinational endeavor from the

1274
01:15:04,790 --> 01:15:01,800
very very start a partnership between

1275
01:15:08,330 --> 01:15:04,800
NASA the European Space Agency and the

1276
01:15:11,060 --> 01:15:08,340
Italian space agency this is an equally

1277
01:15:13,160 --> 01:15:11,070
proud moment for ISA and Ozzy and the

1278
01:15:15,380 --> 01:15:13,170
ISA director of science Alvaro Jimenez

1279
01:15:19,310 --> 01:15:15,390
joins us and the president of hace

1280
01:15:21,950 --> 01:15:19,320
Roberto Pakistan are here to share this

1281
01:15:24,950 --> 01:15:21,960
historic mount moment thank you so much

1282
01:15:26,720 --> 01:15:24,960
for coming I was this something that you

1283
01:15:27,200 --> 01:15:26,730
decided you wouldn't miss it for the

1284
01:15:30,440 --> 01:15:27,210
world

1285
01:15:32,990 --> 01:15:30,450
of course we couldn't miss it because we

1286
01:15:34,790 --> 01:15:33,000
knew this moment was gonna come it's a

1287
01:15:36,980 --> 01:15:34,800
little bit sad because we wanted to

1288
01:15:38,420 --> 01:15:36,990

delay it as much as possible and get as

1289
01:15:40,520 --> 01:15:38,430
much noise as possible

1290
01:15:44,120 --> 01:15:40,530
but we knew it was coming and that sense

1291
01:15:46,700 --> 01:15:44,130
is sad but it's also very nice to see

1292
01:15:50,090 --> 01:15:46,710
that we have opened the possibility for

1293
01:15:52,970 --> 01:15:50,100
the future science also and for the

1294
01:15:55,160 --> 01:15:52,980
scientists to work in on the data that

1295
01:15:58,580 --> 01:15:55,170
Cassini has collected but also as an

1296
01:16:01,880 --> 01:15:58,590
example and I think we have to build on

1297
01:16:04,550 --> 01:16:01,890
this cooperation between the US and

1298
01:16:06,650 --> 01:16:04,560
Europe in ambitious missions like this

1299
01:16:09,620 --> 01:16:06,660
we are very proud of having worked

1300
01:16:13,070 --> 01:16:09,630
together and we have to make sure that

1301
01:16:16,010 --> 01:16:13,080
we continue this way because together we

1302
01:16:19,730 --> 01:16:16,020
can do much better than Excel are and

1303
01:16:29,840 --> 01:16:19,740
Bertil your feelings I mean to be a part

1304
01:16:31,700 --> 01:16:29,850
of this I was not there 20 years ago and

1305
01:16:34,760 --> 01:16:31,710
this started but I know the story of all

1306
01:16:36,950 --> 01:16:34,770
my friends and colleagues and Cassini

1307
01:16:39,350 --> 01:16:36,960
demonstrated we can do that we can

1308
01:16:41,060 --> 01:16:39,360
create a condition for the international

1309
01:16:43,550 --> 01:16:41,070
collaboration omission which can operate

1310
01:16:45,680 --> 01:16:43,560
for 20 years which can learn in tremenda

1311
01:16:47,720 --> 01:16:45,690
mount of things for the future is one

1312
01:16:50,480 --> 01:16:47,730
step a gigantic step toward the future

1313
01:16:52,490 --> 01:16:50,490

in the radio vision hope this is not the

1314
01:16:55,580 --> 01:16:52,500
last one but is only the first one the

1315
01:16:58,469 --> 01:16:55,590
series were you surprised at how long

1316
01:17:01,199 --> 01:16:58,479
this mission has lasted and the

1317
01:17:04,979 --> 01:17:01,209
the amount of information and science

1318
01:17:07,560 --> 01:17:04,989
that it has brought back not not so much

1319
01:17:12,029 --> 01:17:07,570
about the length I think we all ramped

1320
01:17:16,290 --> 01:17:12,039
about it but their discoveries and what

1321
01:17:17,219 --> 01:17:16,300
we have found in the Saturn system are

1322
01:17:20,520 --> 01:17:17,229
simply amazing

1323
01:17:23,549 --> 01:17:20,530
we were surprised by that and ESA's roll

1324
01:17:27,060 --> 01:17:23,559
with Huygens and and working on Titan I

1325
01:17:30,810 --> 01:17:27,070
mean what was the high points for you

1326
01:17:33,899 --> 01:17:30,820
well for me Huygens was getting to Titan

1327
01:17:35,729 --> 01:17:33,909
we landed there in 2005 but the whole

1328
01:17:39,330 --> 01:17:35,739
purpose was to understand the atmosphere

1329
01:17:41,640 --> 01:17:39,340
of Titan to analyze the atmosphere which

1330
01:17:43,859 --> 01:17:41,650
is a pro biotic atmosphere full of

1331
01:17:46,709 --> 01:17:43,869
nitrogen and methane and these kind of

1332
01:17:50,219 --> 01:17:46,719
elements which is what we thought that

1333
01:17:52,919 --> 01:17:50,229
this body is outside the outer part of

1334
01:17:56,339 --> 01:17:52,929
the solar system where be full life

1335
01:17:58,890 --> 01:17:56,349
could appear and and we want to analyze

1336
01:18:02,459 --> 01:17:58,900
that but then we found that we could

1337
01:18:04,259 --> 01:18:02,469
even land we when the mission was design

1338
01:18:06,330 --> 01:18:04,269

it we thought we didn't know how the

1339
01:18:10,850 --> 01:18:06,340
surface was we didn't know if it was

1340
01:18:14,310 --> 01:18:10,860
going to sink it was alive for some time

1341
01:18:16,799 --> 01:18:14,320
and and that was amazing because also we

1342
01:18:20,459 --> 01:18:16,809
could see first this was the farthest

1343
01:18:25,229 --> 01:18:20,469
away landing ever of a human-made probe

1344
01:18:29,939 --> 01:18:25,239
but also we found a landscape totally

1345
01:18:32,939 --> 01:18:29,949
unexpected of Titan something similar to

1346
01:18:37,319 --> 01:18:32,949
earth actually airy with lakes and

1347
01:18:39,719 --> 01:18:37,329
rivers and mountains and very but with a

1348
01:18:42,629 --> 01:18:39,729
totally different chemical composition a

1349
01:18:45,689 --> 01:18:42,639
totally different world and with the

1350
01:18:52,140 --> 01:18:45,699
cycles of methane rather than water but

1351
01:18:55,589 --> 01:18:52,150
it is so interesting is so very very

1352
01:18:59,939 --> 01:18:55,599
familiar and Roberto let's talk about

1353
01:19:03,089 --> 01:18:59,949
Ozzy's role and the high-gain antenna so

1354
01:19:05,399 --> 01:19:03,099
often the project relied on the

1355
01:19:06,989 --> 01:19:05,409
high-gain antenna as protection for the

1356
01:19:09,600 --> 01:19:06,999
rest of the spacecraft was that

1357
01:19:12,640 --> 01:19:09,610
something that

1358
01:19:16,450 --> 01:19:12,650
planned and you thought this is a way to

1359
01:19:18,160 --> 01:19:16,460
use the antenna is amazing it's probably

1360
01:19:20,979 --> 01:19:18,170
the most sophisticated antenna ever

1361
01:19:22,840 --> 01:19:20,989
built for a space mission receiving and

1362
01:19:24,700 --> 01:19:22,850
transmitting of four different band at

1363
01:19:27,430 --> 01:19:24,710

the same time operated for 20 years

1364
01:19:29,169 --> 01:19:27,440
almost continuously so that was the core

1365
01:19:32,020 --> 01:19:29,179
of it but indeed you are right that was

1366
01:19:34,270 --> 01:19:32,030
designed to be as a passive thermal

1367
01:19:39,840 --> 01:19:34,280
protection system going to Venice this

1368
01:19:43,930 --> 01:19:39,850
was shielding the satellite from the

1369
01:19:46,150 --> 01:19:43,940
radiation and getting into the Saturn

1370
01:19:49,060 --> 01:19:46,160
environment it was shooting again the

1371
01:19:51,430 --> 01:19:49,070
micrometer it basically measuring by the

1372
01:19:53,020 --> 01:19:51,440
vibration on the antenna itself the

1373
01:19:55,750 --> 01:19:53,030
amount of micrometer et which was

1374
01:19:59,620 --> 01:19:55,760
hitting and to use that as a protection

1375
01:20:02,729 --> 01:19:59,630
when entering in certain location like

1376
01:20:06,640 --> 01:20:02,739
the space in between the Angeles and

1377
01:20:09,340 --> 01:20:06,650
Saturn planet which was unknown totally

1378
01:20:12,010 --> 01:20:09,350
unknown and I think this is amazing such

1379
01:20:14,560 --> 01:20:12,020
a sophisticated instrument to be used as

1380
01:20:18,580 --> 01:20:14,570
the thermal shield or as a micro metal

1381
01:20:22,419 --> 01:20:18,590
shield indeed Cassini was such a well

1382
01:20:25,990 --> 01:20:22,429
made machine and served so well I think

1383
01:20:28,540 --> 01:20:26,000
in its entire flight it was it had only

1384
01:20:30,970 --> 01:20:28,550
saved I think three times and and that

1385
01:20:34,510 --> 01:20:30,980
was all but could not have done it

1386
01:20:36,430 --> 01:20:34,520
without both Ossie and ISA and we are so

1387
01:20:39,370 --> 01:20:36,440
pleased that you're here and joining us

1388
01:20:45,310 --> 01:20:39,380

the kind of stories about space missions

1389
01:20:48,100 --> 01:20:45,320
we should should be told because design

1390
01:20:50,620 --> 01:20:48,110
without trouble is a tremendous giant

1391
01:20:52,689 --> 01:20:50,630
bones and should be known right well

1392
01:20:55,360 --> 01:20:52,699
thank you again for coming out and being

1393
01:21:01,600 --> 01:20:55,370
with us on this very very special day

1394
01:23:23,600 --> 01:21:23,010
[Music]

1395
01:23:26,000 --> 01:23:23,610
and that video you just saw was called

1396
01:23:29,630 --> 01:23:26,010
Cassini inspires it was made up of

1397
01:23:32,209 --> 01:23:29,640
images that the public you sent in using

1398
01:23:35,360 --> 01:23:32,219
some of Cassini's raw images as well as

1399
01:23:37,700 --> 01:23:35,370
your own artwork thank you so much well

1400
01:23:40,490 --> 01:23:37,710
that wraps it up from here a bittersweet

1401
01:23:43,370 --> 01:23:40,500
day for the Cassini team but we can't

1402
01:23:45,370 --> 01:23:43,380
help but feel proud of the fantastic

1403
01:23:49,790 --> 01:23:45,380
people that made these accomplishments

1404
01:23:52,910 --> 01:23:49,800
possible these last 20 years and about

1405
01:23:55,760 --> 01:23:52,920
an hour from now at 6:30 a.m. Pacific

1406
01:23:58,280 --> 01:23:55,770
9:30 a.m. Eastern there will be a news

1407
01:24:00,830 --> 01:23:58,290
briefing on Cassini's grand finale it

1408
01:24:03,560 --> 01:24:00,840
will be live on NASA TV and also

1409
01:24:06,020 --> 01:24:03,570
streamed and for more information about

1410
01:24:08,990 --> 01:24:06,030
the mission you can check out the URLs

1411
01:24:12,050 --> 01:24:09,000
you see on the screen and a little bit

1412
01:24:14,900 --> 01:24:12,060
earlier Jim Green told you about the

1413
01:24:16,780 --> 01:24:14,910

ebooks some of the most memorable gifts

1414
01:24:19,729 --> 01:24:16,790
from Cassini are those spectacular

1415
01:24:22,820 --> 01:24:19,739
images an e-book of these stunning

1416
01:24:25,640 --> 01:24:22,830
images has been made and you can find it

1417
01:24:28,970 --> 01:24:25,650
by going to that link you see on the

1418
01:24:33,290 --> 01:24:28,980
screen well finally before we go a

1419
01:24:37,160 --> 01:24:33,300
parting look at the DSN now image the

1420
01:24:40,660 --> 01:24:37,170
display you see there a 10 antenna 43

1421
01:24:43,220 --> 01:24:40,670
that's the one in Australia is now dark

1422
01:24:46,760 --> 01:24:43,230
communication with a spacecraft is now

1423
01:24:50,240 --> 01:24:46,770
silent Cassini is no more but what a

1424
01:25:52,470 --> 01:24:50,250
legacy it leaves behind thanks for