
Linda Spitzer
Earl Manza

1
00:00:03,736 --> 00:00:06,473
(majestic music)

2
00:00:20,753 --> 00:00:24,190
- Hello, and welcome to NASA's
Jet Propulsion Laboratory

3
00:00:24,223 --> 00:00:26,226
in Pasadena, California,

4
00:00:31,397 --> 00:00:35,501
and our special preview
of Cassini's Grand Finale.

5
00:00:35,534 --> 00:00:38,104
In just a couple of weeks,
NASA's Cassini mission

6
00:00:38,137 --> 00:00:40,273
to Saturn will begin
the final chapter

7
00:00:40,306 --> 00:00:42,542
in its remarkable
story of exploration.

8
00:00:42,575 --> 00:00:46,479
And we're here to brief you
on what it's planned to do

9
00:00:46,512 --> 00:00:49,082
and what we hope
to learn from it.

10
00:00:49,115 --> 00:00:53,953
Our speakers today, joining
us from NASA Headquarters,

11
00:00:53,986 --> 00:00:56,789

the Director NASA's
Planetary Science Division,

12
00:00:56,822 --> 00:00:57,991
Dr. Jim Green.

13
00:01:01,961 --> 00:01:05,398
Back here at JPL, the
Cassini Program Manager,

14
00:01:05,431 --> 00:01:06,666
Dr. Earl Maize.

15
00:01:10,836 --> 00:01:13,606
To his right, Cassini
Project Scientist,

16
00:01:13,639 --> 00:01:15,141
Dr. Linda Spilker.

17
00:01:17,943 --> 00:01:20,880
And finally, Cassini Guidance
and Control Engineer,

18
00:01:20,913 --> 00:01:21,915
Joan Stupik.

19
00:01:23,816 --> 00:01:27,120
Now, a reminder to reporters
dialed in on the phones,

20
00:01:27,153 --> 00:01:29,822
please dial *1, if
you have a question.

21
00:01:29,855 --> 00:01:32,091
And members of the public,
as well as the media,

22

00:01:32,124 --> 00:01:34,727
can ask questions on
social media via Twitter

23
00:01:34,760 --> 00:01:37,530
using the hashtag askNASA.

24
00:01:37,563 --> 00:01:39,031
And with that, we'll
throw to Washington

25
00:01:39,064 --> 00:01:41,801
for comments from
Dr. Green, Jim.

26
00:01:43,402 --> 00:01:45,238
- Thank you very much.

27
00:01:45,271 --> 00:01:49,442
You know, in 1610 Galileo, with
his very primitive telescope

28
00:01:50,676 --> 00:01:53,847
observed Saturn for
the very first time.

29
00:01:56,749 --> 00:02:01,187
And he was quite astounded
with that beautiful object.

30
00:02:01,220 --> 00:02:04,090
It looked very different
than any other object

31
00:02:04,123 --> 00:02:06,759
he had seen through
his telescope before.

32
00:02:06,792 --> 00:02:09,962
It had these wings

that sort of stuck out.

33
00:02:09,995 --> 00:02:12,965
He continued to observe
it for many years,

34
00:02:12,998 --> 00:02:16,335
making many detailed
notes in his notebook.

35
00:02:16,368 --> 00:02:18,938
This caused quite a
flurry of interest

36
00:02:18,971 --> 00:02:21,908
from other astronomers
building better telescopes

37
00:02:21,941 --> 00:02:24,344
over many decades after that.

38
00:02:25,311 --> 00:02:26,312
And in 1676,

39
00:02:28,380 --> 00:02:31,317
Giovanni Cassini
observed the rings

40
00:02:32,685 --> 00:02:37,190
and saw a division
between Ring A and Ring B.

41
00:02:37,223 --> 00:02:42,094
And that division we call
now, Cassini's Division.

42
00:02:42,127 --> 00:02:45,798
Fast forward to modern
times, and in the 70s

43
00:02:47,433 --> 00:02:50,369
we launched Voyager
I and Voyager II.

44
00:02:50,402 --> 00:02:52,705
And in the early
80s, as they flew

45
00:02:52,738 --> 00:02:56,776
through the Saturn environment,
giving us spectacular views

46
00:02:56,809 --> 00:03:00,713
of the moons and the rings
and the planet itself,

47
00:03:00,746 --> 00:03:04,016
we knew we had to
get back there.

48
00:03:04,049 --> 00:03:05,985
Well, it took quite
a while actually

49
00:03:06,018 --> 00:03:08,354
to formulate a new mission,
and the right mission

50
00:03:08,387 --> 00:03:12,258
actually got together
in the form of Cassini,

51
00:03:12,291 --> 00:03:16,829
we then called the Cassini,
named after Giovanni Cassini

52
00:03:16,862 --> 00:03:20,233
from the Cassini Division,
and the Huygens Probe,

53
00:03:20,266 --> 00:03:23,469
another fabulous scientist
from Europe who had

54
00:03:23,502 --> 00:03:26,739
been also observing
with his telescope.

55
00:03:27,906 --> 00:03:31,177
That spacecraft
launched in 1997.

56
00:03:31,210 --> 00:03:35,215
Finally made it to the
Saturnian system in 2004.

57
00:03:36,749 --> 00:03:39,418
It immediately went to work.

58
00:03:39,451 --> 00:03:41,621
We dropped the Huygens Probe off

59
00:03:41,654 --> 00:03:45,057
onto a fabulous
moon called Titan.

60
00:03:45,090 --> 00:03:47,660
Now Titan, with a
huge atmosphere,

61
00:03:47,693 --> 00:03:51,163
is much bigger than
even the planet Mercury.

62
00:03:51,196 --> 00:03:53,566
It settled through
the atmosphere,

63
00:03:53,599 --> 00:03:55,301

landing down on the surface,

64
00:03:55,334 --> 00:03:58,938
making spectacular measurements
of the temperature,

65
00:03:58,971 --> 00:04:02,742
the density and the
composition of the atmosphere.

66
00:04:02,775 --> 00:04:06,312
Cassini continued to make
other observations of Titan,

67
00:04:06,345 --> 00:04:10,883
telling us a lot about the
liquid that's on its surface.

68
00:04:10,916 --> 00:04:13,586
It's not water, it's methane.

69
00:04:13,619 --> 00:04:16,389
Titan, which seemed
so familiar to us,

70
00:04:16,422 --> 00:04:20,426
because it has liquid, it
has a cycle of evaporation,

71
00:04:20,459 --> 00:04:23,329
transport, and then
rain and runoff

72
00:04:23,362 --> 00:04:25,965
that creates new
bodies of water,

73
00:04:25,998 --> 00:04:28,000
but it's a completely
different world

74
00:04:28,033 --> 00:04:30,803
and a very fascinating one.

75
00:04:30,836 --> 00:04:35,374
Cassini kept going on, making
other fabulous discoveries.

76
00:04:35,407 --> 00:04:39,078
Another moon, called
Enceladus, which just sits

77
00:04:39,111 --> 00:04:41,881
outside the rings of Saturn,

78
00:04:41,914 --> 00:04:44,250
has huge sheets of water ice

79
00:04:45,451 --> 00:04:48,954
pouring out of cracks in
the Southern Hemisphere.

80
00:04:48,987 --> 00:04:52,558
A small percentage of that
actually escapes the moon

81
00:04:52,591 --> 00:04:56,028
and forms a ringed
called the E ring

82
00:04:56,061 --> 00:04:59,832
that's outside the
A ring of Saturn.

83
00:04:59,865 --> 00:05:02,668
Cassini also made
fabulous measurements

84
00:05:02,701 --> 00:05:05,638

of the planet Saturn itself,

85
00:05:05,671 --> 00:05:08,674
observing spectacular storms,

86
00:05:08,707 --> 00:05:11,878
lightning, beautiful
cloud formations,

87
00:05:13,145 --> 00:05:16,015
and many other new
discoveries that it continues

88
00:05:16,048 --> 00:05:17,984
to make in that system.

89
00:05:19,985 --> 00:05:22,321
But now we're coming to the end.

90
00:05:22,354 --> 00:05:25,624
As it runs out fuel, the
things that it can do

91
00:05:25,657 --> 00:05:28,027
are quite limited,
at least we thought,

92
00:05:28,060 --> 00:05:31,464
until we decided
on a new approach,

93
00:05:31,497 --> 00:05:35,634
a grand adventure, new
discoveries that we can use

94
00:05:35,667 --> 00:05:39,839
this system to make, and we
call that the Grand Finale.

95

00:05:41,473 --> 00:05:44,710
And here's a little video
that we've put together

96
00:05:44,743 --> 00:05:47,947
that I hope you'll like that
gives you a little overview

97
00:05:47,980 --> 00:05:49,482
of what to expect.

98
00:05:50,916 --> 00:05:53,653
(majestic music)

99
00:05:56,722 --> 00:05:59,125
- [Narrator] A lone explorer,

100
00:06:00,292 --> 00:06:03,195
on a mission to reveal
the grandeur of Saturn,

101
00:06:03,228 --> 00:06:04,830
its rings and moons.

102
00:06:04,863 --> 00:06:07,633
(majestic music)

103
00:06:10,402 --> 00:06:14,240
After 20 years in space,
NASA's Cassini spacecraft

104
00:06:14,273 --> 00:06:16,175
is running out of fuel.

105
00:06:17,976 --> 00:06:21,480
And so, to protect
the moons of Saturn

106
00:06:21,513 --> 00:06:24,517

that could have conditions
suitable for life,

107
00:06:24,550 --> 00:06:26,585
a spectacular end
has been planned

108
00:06:26,618 --> 00:06:29,789
for this long-lived
traveler from Earth.

109
00:06:29,822 --> 00:06:32,358
(majestic music)

110
00:06:32,391 --> 00:06:35,461
- [NASA] Five, four,
three, two, one.

111
00:06:38,030 --> 00:06:40,866
And liftoff of the
Cassini spacecraft

112
00:06:40,899 --> 00:06:43,436
on a billion mile
trek to Saturn.

113
00:06:43,469 --> 00:06:46,772
We have cleared the
tower, program is in,

114
00:06:46,805 --> 00:06:48,307
the program is in.

115
00:06:49,808 --> 00:06:52,545
- [Narrator] In 2004,
following a seven year journey

116
00:06:52,578 --> 00:06:56,749
through the solar system,
Cassini arrived at Saturn.

117
00:06:56,782 --> 00:06:59,185
- [NASA] Through the SOI burn
attitude appointing position.

118
00:06:59,218 --> 00:07:00,853
Right up the right.

119
00:07:02,187 --> 00:07:04,223
- [Narrator] The spacecraft
carried a passenger,

120
00:07:04,256 --> 00:07:06,559
the European Huygens Probe,

121
00:07:06,592 --> 00:07:09,595
the first human-made
object to land on a world

122
00:07:09,628 --> 00:07:12,465
in the distant
outer solar system.

123
00:07:15,367 --> 00:07:18,704
For over a decade, Cassini
has shared the wonders

124
00:07:18,737 --> 00:07:22,374
of Saturn and its
family of icy moons,

125
00:07:22,407 --> 00:07:24,844
taking us to astounding worlds

126
00:07:24,877 --> 00:07:28,747
where methane rivers
run to a methane sea,

127
00:07:28,780 --> 00:07:32,051

where jets of ice and
gas are blasting material

128
00:07:32,084 --> 00:07:35,621
into space from a
liquid water ocean

129
00:07:35,654 --> 00:07:39,258
that might harbor the
ingredients for life.

130
00:07:40,659 --> 00:07:45,030
And Saturn, a giant world
ruled by raging storms

131
00:07:45,063 --> 00:07:47,733
and delicate
harmonies of gravity.

132
00:07:47,766 --> 00:07:50,836
(majestic music)

133
00:07:50,869 --> 00:07:54,540
Now, Cassini has one
last daring assignment.

134
00:07:55,507 --> 00:07:58,277
(majestic music)

135
00:08:03,782 --> 00:08:07,787
Cassini's Grand Finale
is a brand new adventure.

136
00:08:09,955 --> 00:08:14,560
22 dives through the space
between Saturn and its rings.

137
00:08:14,593 --> 00:08:17,363
(majestic music)

138
00:08:18,797 --> 00:08:22,167
As it repeatedly braves
this unexplored region,

139
00:08:22,200 --> 00:08:26,038
Cassini seeks new insights
about the origins of the rings

140
00:08:26,071 --> 00:08:29,174
and the nature of the
planet's interior.

141
00:08:29,207 --> 00:08:31,877
Closer to Saturn
than ever before.

142
00:08:31,910 --> 00:08:34,680
(majestic music)

143
00:08:38,817 --> 00:08:42,989
On the final orbit, Cassini
will plunge into Saturn,

144
00:08:44,289 --> 00:08:47,259
fighting to keep its
antenna pointed at Earth

145
00:08:47,292 --> 00:08:49,695
as it transmits its farewell.

146
00:08:51,863 --> 00:08:55,268
In the skies of Saturn,
the journey ends,

147
00:08:56,668 --> 00:08:59,038
(majestic music)

148
00:08:59,071 --> 00:09:03,509
as Cassini becomes part

of the planet itself.

149
00:09:03,542 --> 00:09:06,245
(majestic music)

150
00:09:24,563 --> 00:09:27,733
(audience applauding)

151
00:09:34,606 --> 00:09:38,777
- What a spectacular end
to a spectacular mission.

152
00:09:38,810 --> 00:09:41,747
You know, I feel a
little sad in many ways

153
00:09:41,780 --> 00:09:45,217
that Cassini's
discoveries will end,

154
00:09:45,250 --> 00:09:48,554
but I'm also quite optimistic
that we're gonna discover

155
00:09:48,587 --> 00:09:52,224
some new and really
exciting science

156
00:09:52,257 --> 00:09:55,928
as we probe the region
we've never probed before.

157
00:09:55,961 --> 00:09:57,763
It can be kind of risky.

158
00:09:57,796 --> 00:10:00,799
The ring material actually
falls into Saturn,

159

00:10:00,832 --> 00:10:03,469
and it doesn't take much
to stop our spacecraft

160
00:10:03,502 --> 00:10:05,938
at the velocities it's flying.

161
00:10:05,971 --> 00:10:09,375
But for more details
on how this will occur

162
00:10:09,408 --> 00:10:13,045
and what our plans are,
let me turn it over now

163
00:10:13,078 --> 00:10:16,415
to the Project Manager,
Earl Mays, Earl.

164
00:10:18,050 --> 00:10:21,020
- Thank you Jim, that
video's a very hard act

165
00:10:21,053 --> 00:10:23,822
for us to follow,
we get goosebumps

166
00:10:23,855 --> 00:10:26,291
and a little emotional
every time we see it.

167
00:10:26,324 --> 00:10:28,060
But let me try.

168
00:10:28,093 --> 00:10:29,528
Thank you, thank
you all very much

169
00:10:29,561 --> 00:10:31,296
for your interest in

the Cassini mission.

170
00:10:31,329 --> 00:10:32,998
I wanted to augment
Jim's comments

171
00:10:33,031 --> 00:10:34,733
with just a couple
more of my own.

172
00:10:34,766 --> 00:10:38,437
One is just to acknowledge
again the tremendous

173
00:10:38,470 --> 00:10:42,374
international effort that
the Cassini-Huygens has been.

174
00:10:42,407 --> 00:10:45,911
We had 19 nations and
three space agencies

175
00:10:45,944 --> 00:10:48,914
contributing hardware to
this Cassini-Huygens mission.

176
00:10:48,947 --> 00:10:51,950
We have remote sites
all over the world.

177
00:10:51,983 --> 00:10:54,319
It's truly an
international triumph.

178
00:10:54,352 --> 00:10:56,822
And again, I want to
also acknowledge not only

179
00:10:56,855 --> 00:11:00,392
the tremendous scientific

discovery that has occurred,

180
00:11:00,425 --> 00:11:02,594
but the engineering
achievements.

181
00:11:02,627 --> 00:11:05,497
The absolutely brilliant
creative and innovative

182
00:11:05,530 --> 00:11:08,867
mission design, the
astonishingly-accurate
navigation,

183
00:11:08,900 --> 00:11:13,439
the flawless engineering and
the meticulous melding together

184
00:11:13,472 --> 00:11:16,775
of 12 disparate
scientific investigations

185
00:11:16,808 --> 00:11:19,445
into a cohesive whole
that has essentially

186
00:11:19,478 --> 00:11:21,914
rewritten the books on Saturn.

187
00:11:21,947 --> 00:11:24,950
It is just a
phenomenal achievement.

188
00:11:26,151 --> 00:11:27,553
Cassini's legacy is
absolutely assured.

189
00:11:27,586 --> 00:11:31,790
We are in the books,

guys, it is just there.

190
00:11:31,823 --> 00:11:35,194
But, the best is still
yet to come, perhaps,

191
00:11:35,227 --> 00:11:37,863
but we are certainly gonna
provide more excitement.

192
00:11:37,896 --> 00:11:41,567
Let's bring back one
of those clips, please.

193
00:11:43,535 --> 00:11:47,005
We are going to
dive into the gap

194
00:11:47,038 --> 00:11:50,409
between the rings of Saturn
and Saturn's atmosphere,

195
00:11:50,442 --> 00:11:53,445
a place no one, no
spacecraft's ever gone.

196
00:11:53,478 --> 00:11:56,081
We're gonna be going
70,000 miles per hour

197
00:11:56,114 --> 00:11:58,350
into a 1,200 mile wide gap.

198
00:11:59,551 --> 00:12:01,120
At that velocity,
oh, by the way,

199
00:12:01,153 --> 00:12:02,855
we're gonna be doing it from
a billion kilometers away.

200
00:12:02,888 --> 00:12:04,223
It's all being run
from right here.

201
00:12:04,256 --> 00:12:05,224
(audience laughing)

202
00:12:05,257 --> 00:12:06,558
Just another stunt.

203
00:12:06,591 --> 00:12:08,961
Even a piece of sand
at that velocity

204
00:12:08,994 --> 00:12:10,496
will take out one
of our instruments.

205
00:12:10,529 --> 00:12:13,098
Or if it's in the wrong place,
could cripple the spacecraft.

206
00:12:13,131 --> 00:12:14,900
So this is something
we wouldn't want

207
00:12:14,933 --> 00:12:17,736
to really try any other time.

208
00:12:17,769 --> 00:12:19,705
But now it is the time.

209
00:12:21,373 --> 00:12:24,610
There is a question I
suppose we've been asked

210
00:12:24,643 --> 00:12:27,346
many times is, why

are you doing this?

211
00:12:27,379 --> 00:12:30,149
You've got a discovery machine
that's performing flawlessly,

212
00:12:30,182 --> 00:12:31,650
what's going on?

213
00:12:31,683 --> 00:12:33,786
Well, the short answer,
and Jim alluded to it is,

214
00:12:33,819 --> 00:12:35,554
we're out of propellant.

215
00:12:35,587 --> 00:12:39,258
Back in 2010 we decided
then that we would use

216
00:12:39,291 --> 00:12:42,194
every last kilogram
of our propellant

217
00:12:42,227 --> 00:12:44,296
to explore the Saturnian system

218
00:12:44,329 --> 00:12:48,167
as thoroughly as we could, end
up with no gas in the tank,

219
00:12:48,200 --> 00:12:50,903
but at the same time had
a very serious constraint.

220
00:12:50,936 --> 00:12:54,006
Cassini's own discoveries
were its demise.

221

00:12:54,039 --> 00:12:58,477
Enceladus has got a warm,
salt water, undersea ocean,

222
00:12:58,510 --> 00:13:00,379
and it's got plumes coming out.

223
00:13:00,412 --> 00:13:03,048
We cannot risk an
inadvertent contact

224
00:13:03,081 --> 00:13:05,384
with that pristine body.

225
00:13:05,417 --> 00:13:07,586
Cassini has got to
be put safely away.

226
00:13:07,619 --> 00:13:09,354
And since we wanted
to stay at Saturn,

227
00:13:09,387 --> 00:13:11,390
the only choice
was to destroy it

228
00:13:11,423 --> 00:13:13,392
in some controlled fashion.

229
00:13:13,425 --> 00:13:15,661
And that's when the
Grand Finale came in.

230
00:13:15,694 --> 00:13:18,096
The mission designers
again conceived

231
00:13:18,129 --> 00:13:20,833
and found a way for us
to go between the gaps.

232
00:13:20,866 --> 00:13:22,201
And that's right
where we're gonna go,

233
00:13:22,234 --> 00:13:23,569
starting April 26th.

234
00:13:23,602 --> 00:13:26,138
In about three weeks,
our final Titan flyby

235
00:13:26,171 --> 00:13:28,006
will push us into that gap.

236
00:13:28,039 --> 00:13:31,443
So maybe we could go to the
next slide for just a sec.

237
00:13:31,476 --> 00:13:32,778
Let's speak to a little bit.

238
00:13:32,811 --> 00:13:35,314
This ball of yarn,
is what we call it,

239
00:13:35,347 --> 00:13:36,815
if you would step
back a little bit,

240
00:13:36,848 --> 00:13:39,318
you'll see a bright spot in
the middle, that's Saturn.

241
00:13:39,351 --> 00:13:43,589
Those are all of the
Solstice Mission orbits.

242
00:13:43,622 --> 00:13:45,490

And you can see it's
gone all over the system.

243
00:13:45,523 --> 00:13:49,595
Every time that orbit bends,
kinks, changes, it's Titan.

244
00:13:49,628 --> 00:13:52,431
That Titan flyby is moving
us all over the place

245
00:13:52,464 --> 00:13:55,200
and we've exploited
it to perfection,

246
00:13:55,233 --> 00:13:57,269
all over the Saturnian system.

247
00:13:57,302 --> 00:14:00,072
But now the color
ones, they're very,

248
00:14:00,105 --> 00:14:03,375
the kind of goldish looking
ones you're looking at,

249
00:14:03,408 --> 00:14:04,977
are where we are right now.

250
00:14:05,010 --> 00:14:06,511
Titan flotus put us in there.

251
00:14:06,544 --> 00:14:09,615
And then one more Titan
flyby, and let's jump again,

252
00:14:09,648 --> 00:14:12,050
I'll speak quickly, you're gonna
see this again in a second,

253
00:14:12,083 --> 00:14:15,454
but one more Titan
flyby is going to put us

254
00:14:15,487 --> 00:14:18,423
into that gap between
Saturn and its rings.

255
00:14:18,456 --> 00:14:20,025
And you can see the
orbit of Titan there.

256
00:14:20,058 --> 00:14:22,628
And what's even funnier
is that as we go by,

257
00:14:22,661 --> 00:14:25,664
Titan's still messing with us.

258
00:14:25,697 --> 00:14:27,866
Once again it's gonna come
and by and keep pushing

259
00:14:27,899 --> 00:14:29,601
this spacecraft in and out,
and I'll show you a little bit,

260
00:14:29,634 --> 00:14:33,305
but this one, that
last kiss goodbye

261
00:14:33,338 --> 00:14:35,774
will put Cassini into Saturn.

262
00:14:37,575 --> 00:14:39,177
This is a roller coaster ride.

263
00:14:39,210 --> 00:14:41,813
We're going in, and

we are not coming out.

264
00:14:41,846 --> 00:14:43,515
It's a one way trip.

265
00:14:45,016 --> 00:14:47,786
Let me go to the next
slide for just a sec.

266
00:14:47,819 --> 00:14:49,889
This is not without risk.

267
00:14:51,356 --> 00:14:55,527
That is a high contrast view
of the inner rings of Saturn.

268
00:14:56,661 --> 00:14:58,597
You can see the dust
kind of extending

269
00:14:58,630 --> 00:15:01,934
and slowly disappearing
into the black.

270
00:15:03,168 --> 00:15:05,170
Now, if we go one
more click, you'll see

271
00:15:05,203 --> 00:15:07,839
where we're gonna
fly, that's the plan.

272
00:15:07,872 --> 00:15:10,809
We're gonna stay as far
away from the visible dust

273
00:15:10,842 --> 00:15:14,112
as we can, and we're
using our very best models

274
00:15:14,145 --> 00:15:16,581
of the rings that
we've been developing,

275
00:15:16,614 --> 00:15:18,617
we have some of the best
ring experts in the world,

276
00:15:18,650 --> 00:15:21,453
are various models to
extrapolate into the region

277
00:15:21,486 --> 00:15:24,256
we can't see in order to
determine if we can be safe.

278
00:15:24,289 --> 00:15:27,126
So again, let's
go one more slide.

279
00:15:28,393 --> 00:15:31,129
There are the 22
proximal orbits.

280
00:15:31,162 --> 00:15:32,531
And here is what it looks like

281
00:15:32,564 --> 00:15:36,168
from a Cassini point
of view coming in.

282
00:15:36,201 --> 00:15:38,203
Starting left to right,
each of those final orbits,

283
00:15:38,236 --> 00:15:42,107
as you can see, that red one
on the end is the last one.

284

00:15:42,140 --> 00:15:43,475
Now we go in a little bit more.

285
00:15:43,508 --> 00:15:45,544
We'll have the artist
put in where we think

286
00:15:45,577 --> 00:15:47,813
we're going to be.

287
00:15:47,846 --> 00:15:50,615
Again, from the
navigational precision,

288
00:15:50,648 --> 00:15:52,851
this is an easy shot.

289
00:15:52,884 --> 00:15:55,287
Our problem is, or
concern I should say,

290
00:15:55,320 --> 00:15:56,722
is not our accuracy,

291
00:15:56,755 --> 00:16:00,092
but have we modeled
that system correctly?

292
00:16:00,125 --> 00:16:03,161
So, for a couple of
those revs or orbits,

293
00:16:03,194 --> 00:16:06,565
you see that the ring plane
crossing is kind of flirting

294
00:16:06,598 --> 00:16:09,034
with the edge of where
we think it's safe.

295
00:16:09,067 --> 00:16:10,635
Well, that's where
this comes in.

296
00:16:10,668 --> 00:16:13,105
This is a model of the
Cassini spacecraft,

297
00:16:13,138 --> 00:16:15,674
and this right up here
is our high-gain antenna,

298
00:16:15,707 --> 00:16:18,977
a great big dish, and if
you notice, almost all

299
00:16:19,010 --> 00:16:21,480
of the instruments, if you
point it the right way,

300
00:16:21,513 --> 00:16:24,282
are shadowed or shielded
by that antenna.

301
00:16:24,315 --> 00:16:26,084
So, first time
in, we're gonna go

302
00:16:26,117 --> 00:16:28,387
behind the high-gain
antenna, having it shield

303
00:16:28,420 --> 00:16:30,255
everything we possibly can.

304
00:16:30,288 --> 00:16:32,057
Of course, the magnetometers'
hanging out here,

305

00:16:32,090 --> 00:16:33,825
and they're on their
own, but everybody else,

306
00:16:33,858 --> 00:16:35,193
(audience laughing)

307
00:16:35,226 --> 00:16:37,396
everybody else will be
back behind the shield.

308
00:16:37,429 --> 00:16:40,499
And what we'll do is, we
have a couple of instruments

309
00:16:40,532 --> 00:16:42,067
that can tell us very quickly

310
00:16:42,100 --> 00:16:43,902
if we've modeled
the dust correctly.

311
00:16:43,935 --> 00:16:46,705
If we have, great, we're gonna
use the high-gain antenna.

312
00:16:46,738 --> 00:16:49,007
A couple more times, you
can see a few of those revs

313
00:16:49,040 --> 00:16:51,243
where we sneak up
over the dotted line

314
00:16:51,276 --> 00:16:53,178
and we will shield
ourselves again.

315
00:16:53,211 --> 00:16:56,181
But every time else we'll

turn the spacecraft over

316
00:16:56,214 --> 00:16:59,051
to one of several
prime instruments

317
00:16:59,084 --> 00:17:02,954
to interrogate that
unexplored region of Saturn.

318
00:17:02,987 --> 00:17:04,890
If we get surprised,
well we've got a bunch

319
00:17:04,923 --> 00:17:07,759
of contingency plans, we'll
do some broken field running.

320
00:17:07,792 --> 00:17:10,028
We'll milk the very
best out of this.

321
00:17:10,061 --> 00:17:11,997
And if we really get surprised,

322
00:17:12,030 --> 00:17:14,366
if indeed we've modeled
so badly that there are

323
00:17:14,399 --> 00:17:16,835
BB-sized material
out there, well,

324
00:17:16,868 --> 00:17:20,105
Cassini will still finish up
exactly where we've planned,

325
00:17:20,138 --> 00:17:22,407
but we may end up with a
little bit less science

326
00:17:22,440 --> 00:17:23,909
than we'd hoped for.

327
00:17:23,942 --> 00:17:27,045
But we've got every confidence
that our models are correct

328
00:17:27,078 --> 00:17:29,047
and that we are going
to finish this up

329
00:17:29,080 --> 00:17:31,450
exactly as we say,
with a grand finale,

330
00:17:31,483 --> 00:17:34,153
and end up a spectacular ending.

331
00:17:36,354 --> 00:17:39,391
On a more personal
note, there are a couple

332
00:17:39,424 --> 00:17:41,960
of different
perspectives on this.

333
00:17:41,993 --> 00:17:44,162
One is just excitement,
we've been flying

334
00:17:44,195 --> 00:17:46,264
this spacecraft for 20 years.

335
00:17:46,297 --> 00:17:47,732
Some of us have been
here on the mission

336
00:17:47,765 --> 00:17:49,801

the entire time, I
can't say that I'm one,

337
00:17:49,834 --> 00:17:53,905
but it's been a lifetime or
a career of just achievement.

338
00:17:53,938 --> 00:17:57,476
And every time we come
around we find more ways

339
00:17:57,509 --> 00:18:00,545
to repurpose the spacecraft,
to use it more creatively,

340
00:18:00,578 --> 00:18:03,048
and to find more and
more revelations.

341
00:18:03,081 --> 00:18:04,683
I'm excited about that.

342
00:18:04,716 --> 00:18:07,752
We saw something two weeks ago
that we've never seen before.

343
00:18:07,785 --> 00:18:11,423
I fully expect that to
continue for the next,

344
00:18:11,456 --> 00:18:14,359
well, I've lost track,
probably five months.

345
00:18:14,392 --> 00:18:16,161
It's gonna be phenomenal.

346
00:18:16,194 --> 00:18:18,163
A tremendous sense of pride.

347
00:18:18,196 --> 00:18:21,500
This mission and anyone that's
been associated with it,

348
00:18:21,533 --> 00:18:22,901
should just hold their heads up

349
00:18:22,934 --> 00:18:26,304
because it has just
rewritten the books.

350
00:18:26,337 --> 00:18:28,673
And again, it's gonna continue.

351
00:18:28,706 --> 00:18:31,877
This book, this
spacecraft, this mission,

352
00:18:31,910 --> 00:18:35,447
the folks that are on it,
it's just been phenomenal.

353
00:18:35,480 --> 00:18:39,251
And, of course, there's
a sense of loss.

354
00:18:39,284 --> 00:18:42,120
We, humankind, through us,

355
00:18:42,153 --> 00:18:44,923
have been at Saturn
for 13 years.

356
00:18:46,057 --> 00:18:47,325
You can get up in the morning,

357
00:18:47,358 --> 00:18:48,560
you can get a weather report,

358
00:18:48,593 --> 00:18:50,829
you can see what the
images look like,

359
00:18:50,862 --> 00:18:52,564
you can get the status
on the space weather,

360
00:18:52,597 --> 00:18:54,933
magnetic fields,
we are connected.

361
00:18:54,966 --> 00:18:56,968
And we've connected
the entire planet.

362
00:18:57,001 --> 00:18:58,603
The social media and
everyone else is all

363
00:18:58,636 --> 00:19:01,673
on this ride with us,
that's gonna go away.

364
00:19:01,706 --> 00:19:03,141
And there's not
a, unfortunately,

365
00:19:03,174 --> 00:19:06,778
not a substitute for that
for some time to come.

366
00:19:06,811 --> 00:19:08,446
We've had an incredible family.

367
00:19:08,479 --> 00:19:11,383
It really takes a village
to fly this thing.

368

00:19:11,416 --> 00:19:13,585
Only this village is
all over the world

369
00:19:13,618 --> 00:19:16,454
and we're connected with
high-speed data lines

370
00:19:16,487 --> 00:19:19,991
rather than backyard fences,
but it's still exactly,

371
00:19:20,024 --> 00:19:21,960
the team, the family
that we've developed,

372
00:19:21,993 --> 00:19:24,963
the personal relationships,
it's gonna be

373
00:19:24,996 --> 00:19:26,531
a hard thing to let
go of, and I'm hoping

374
00:19:26,564 --> 00:19:30,202
to see many of you and
many of us in other places.

375
00:19:30,235 --> 00:19:31,836
It's been a ride of a lifetime,

376
00:19:31,869 --> 00:19:35,173
and I would not trade
it for anything.

377
00:19:35,206 --> 00:19:38,410
And with that, I'll turn
this over to Linda Spilker.

378
00:19:38,443 --> 00:19:40,445

- I'm the Cassini
Project Scientist,

379
00:19:40,478 --> 00:19:43,448
and as the Project
Scientist, I lead a team

380
00:19:43,481 --> 00:19:47,385
of 300 scientists from
all over the world.

381
00:19:47,418 --> 00:19:50,589
And our goal is to use
this capable spacecraft

382
00:19:50,622 --> 00:19:53,858
to collect the best
science that we can.

383
00:19:53,891 --> 00:19:58,530
I've worked on the
Cassini mission for
almost three decades.

384
00:19:58,563 --> 00:20:02,000
My oldest daughter, Jennifer,
started kindergarten

385
00:20:02,033 --> 00:20:04,369
when I started
working on Cassini.

386
00:20:04,402 --> 00:20:08,139
And now she's married and
has a daughter of her own.

387
00:20:08,172 --> 00:20:11,309
Those decades of
Cassini have flown by,

388

00:20:11,342 --> 00:20:15,514
and now here we stand on the
brink of the Grand Finale.

389
00:20:16,447 --> 00:20:19,818
In so many ways,
the Grand Finale

390
00:20:19,851 --> 00:20:22,020
is like a brand new mission.

391
00:20:22,053 --> 00:20:24,289
We're going to a place
and obtaining data

392
00:20:24,322 --> 00:20:27,292
with the Cassini spacecraft
we could only obtain

393
00:20:27,325 --> 00:20:28,960
in doing it this way.

394
00:20:28,993 --> 00:20:31,263
In fact, I wouldn't
be a bit surprised

395
00:20:31,296 --> 00:20:33,398
if some of the discoveries
we make with Cassini

396
00:20:33,431 --> 00:20:36,201
might be the very
best of the mission

397
00:20:36,234 --> 00:20:38,637
from these Grand Finale orbits.

398
00:20:38,670 --> 00:20:40,205
I'd like to share with you
some of the highlights,

399
00:20:40,238 --> 00:20:42,440
in particular about
Saturn's rings

400
00:20:42,473 --> 00:20:44,042
and about the planet itself.

401
00:20:44,075 --> 00:20:46,511
If I could have the
first graphic, please.

402
00:20:46,544 --> 00:20:48,513
This is a view of
Saturn's rings.

403
00:20:48,546 --> 00:20:50,782
This system is huge.

404
00:20:50,815 --> 00:20:53,852
If you take Saturn plus its
rings, it would just fit

405
00:20:53,885 --> 00:20:56,087
in between the
Earth and the Moon,

406
00:20:56,120 --> 00:20:58,556
a tremendously huge system.

407
00:20:58,589 --> 00:21:00,792
And one of the things we
can do with the rings is,

408
00:21:00,825 --> 00:21:03,328
in the Grand Finale
orbits, for the first time

409
00:21:03,361 --> 00:21:05,397

address the question
of the origin

410
00:21:05,430 --> 00:21:07,832
and the age of the rings.

411
00:21:07,865 --> 00:21:09,634
We'll do this by
measuring the mass

412
00:21:09,667 --> 00:21:11,970
of the rings very accurately.

413
00:21:12,003 --> 00:21:15,040
If the rings are a lot more
massive than we expect,

414
00:21:15,073 --> 00:21:18,310
perhaps they're old, as
old as Saturn itself.

415
00:21:18,343 --> 00:21:20,245
And they've been massive
enough to survive

416
00:21:20,278 --> 00:21:22,847
the micrometeroid
bombardment and erosion

417
00:21:22,880 --> 00:21:25,950
and leave us with the
rings we see today.

418
00:21:25,983 --> 00:21:28,586
Now, on the other hand, if
the rings are less massive,

419
00:21:28,619 --> 00:21:31,990
perhaps they're very young,
maybe forming as little

420
00:21:32,023 --> 00:21:34,092
as a hundred million years ago.

421
00:21:34,125 --> 00:21:36,428
Maybe a comet or a
moon got too close,

422
00:21:36,461 --> 00:21:38,863
got torn apart by
Saturn's gravity,

423
00:21:38,896 --> 00:21:41,733
and we have the rings
that we see today.

424
00:21:41,766 --> 00:21:43,835
The other thing we can
do for the first time is

425
00:21:43,868 --> 00:21:47,605
determine the composition
of the ring particles.

426
00:21:47,638 --> 00:21:50,875
Now I know that Saturn's
rings are 99% water ice,

427
00:21:50,908 --> 00:21:54,746
but we're not certain
about that other 1%,

428
00:21:54,779 --> 00:21:56,448
non-icy constituent.

429
00:21:57,382 --> 00:21:58,783
What is it made of?

430
00:21:58,816 --> 00:22:02,053

Could it be tiny grains
of iron, silicates,

431
00:22:02,086 --> 00:22:04,856
organics, a mix of all three,

432
00:22:04,889 --> 00:22:07,359
something else we
haven't even thought of?

433
00:22:07,392 --> 00:22:09,761
When our cosmic dust analyzer
goes to the ring plane,

434
00:22:09,794 --> 00:22:12,797
we'll scoop up ring
particles and directly taste

435
00:22:12,830 --> 00:22:16,334
and measure the composition
of those particles.

436
00:22:16,367 --> 00:22:19,671
And then imagine the
pictures we're gonna get back

437
00:22:19,704 --> 00:22:23,108
of Saturn's rings, in particular
the C ring and the D ring.

438
00:22:23,141 --> 00:22:27,145
Maybe we'll even see one of
those largest ring particles

439
00:22:27,178 --> 00:22:31,350
as we go by, wouldn't that
be very cool to do as well?

440
00:22:32,517 --> 00:22:33,885
If you go on to

the next graphic,

441
00:22:33,918 --> 00:22:35,787
then we have the planet itself.

442
00:22:35,820 --> 00:22:37,756
Basically, as we're skimming
close to the planet,

443
00:22:37,789 --> 00:22:41,626
we'll have the best views ever
of the poles of the planet.

444
00:22:41,659 --> 00:22:43,128
We'll see the giant hurricanes

445
00:22:43,161 --> 00:22:44,996
at the north and south poles.

446
00:22:45,029 --> 00:22:47,198
We'll also see, this is
the north pole of Saturn.

447
00:22:47,231 --> 00:22:51,603
We'll see the giant hexagon,
six-sided jet stream

448
00:22:51,636 --> 00:22:54,239
that's two Earth
diameters across.

449
00:22:54,272 --> 00:22:57,575
What keeps those
six sides in place?

450
00:22:57,608 --> 00:22:59,844
It's been there
for decades itself.

451

00:22:59,877 --> 00:23:01,613
Perhaps getting
close with Cassini

452
00:23:01,646 --> 00:23:05,483
we can answer the question,
what keeps the hexagon there

453
00:23:05,516 --> 00:23:07,752
in this particular shape?

454
00:23:07,785 --> 00:23:09,387
We'll get to see
the clouds up close.

455
00:23:09,420 --> 00:23:12,724
Maybe little tiny storms,
little vortices whirling around.

456
00:23:12,757 --> 00:23:16,261
Some of the best images
ever of the planet itself.

457
00:23:16,294 --> 00:23:18,430
And then, of course,
on the last five orbits

458
00:23:18,463 --> 00:23:20,465
we're actually gonna dip our toe

459
00:23:20,498 --> 00:23:22,200
in the atmosphere of Saturn.

460
00:23:22,233 --> 00:23:23,935
With our iron and neutral
mass spectrometer,

461
00:23:23,968 --> 00:23:26,237
measure the composition
of the atmosphere.

462
00:23:26,270 --> 00:23:27,939
Now, it's mostly
hydrogen and helium,

463
00:23:27,972 --> 00:23:31,676
but what else is there,
and in what abundance?

464
00:23:31,709 --> 00:23:33,878
And, of course, on
our final orbit,

465
00:23:33,911 --> 00:23:35,914
we're gonna actually
point the instrument

466
00:23:35,947 --> 00:23:39,684
in the direction of the
atmosphere coming from Saturn

467
00:23:39,717 --> 00:23:42,921
and make measurements
until the very final moment

468
00:23:42,954 --> 00:23:45,957
when Cassini turns away
and the mission ends,

469
00:23:45,990 --> 00:23:49,861
going as deeply as we can
into Saturn's atmosphere.

470
00:23:49,894 --> 00:23:51,429
If we go on to the next,
we're also gonna look

471
00:23:51,462 --> 00:23:53,431
at the aurora of
the planet as well.

472
00:23:53,464 --> 00:23:56,134
This is in the near
infrared, it's a false color.

473
00:23:56,167 --> 00:23:58,870
You can see the greenish
aurora at the south pole.

474
00:23:58,903 --> 00:24:00,972
There's a similar aurora
at the north pole,

475
00:24:01,005 --> 00:24:05,210
so the northern and southern
lights of Saturn itself.

476
00:24:05,243 --> 00:24:06,744
And if we go on to
the next graphic,

477
00:24:06,777 --> 00:24:09,380
we're also gonna get
an incredible view

478
00:24:09,413 --> 00:24:11,649
of the interior of the
planet with our gravity

479
00:24:11,682 --> 00:24:14,819
and magnetic field measurements.

480
00:24:14,852 --> 00:24:17,021
With our gravity measurements,
we'll measure the size

481
00:24:17,054 --> 00:24:19,257
of the rocky core on Saturn.

482

00:24:19,290 --> 00:24:21,493
That's right in the
center of the planet.

483
00:24:21,526 --> 00:24:25,563
Is it one Earth diameter in
size, two Earths, smaller?

484
00:24:25,596 --> 00:24:27,365
We'll find out for
the first time.

485
00:24:27,398 --> 00:24:29,534
We'll actually be peeling
back the atmosphere

486
00:24:29,567 --> 00:24:31,769
and looking inside the planet.

487
00:24:31,802 --> 00:24:33,905
Now, any irregularities
in the gravity field

488
00:24:33,938 --> 00:24:36,674
will tell us how deeply
those winds continue

489
00:24:36,707 --> 00:24:38,476
to blow on Saturn.

490
00:24:38,509 --> 00:24:40,111
Are they shallow
winds, maybe only going

491
00:24:40,144 --> 00:24:42,480
down 150 miles or so?

492
00:24:42,513 --> 00:24:45,917
Are they deep winds, going 10
times as deep in the planet?

493
00:24:45,950 --> 00:24:47,352
Or deeper still?

494
00:24:47,385 --> 00:24:49,721
We'll be able to make those
kinds of measurements.

495
00:24:49,754 --> 00:24:51,689
And with the magnetic
field, we'll be able

496
00:24:51,722 --> 00:24:54,192
to get for the
first time, we hope,

497
00:24:54,225 --> 00:24:56,661
the length of a day for
the interior Saturn.

498
00:24:56,694 --> 00:24:58,863
How fast is Saturn rotating?

499
00:24:58,896 --> 00:25:01,132
If there's just a slight
tilt of the magnetic field,

500
00:25:01,165 --> 00:25:04,836
then it will wobble around and
give us the length of a day.

501
00:25:04,869 --> 00:25:07,272
And then the magnetic field
will help us understand

502
00:25:07,305 --> 00:25:09,908
the interior, we can
see in that gold region

503

00:25:09,941 --> 00:25:13,611
in the outer part of Saturn,
that's the molecular hydrogen.

504
00:25:13,644 --> 00:25:16,748
That gray boundary is where
you go to the metallic phase

505
00:25:16,781 --> 00:25:19,551
as the pressures
increase inside Saturn.

506
00:25:19,584 --> 00:25:21,753
In the metallic phase,
currents can flow.

507
00:25:21,786 --> 00:25:24,055
And you can see the blue
magnetic field lines

508
00:25:24,088 --> 00:25:26,824
coming out from the
interior of Saturn.

509
00:25:26,857 --> 00:25:28,693
You can see the
rings are really good

510
00:25:28,726 --> 00:25:30,228
at shielding the
magnetic field lines,

511
00:25:30,261 --> 00:25:32,463
but you see field
lines outside the rings

512
00:25:32,496 --> 00:25:35,667
that in that region
where Cassini will fly

513

00:25:35,700 --> 00:25:37,402
and we'll look at
the radiation belts

514
00:25:37,435 --> 00:25:39,904
in that particular
region as well.

515
00:25:39,937 --> 00:25:44,509
So the Grand Finale mission
is absolutely incredible.

516
00:25:44,542 --> 00:25:48,413
Flying in a region that no
spacecraft has flown before.

517
00:25:48,446 --> 00:25:52,050
And getting this close to
the rings and the planet,

518
00:25:52,083 --> 00:25:54,586
that's a once in a
lifetime experience

519
00:25:54,619 --> 00:25:56,588
for a scientist like me.

520
00:25:56,621 --> 00:25:59,424
We've wanted to do
this for a long time.

521
00:25:59,457 --> 00:26:02,360
And we had to wait for
just the right time

522
00:26:02,393 --> 00:26:04,662
and just the right
mission design

523
00:26:04,695 --> 00:26:08,166

to actually fly in
this particular region.

524
00:26:08,199 --> 00:26:10,234
And I can't wait for
those new discoveries

525
00:26:10,267 --> 00:26:14,238
in the Grand Finale mission
and I'm just incredibly proud

526
00:26:14,271 --> 00:26:16,341
to have been part of
the Cassini mission

527
00:26:16,374 --> 00:26:19,043
from the beginning
until the end.

528
00:26:19,076 --> 00:26:22,847
But, of course, it's really
gonna be hard to say goodbye,

529
00:26:22,880 --> 00:26:26,551
to say goodbye to this plucky,
capable little spacecraft

530
00:26:26,584 --> 00:26:29,587
that has returned all
of this great science,

531
00:26:29,620 --> 00:26:32,190
and then to say goodbye
to the Cassini family.

532
00:26:32,223 --> 00:26:35,159
We've been together
for a long time,

533
00:26:35,192 --> 00:26:37,829

and we've flown this
spacecraft together.

534
00:26:37,862 --> 00:26:42,033
So on that final day,
it'll be a very sad time

535
00:26:42,066 --> 00:26:44,035
and hard to say goodbye.

536
00:26:44,068 --> 00:26:46,237
And with that I'd like to turn
it over to Joannie Stupik.

537
00:26:46,270 --> 00:26:49,140
She's the Guidance and
Control Engineer for Cassini.

538
00:26:49,173 --> 00:26:50,508
- Thanks, Linda.

539
00:26:52,943 --> 00:26:55,747
I am part of the team
of engineers that manage

540
00:26:55,780 --> 00:26:58,216
and control the
spacecraft itself,

541
00:26:58,249 --> 00:27:01,452
and specifically, I
work on the orientation

542
00:27:01,485 --> 00:27:04,222
of the spacecraft and
point the cameras.

543
00:27:04,255 --> 00:27:06,924
All of the spacecraft
movements that we've designed

544
00:27:06,957 --> 00:27:10,328
for the whole mission
through the Grand Finale

545
00:27:10,361 --> 00:27:13,231
are now available for
anyone to check out

546
00:27:13,264 --> 00:27:15,933
in a program called Eyes
on the Solar System,

547
00:27:15,966 --> 00:27:18,970
which you can find
at eyes.nasa.gov.

548
00:27:20,771 --> 00:27:23,474
Eyes on the Solar System is
a free, interactive software

549
00:27:23,507 --> 00:27:26,844
that allows anyone to
explore various spacecraft,

550
00:27:26,877 --> 00:27:30,982
not just Cassini, and
planets in our solar system.

551
00:27:31,015 --> 00:27:33,918
The special Cassini module
highlights the Grand Finale

552
00:27:33,951 --> 00:27:36,821
specifically, so to
enter the Cassini module,

553
00:27:36,854 --> 00:27:38,122
we'll click right here.

554
00:27:38,155 --> 00:27:39,857
The first thing we can
do is check out and see

555
00:27:39,890 --> 00:27:42,127
where Cassini is right now.

556
00:27:43,661 --> 00:27:46,330
At this very moment, this
is Cassini's position

557
00:27:46,363 --> 00:27:49,033
and orientation
relative to Saturn

558
00:27:49,066 --> 00:27:53,504
and also relative to the
rest of the solar system,

559
00:27:53,537 --> 00:27:56,507
which is hanging
out right there.

560
00:27:56,540 --> 00:27:59,811
To enter the Grand Finale
module, I hit this button.

561
00:27:59,844 --> 00:28:02,180
And here we have
a zoomed out view

562
00:28:02,213 --> 00:28:05,316
of Cassini's orbit right now.

563
00:28:05,349 --> 00:28:08,419
When we come in
close to the rings,

564
00:28:08,452 --> 00:28:10,421

we will still be
outside the rings.

565
00:28:10,454 --> 00:28:13,224
So to make that final hhop
from outside the rings

566
00:28:13,257 --> 00:28:16,227
to inside the rings,
we need Titan's help.

567
00:28:16,260 --> 00:28:20,064
Our very last Titan flyby
will be on April 22nd.

568
00:28:20,097 --> 00:28:22,100
And this is a simulation
of what the spacecraft

569
00:28:22,133 --> 00:28:24,535
will really be
doing on that day.

570
00:28:24,568 --> 00:28:27,138
These purple lines here
represent the radar beam

571
00:28:27,171 --> 00:28:31,342
as it sweeps across the
moon and takes science.

572
00:28:31,375 --> 00:28:34,212
All of the spacecraft movements
shown in the simulation

573
00:28:34,245 --> 00:28:36,848
are using the real
engineering data

574
00:28:36,881 --> 00:28:40,351

that I use every
day to do my job.

575
00:28:40,384 --> 00:28:42,687
When we get a zoomed out
view of the trajectory,

576
00:28:42,720 --> 00:28:46,291
we'll see what Titan
has done to our orbit.

577
00:28:47,858 --> 00:28:50,128
We can see that that last
big tug that Titan gave us

578
00:28:50,161 --> 00:28:52,063
has kinked our orbit right here.

579
00:28:52,096 --> 00:28:54,365
So it's now popped us
onto the very first

580
00:28:54,398 --> 00:28:57,068
of the Grand Finale orbits.

581
00:28:57,101 --> 00:28:59,504
So the next time that we
come in close to Saturn,

582
00:28:59,537 --> 00:29:01,372
we'll be inside the rings.

583
00:29:01,405 --> 00:29:03,775
The first time that we'll
plunge through that gap

584
00:29:03,808 --> 00:29:05,643
will be on April 26th.

585

00:29:07,778 --> 00:29:10,481
And you can see here we're
coming in from above,

586
00:29:10,514 --> 00:29:13,451
looking at a bunch of
things like the hexagon

587
00:29:13,484 --> 00:29:15,286
and taking new science.

588
00:29:15,319 --> 00:29:18,389
As Earl talked about,
the very first time

589
00:29:18,422 --> 00:29:20,691
that we plunge through
the gap we're gonna be

590
00:29:20,724 --> 00:29:23,995
at a very specific orientation.

591
00:29:24,028 --> 00:29:27,665
As Earl was talking about,
we just don't know exactly

592
00:29:27,698 --> 00:29:30,701
where that D ring
comes, we think we know,

593
00:29:30,734 --> 00:29:33,938
we're pretty sure, but
to be on the safe side,

594
00:29:33,971 --> 00:29:37,909
we want to protect all of
the science instruments

595
00:29:37,942 --> 00:29:41,179
on the body of the spacecraft

from those pieces of dust.

596
00:29:41,212 --> 00:29:43,648
You can see here
right now it's 74,000,

597
00:29:43,681 --> 00:29:46,851
it gets up to 76,000
miles an hour.

598
00:29:46,884 --> 00:29:49,086
At those speeds, even a
tiny piece could do damage

599
00:29:49,119 --> 00:29:51,522
to our science instruments.

600
00:29:51,555 --> 00:29:53,858
So we use our high-gain
antenna as a shield

601
00:29:53,891 --> 00:29:56,160
to protect the rest
of the spacecraft.

602
00:29:56,193 --> 00:29:58,129
And the other thing that
we can see is our distance

603
00:29:58,162 --> 00:30:00,097
relative to the
cloud tops of Saturn.

604
00:30:00,130 --> 00:30:03,701
In this case, we can watch
as we plunge through,

605
00:30:03,734 --> 00:30:07,438
and the distance gets
down to about 1,800 miles,

606
00:30:07,471 --> 00:30:09,674
which is very
roughly the distance

607
00:30:09,707 --> 00:30:12,443
across the continental
United States.

608
00:30:12,476 --> 00:30:15,580
In space terms, that's
a really short distance.

609
00:30:15,613 --> 00:30:17,348
(audience laughing)

610
00:30:17,381 --> 00:30:19,083
And we can also sort
of get a little peek

611
00:30:19,116 --> 00:30:21,152
through Eyes on the
Solar System at some

612
00:30:21,185 --> 00:30:24,956
of the spectacular views that
we expect Cassini to see.

613
00:30:24,989 --> 00:30:28,526
But that was just the
first of 22 proximal,

614
00:30:28,559 --> 00:30:30,361
we call them proximal
orbits because we get

615
00:30:30,394 --> 00:30:33,030
in close proximity to Saturn.

616

00:30:33,063 --> 00:30:35,366
So we'll do a total of 22.

617
00:30:35,399 --> 00:30:36,968
We'll be crossing
through the ring plane

618
00:30:37,001 --> 00:30:38,503
about once a week.

619
00:30:39,703 --> 00:30:43,541
And as Earl alluded to,
each time we come out

620
00:30:43,574 --> 00:30:46,077
far away from Saturn, Titan
is pulling us a little bit,

621
00:30:46,110 --> 00:30:49,948
and that essentially
moves where we intersect,

622
00:30:51,115 --> 00:30:52,650
where we intersect
the ring plane around.

623
00:30:52,683 --> 00:30:55,419
So we are different distances
from Saturn each time.

624
00:30:55,452 --> 00:30:57,121
You can see that in
Eyes on the Solar System

625
00:30:57,154 --> 00:31:00,191
we have the real
trajectory, so you can see

626
00:31:00,224 --> 00:31:03,494
each time how far away

we'll be from Saturn.

627
00:31:03,527 --> 00:31:06,163
And the very last time
that Cassini comes

628
00:31:06,196 --> 00:31:07,798
to cross the ring
plane, we will enter

629
00:31:07,831 --> 00:31:11,335
into Saturn's atmosphere and
not come out the other side.

630
00:31:11,368 --> 00:31:13,137
We can see right here,
this is the point

631
00:31:13,170 --> 00:31:14,705
that Cassini will
be intersecting

632
00:31:14,738 --> 00:31:16,741
with Saturn's atmosphere.

633
00:31:16,774 --> 00:31:20,778
And that will be a very
emotional day for all of us.

634
00:31:20,811 --> 00:31:24,215
Cassini received
federal funding in 1989,

635
00:31:25,683 --> 00:31:27,585
and I was born in 1989.

636
00:31:27,618 --> 00:31:29,253
(audience laughing)

637

00:31:29,286 --> 00:31:33,458
So you could say we're the same
age, born in the same year.

638
00:31:34,625 --> 00:31:36,761
Cassini left Earth when
I was eight years old.

639
00:31:36,794 --> 00:31:39,563
So it's been an incredible
honor and privilege

640
00:31:39,596 --> 00:31:43,567
for me to begin my career
working on the last four years

641
00:31:43,600 --> 00:31:46,437
of such an incredibly
successful mission.

642
00:31:46,470 --> 00:31:47,905
I'm gonna turn it back to
Earl and he's gonna talk

643
00:31:47,938 --> 00:31:51,709
about the last few
minutes of Cassini's life.

644
00:31:52,910 --> 00:31:56,247
- So, that's how
we plan to end one

645
00:31:56,280 --> 00:31:59,183
of the most amazing
voyages of exploration.

646
00:31:59,216 --> 00:32:02,353
If I could have
the next animation.

647

00:32:02,386 --> 00:32:04,455
Cassini will enter
Saturn's atmosphere

648
00:32:04,488 --> 00:32:07,491
on rev 22 and a half,
valiantly fighting

649
00:32:07,524 --> 00:32:11,195
against the ever-increasing
torques on the atmosphere,

650
00:32:11,228 --> 00:32:13,364
pointing its high-gain
antenna to Earth

651
00:32:13,397 --> 00:32:16,600
to send down every
last precious bit.

652
00:32:16,633 --> 00:32:19,236
We will be sampling the
atmosphere of Saturn.

653
00:32:19,269 --> 00:32:23,441
Every bit will be transferred
back as quickly as we can.

654
00:32:24,842 --> 00:32:27,411
Inevitably, Cassini's
going to lose the battle.

655
00:32:27,444 --> 00:32:29,447
It has got small
thrusters, it wasn't built

656
00:32:29,480 --> 00:32:31,415
for the atmosphere,
and eventually

657

00:32:31,448 --> 00:32:34,585
it will lose point and control.

658
00:32:34,618 --> 00:32:39,290
Shortly after that, it will
fall apart, break apart,

659
00:32:39,323 --> 00:32:41,892
it will melt, it will
vaporize and will

660
00:32:41,925 --> 00:32:44,295
become a part of the very planet

661
00:32:44,328 --> 00:32:47,898
it left Earth 20
years ago to explore.

662
00:32:47,931 --> 00:32:50,201
The spectacular ending,
the Grand Finale,

663
00:32:50,234 --> 00:32:54,005
going out in a blaze of glory
is a phenomenal conclusion

664
00:32:54,038 --> 00:32:58,209
to a chapter in humankind's
exploration of the planets.

665
00:32:59,410 --> 00:33:01,712
Just a chapter, the
book is not complete,

666
00:33:01,745 --> 00:33:05,649
there's more to come, but this
has been a marvelous ride.

667
00:33:05,682 --> 00:33:07,118
Thank you.

668
00:33:07,151 --> 00:33:10,321
(audience applauding)

669
00:33:14,425 --> 00:33:16,660
- All right, thanks so
much to our speakers.

670
00:33:16,693 --> 00:33:18,396
We have time for questions now.

671
00:33:18,429 --> 00:33:19,997
A reminder to reporters
who've dialed in,

672
00:33:20,030 --> 00:33:21,866
please dial *1 if you
have a question to ask.

673
00:33:21,899 --> 00:33:24,668
We'll start here in
the audience at JPL.

674
00:33:24,701 --> 00:33:28,205
Please raise your hand
if you have a question.

675
00:33:28,238 --> 00:33:30,341
And I see a couple down
here, why don't we start

676
00:33:30,374 --> 00:33:33,544
close to the aisle
and then go inward.

677
00:33:33,577 --> 00:33:37,248
Please wait for the mic and
state your name and affiliation.

678

00:33:37,281 --> 00:33:40,751
- Hi there, Ian
O'Neill for Space.com.

679
00:33:40,784 --> 00:33:42,920
Congratulations on
a fantastic mission.

680
00:33:42,953 --> 00:33:44,688
I've been captivated
ever since I started

681
00:33:44,721 --> 00:33:48,225
science communications, so
it's been an amazing voyage.

682
00:33:48,258 --> 00:33:52,296
I just had a quick
question on what you think

683
00:33:52,329 --> 00:33:55,466
Cassini will encounter as
it goes through the gap.

684
00:33:55,499 --> 00:34:00,004
Have you done statistical
analysis that it could get hit?

685
00:34:00,037 --> 00:34:02,006
I mean, is there a
percentage chance

686
00:34:02,039 --> 00:34:03,908
that it will just be lost?

687
00:34:03,941 --> 00:34:06,310
And if it is lost,
is there gonna

688
00:34:06,343 --> 00:34:08,646

be any contamination issues
or is it all just gonna

689
00:34:08,679 --> 00:34:11,615
eventually fall into
the planet anyway?

690
00:34:11,648 --> 00:34:13,517
- I think that one's mine.

691
00:34:13,550 --> 00:34:16,654
We've done a lot of modeling,
and what we believe,

692
00:34:16,687 --> 00:34:19,423
we've done, we've gone
through the rings,

693
00:34:19,456 --> 00:34:21,759
other diaphanous rings of Saturn

694
00:34:21,792 --> 00:34:23,661
and we expect a lot of impacts.

695
00:34:23,694 --> 00:34:25,529
Very light wake
impacts more like going

696
00:34:25,562 --> 00:34:28,032
through smoke than particles.

697
00:34:28,065 --> 00:34:30,301
Every now and then we'll see
a slightly higher impact,

698
00:34:30,334 --> 00:34:32,837
but still very small material.

699
00:34:34,004 --> 00:34:36,908

We believe that the
ring, the D ring,

700
00:34:38,275 --> 00:34:40,478
which is the one that's
slowly extending into Saturn,

701
00:34:40,511 --> 00:34:42,213
at the point where
we're going through is,

702
00:34:42,246 --> 00:34:45,650
is diffuse enough that
we should be fine.

703
00:34:47,151 --> 00:34:49,386
Nevertheless, you
do that 22 times,

704
00:34:49,419 --> 00:34:53,424
and we have a probability
of losing the spacecraft

705
00:34:53,457 --> 00:34:57,628
of slightly under 99%, I'm
sorry, slightly over 1%.

706
00:34:59,496 --> 00:35:01,198
(audience laughing)

707
00:35:01,231 --> 00:35:04,635
Let me make myself
perfectly clear.

708
00:35:04,668 --> 00:35:07,839
98.8% chance of
being successful.

709
00:35:09,039 --> 00:35:11,475
Our most conservative,

most dire models

710
00:35:11,508 --> 00:35:13,811
where all the engineers
awfulize everything,

711
00:35:13,844 --> 00:35:16,080
put us at 97%.

712
00:35:16,113 --> 00:35:19,016
We would never take
a flagship mission

713
00:35:19,049 --> 00:35:22,386
on that kind of course in
any other time of the mission

714
00:35:22,419 --> 00:35:25,089
except when it's about to end.

715
00:35:25,122 --> 00:35:29,226
Once we've flown by Titan,
T-126 is its nomenclature,

716
00:35:29,259 --> 00:35:31,829
it's really our
127th Titan flyby,

717
00:35:31,862 --> 00:35:33,998
in April, Cassini is essentially

718
00:35:34,031 --> 00:35:37,835
on a ballistic
trajectory into Saturn.

719
00:35:37,868 --> 00:35:40,237
Because of those orbits
that Joannie showed you,

720

00:35:40,270 --> 00:35:43,607
Titan's still there, and we
can't, even if we wanted to,

721
00:35:43,640 --> 00:35:45,576
can't avoid it enough
to not have it put us

722
00:35:45,609 --> 00:35:48,245
into Saturn September 15th.

723
00:35:48,278 --> 00:35:52,183
So even if we do lose the
spacecraft completely,

724
00:35:52,216 --> 00:35:54,318
the science is
gone, but any issues

725
00:35:54,351 --> 00:35:58,089
of contaminating Titan
or Enceladus are moot.

726
00:35:59,156 --> 00:36:01,258
- I think we had
a question here.

727
00:36:01,291 --> 00:36:03,527
- Emily Lakdawalla from
the Planetary Society.

728
00:36:03,560 --> 00:36:05,162
Thank you for a
wonderful mission.

729
00:36:05,195 --> 00:36:08,032
My professional career
began reporting on Cassini,

730
00:36:08,065 --> 00:36:10,100

so it's been quite a
journey for me too.

731
00:36:10,133 --> 00:36:12,403
I have questions for
Linda and for Joan.

732
00:36:12,436 --> 00:36:15,039
For Linda, I'm wondering
if you can tell me

733
00:36:15,072 --> 00:36:17,441
what questions
Cassini has raised

734
00:36:17,474 --> 00:36:20,044
that you couldn't possibly
answer with Cassini,

735
00:36:20,077 --> 00:36:22,179
that you need to
do something else

736
00:36:22,212 --> 00:36:24,281
in order to answer
those questions.

737
00:36:24,314 --> 00:36:26,317
- Oh, there's a large
number of questions

738
00:36:26,350 --> 00:36:28,452
that Cassini has raised,
and I'll just highlight

739
00:36:28,485 --> 00:36:29,820
a couple of them.

740
00:36:29,853 --> 00:36:32,456
One has to do with the

tiny moon Enceladus.

741
00:36:32,489 --> 00:36:35,059
We thought this tiny moon
would be frozen solid

742
00:36:35,092 --> 00:36:37,695
and inactive, and
what a surprise

743
00:36:37,728 --> 00:36:40,531
to find not only
geysers of water vapor

744
00:36:40,564 --> 00:36:44,034
and water particles coming
out, but to find organics,

745
00:36:44,067 --> 00:36:47,471
a salty global ocean
underneath the icy crust,

746
00:36:47,504 --> 00:36:50,874
and even the possibility
of hydrothermal vents.

747
00:36:50,907 --> 00:36:53,477
The conditions that
could be right for life.

748
00:36:53,510 --> 00:36:55,713
To find an ocean
world that small

749
00:36:55,746 --> 00:36:57,181
with conditions right for life.

750
00:36:57,214 --> 00:36:59,316
And then, of course,
Titan's surface, seeing it

751
00:36:59,349 --> 00:37:02,586
for the first time, seeing
the methane lakes and seas,

752
00:37:02,619 --> 00:37:05,022
understanding that
clouds form with methane,

753
00:37:05,055 --> 00:37:08,158
it rains methane, to
understand and see that surface

754
00:37:08,191 --> 00:37:10,494
was really a complete surprise.

755
00:37:10,527 --> 00:37:12,363
Voyager just saw a fuzzy ball,

756
00:37:12,396 --> 00:37:14,598
and it took the Huygens
Probe and Cassini

757
00:37:14,631 --> 00:37:17,001
to reveal that incredible world.

758
00:37:17,034 --> 00:37:19,937
And then each of the moons
have gone from pinpoints

759
00:37:19,970 --> 00:37:22,373
of light, or in some cases
some pretty good data

760
00:37:22,406 --> 00:37:25,609
back from Voyager, to
worlds in their own right.

761
00:37:25,642 --> 00:37:27,745

We have red streaks on Tethys.

762
00:37:27,778 --> 00:37:29,913
We have interesting
fractures on Dione.

763
00:37:29,946 --> 00:37:32,716
We wonder if Dione too
might have been active

764
00:37:32,749 --> 00:37:35,919
or be active at some
level, so many questions.

765
00:37:35,952 --> 00:37:38,022
And then this water-filled
magnetosphere.

766
00:37:38,055 --> 00:37:39,590
That wasn't expected
because, of course,

767
00:37:39,623 --> 00:37:42,760
the source of the water
is Enceladus itself.

768
00:37:42,793 --> 00:37:44,928
And then for the planet,
there's still questions

769
00:37:44,961 --> 00:37:47,531
about the atmosphere, we
haven't had a probe yet

770
00:37:47,564 --> 00:37:49,867
into Saturn's atmosphere,
so a future mission

771
00:37:49,900 --> 00:37:52,169
might go deep into

Saturn's atmosphere,

772
00:37:52,202 --> 00:37:54,772
as we did with the
Galileo probe at Jupiter

773
00:37:54,805 --> 00:37:56,173
to better understand it.

774
00:37:56,206 --> 00:37:58,876
So you've got the
planet, Enceladus, Titan,

775
00:37:58,909 --> 00:38:03,280
many places to go back
with another mission.

776
00:38:03,313 --> 00:38:07,451
- Jim Green, did you want
to chime in on that at all?

777
00:38:08,852 --> 00:38:11,255
- Yes, I did.
(audience laughing)

778
00:38:11,288 --> 00:38:14,892
Let me also mention that we
have released an announcement

779
00:38:14,925 --> 00:38:17,695
of opportunity
called New Frontiers

780
00:38:17,728 --> 00:38:21,832
that allows further
exploration of Enceladus,

781
00:38:21,865 --> 00:38:23,134
but also Titan.

782
00:38:24,568 --> 00:38:27,705
Titan is a fabulous world,
I think really surprised

783
00:38:27,738 --> 00:38:30,441
so many of us, because
as I mentioned,

784
00:38:30,474 --> 00:38:32,876
it's Earth-like in the
sense that it has liquid

785
00:38:32,909 --> 00:38:36,414
on its surface, it has
a cycle of methane,

786
00:38:37,814 --> 00:38:42,486
much like our water cycle,
and it has plenty of organics,

787
00:38:42,519 --> 00:38:46,457
but it is so cold and
methane being the liquid,

788
00:38:47,691 --> 00:38:50,494
brings up the question
of a different

789
00:38:50,527 --> 00:38:52,797
potential life environment.

790
00:38:54,598 --> 00:38:57,268
Maybe Titan holds us in question

791
00:38:58,869 --> 00:39:02,806
about how we view life
as being DNA based.

792
00:39:02,839 --> 00:39:06,610

Perhaps it's based on a
completely different system.

793
00:39:06,643 --> 00:39:09,980
And Titan might be able
to give us that hint

794
00:39:10,013 --> 00:39:13,183
or that view into an environment

795
00:39:13,216 --> 00:39:16,320
that's so different
but still could support

796
00:39:16,353 --> 00:39:18,455
fascinating types of life.

797
00:39:18,488 --> 00:39:21,825
We call that field of
research Weird Life.

798
00:39:21,858 --> 00:39:26,663
And that's a gateway to what
we might find for exoplanets.

799
00:39:26,696 --> 00:39:30,467
So indeed, there's
plenty left to do.

800
00:39:30,500 --> 00:39:32,536
- Thanks a lot, Jim, we're
gonna go to the phones now.

801
00:39:32,569 --> 00:39:36,741
I think we have Bill Harwood
on the line from CBS News.

802
00:39:38,708 --> 00:39:40,378
Bill, are you there?

803
00:39:41,778 --> 00:39:45,750
All right, I think we also have
Traci Watson from USA Today.

804
00:39:47,150 --> 00:39:48,385
- [Bill] Oh I'm here,
I'm here, do you hear me?

805
00:39:48,418 --> 00:39:50,754
- That's Bill, there's
Bill, go ahead, Bill.

806
00:39:50,787 --> 00:39:53,724
- (laughing) Sorry about that,
my daughter had just rung in.

807
00:39:53,757 --> 00:39:54,958
(audience laughing)

808
00:39:54,991 --> 00:39:57,294
Can you, I'd like to ask
Earl about the details

809
00:39:57,327 --> 00:39:59,029
of the encounter, I'm
curious how much fuel

810
00:39:59,062 --> 00:40:02,266
Cassini still has going
in to the final flyby,

811
00:40:02,299 --> 00:40:05,969
how much fuel, is any
fuel needed after that?

812
00:40:06,002 --> 00:40:07,938
Give me a little bit of
a look at any maneuvers

813

00:40:07,971 --> 00:40:11,008
that are planned, and
during the crossings itself,

814
00:40:11,041 --> 00:40:14,044
I heard the velocity
is 76,000 miles an hour

815
00:40:14,077 --> 00:40:15,512
or kilometers per hour,
I'm not sure which,

816
00:40:15,545 --> 00:40:17,881
they're both big numbers, what
does that do with imaging?

817
00:40:17,914 --> 00:40:20,551
I mean, where are you doing
imaging on these flybys

818
00:40:20,584 --> 00:40:23,787
and what's sorts of
resolution can you achieve?

819
00:40:23,820 --> 00:40:25,022
Thanks.

820
00:40:25,055 --> 00:40:26,890
- Okay, Jim, I'm gonna
punt that first part

821
00:40:26,923 --> 00:40:28,192
of that question
to Julie Webster,

822
00:40:28,225 --> 00:40:32,329
so while the microphone
is coming up to Julie,

823
00:40:32,362 --> 00:40:33,797

I don't know
exactly where it go,

824
00:40:33,830 --> 00:40:36,333
I'll tell you a little bit about
that 76,000 miles per hour.

825
00:40:36,366 --> 00:40:39,136
It smears the dickens
out of the images.

826
00:40:39,169 --> 00:40:41,638
So we really can't take
images right up that close.

827
00:40:41,671 --> 00:40:43,640
We have to be a
little further away.

828
00:40:43,673 --> 00:40:45,509
But to answer some of
the prop questions,

829
00:40:45,542 --> 00:40:47,511
I'm gonna put this
on to the spacecraft

830
00:40:47,544 --> 00:40:51,148
operations manager,
Julie Webster.

831
00:40:51,181 --> 00:40:54,084
- Okay, I had the funny
feeling that was looking up,

832
00:40:54,117 --> 00:40:56,253
so while you were doing the
Eyes on the Solar System

833
00:40:56,286 --> 00:40:59,723

I looked up Todd Barber's
last prop report.

834
00:40:59,756 --> 00:41:04,261
We've got about 36
kilograms of hydrazine left.

835
00:41:04,294 --> 00:41:06,430
Those are the little thrusters.

836
00:41:06,463 --> 00:41:10,100
And that's about where we
want it to be to finish up,

837
00:41:10,133 --> 00:41:11,869
because we use a
lot of hydrazine,

838
00:41:11,902 --> 00:41:16,073
we use hydrazine every day
to keep the reaction wheels

839
00:41:18,441 --> 00:41:21,445
spun to the right place
and then we also use them,

840
00:41:21,478 --> 00:41:24,548
we'll use them for
the Titan 126 flyby

841
00:41:24,581 --> 00:41:27,117
when we got by a 979 kilometers.

842
00:41:27,150 --> 00:41:31,322
We'll use about 10 to 15
kilos of that 36 that's left.

843
00:41:34,324 --> 00:41:37,261
And I'm gonna fudge Todd's
numbers here a little bit,

844
00:41:37,294 --> 00:41:40,297
because this is the,
the big question is,

845
00:41:40,330 --> 00:41:42,733
the fuel, the bi-propellants,

846
00:41:42,766 --> 00:41:47,104
the monomethylhydrazine
and the nitrogen tetroxide.

847
00:41:47,137 --> 00:41:51,308
There's about 10 plus
or minus 20 (laughing)

848
00:41:53,910 --> 00:41:57,180
kilos of the fuel left,
and that's the one

849
00:41:57,213 --> 00:41:59,616
that we're worried
about the most.

850
00:41:59,649 --> 00:42:03,253
We could be out today,
we could have 30 kilos.

851
00:42:03,286 --> 00:42:04,755
The oxidizer's a
little bit more,

852
00:42:04,788 --> 00:42:08,492
the oxidizer's running
about 25 plus or minus

853
00:42:08,525 --> 00:42:11,529
that same 20, and
so there's no more

854
00:42:12,429 --> 00:42:14,932
main engine maneuvers planned.

855
00:42:15,765 --> 00:42:17,401
We may need one at the end,

856
00:42:17,434 --> 00:42:19,336
but there's no more main
engine maneuvers planned.

857
00:42:19,369 --> 00:42:22,406
We are doing maneuvers
prior to T-126,

858
00:42:22,439 --> 00:42:24,841
three days before
and three days after,

859
00:42:24,874 --> 00:42:27,945
and hopefully that'll
be done on hydrazine.

860
00:42:27,978 --> 00:42:29,346
- Thanks, Julie, appreciate it.

861
00:42:29,379 --> 00:42:31,448
We have another call
from Traci Watson

862
00:42:31,481 --> 00:42:33,917
at USA Today, I believe.

863
00:42:33,950 --> 00:42:35,919
- [Traci] Yes, thanks,
can you hear me?

864
00:42:35,952 --> 00:42:37,421
- We can, thanks.

865
00:42:37,454 --> 00:42:40,791
- [Traci] Great, can you talk
about how close you'll come

866
00:42:40,824 --> 00:42:43,527
to the planet itself
before you plunge

867
00:42:43,560 --> 00:42:47,598
into the atmosphere,
how big the gap is

868
00:42:47,631 --> 00:42:49,366
between the D ring
and the planet,

869
00:42:49,399 --> 00:42:52,302
and how hard it is
to target that gap?

870
00:42:52,335 --> 00:42:55,272
That would be great, thanks.

871
00:42:55,305 --> 00:42:58,842
- Well, Traci, the
last five orbits,

872
00:42:58,875 --> 00:43:02,179
first of all, Saturn's
atmosphere has been

873
00:43:02,212 --> 00:43:04,481
not an easy thing to nail down.

874
00:43:04,514 --> 00:43:06,683
It's been moving back and forth.

875
00:43:06,716 --> 00:43:08,952
We once thought we

were going to actually

876
00:43:08,985 --> 00:43:11,221
be too close and have
to fight with it.

877
00:43:11,254 --> 00:43:12,923
Then it's kind of moved back in

878
00:43:12,956 --> 00:43:14,591
and we thought we'd
have to dive back closer

879
00:43:14,624 --> 00:43:16,693
to get a sample, now
it's back in the middle

880
00:43:16,726 --> 00:43:19,162
of those two places.

881
00:43:19,195 --> 00:43:20,697
Relative to how
close we're getting,

882
00:43:20,730 --> 00:43:23,300
we expect the final five
orbits to actually be

883
00:43:23,333 --> 00:43:25,802
within the sensible atmosphere
and be sampling of it.

884
00:43:25,835 --> 00:43:29,940
And, of course, the sixth
orbit will be way in the side.

885
00:43:29,973 --> 00:43:32,909
The gap is about
1,200 kilometers.

886
00:43:32,942 --> 00:43:35,879
Sorry, 1,200 miles,
you'll hear 1,500

887
00:43:35,912 --> 00:43:37,981
or something like
that, but I hold

888
00:43:38,014 --> 00:43:40,751
project manager's reserve
on both ends of that

889
00:43:40,784 --> 00:43:42,552
in order to keep
us out of trouble.

890
00:43:42,585 --> 00:43:45,189
So the gap's about 1,250 miles.

891
00:43:47,957 --> 00:43:52,796
The navigation of that is
actually pretty straightforward.

892
00:43:52,829 --> 00:43:55,565
We have that system, the
navigators, I should say,

893
00:43:55,598 --> 00:43:58,168
I'll use the royal we
here, have that system

894
00:43:58,201 --> 00:44:02,072
so well calibrated and
the gravitational forces,

895
00:44:02,105 --> 00:44:04,574
the dynamics of the
spacecraft and Saturn

896

00:44:04,607 --> 00:44:07,344
and its moons that that
trajectory, if we don't fiddle

897
00:44:07,377 --> 00:44:10,414
around with it, is
really pretty rock solid.

898
00:44:10,447 --> 00:44:14,584
The most concern we'll,
we may be a handful

899
00:44:14,617 --> 00:44:17,487
of kilometers off
in altitude on each

900
00:44:17,520 --> 00:44:20,958
of those passages
through the ring plane.

901
00:44:23,393 --> 00:44:26,029
Little bit more uncertain on
when we're gonna pass through.

902
00:44:26,062 --> 00:44:27,597
That might be on the
order of a few tens

903
00:44:27,630 --> 00:44:30,033
to a few hundreds of kilometers,
but that doesn't matter

904
00:44:30,066 --> 00:44:31,968
anywhere near as much
for health and safety

905
00:44:32,001 --> 00:44:35,105
as it does where we
are between the rings.

906

00:44:35,138 --> 00:44:36,773
- Let me add that
the navigation system

907
00:44:36,806 --> 00:44:38,709
is absolutely incredible.

908
00:44:38,742 --> 00:44:41,511
We have flown within
25 miles or so

909
00:44:41,544 --> 00:44:44,347
of the surface of Enceladus,
actually through the geysers.

910
00:44:44,380 --> 00:44:47,017
And it's just
incredible so, hey,

911
00:44:47,050 --> 00:44:49,386
1,200 miles, that's nothing.

912
00:44:49,419 --> 00:44:50,687
(audience laughing)

913
00:44:50,720 --> 00:44:52,122
- All right, let's go
to social media now.

914
00:44:52,155 --> 00:44:54,357
Stephanie Smith from our
social media team standing by.

915
00:44:54,390 --> 00:44:55,625
Steph, what do we have?

916
00:44:55,658 --> 00:44:58,195
- We've got a lot of
outpouring of emotion,

917
00:44:58,228 --> 00:45:00,464
a lot of fans of
Cassini on line,

918
00:45:00,497 --> 00:45:02,399
many of whom who've
come to know the mission

919
00:45:02,432 --> 00:45:04,568
through the photos
that it's taken.

920
00:45:04,601 --> 00:45:07,003
And Misra on Twitter
would like to know,

921
00:45:07,036 --> 00:45:09,873
in your opinion, what's the
most stunning picture taken

922
00:45:09,906 --> 00:45:11,408
by Cassini so far?

923
00:45:12,876 --> 00:45:15,212
- I think for me, one
of my favorite pictures

924
00:45:15,245 --> 00:45:18,248
and I think the most stunning
is the back lit Saturn,

925
00:45:18,281 --> 00:45:20,851
that picture where Saturn
is covering up the Sun

926
00:45:20,884 --> 00:45:24,621
and you see the rings blazing
in all of their glory.

927

00:45:24,654 --> 00:45:26,957
You see actually a ring
of light around the planet

928
00:45:26,990 --> 00:45:28,925
as the sunlight refracts
through the atmosphere

929
00:45:28,958 --> 00:45:32,329
and it's just not only a
stunning picture scientifically,

930
00:45:32,362 --> 00:45:35,165
but also very beautiful,
and if you look carefully,

931
00:45:35,198 --> 00:45:37,701
you'll find the
Earth, Mars and Venus

932
00:45:37,734 --> 00:45:39,737
in that picture as well.

933
00:45:41,104 --> 00:45:44,708
- She stole my answer,
that's my favorite one too.

934
00:45:44,741 --> 00:45:47,478
It's the background
on my laptop.

935
00:45:48,812 --> 00:45:52,015
- So both Artem on Facebook
and Lars on Twitter

936
00:45:52,048 --> 00:45:54,484
are wondering about the
detail of the imagery

937
00:45:54,517 --> 00:45:57,587

that we're gonna see
during the Grand Finale.

938
00:45:57,620 --> 00:45:59,222
What scale are we talking about?

939
00:45:59,255 --> 00:46:03,193
What size ring particles
could Cassini resolve?

940
00:46:03,226 --> 00:46:05,428
- When we're in very close
we could probably see

941
00:46:05,461 --> 00:46:09,266
ring particles on the
order of a kilometer or so.

942
00:46:09,299 --> 00:46:11,535
Or maybe a little bit bigger.

943
00:46:11,568 --> 00:46:13,270
And there will probably be
clumps of ring particles.

944
00:46:13,303 --> 00:46:14,938
But it's tricky
because there's a lot

945
00:46:14,971 --> 00:46:17,140
of ring particles around it
and a lot of scattered light,

946
00:46:17,173 --> 00:46:19,376
but the bigger ring
particles tend to sort of

947
00:46:19,409 --> 00:46:21,444
shoulder the other
particles out of the way,

948
00:46:21,477 --> 00:46:24,181
opening up a gap, we
call it a propeller gap.

949
00:46:24,214 --> 00:46:26,783
So maybe we'll see a
propeller parent or two

950
00:46:26,816 --> 00:46:29,419
in the Grand Finale orbits.

951
00:46:29,452 --> 00:46:31,488
- And one final
one for this batch,

952
00:46:31,521 --> 00:46:34,724
at what distance above
Saturn before the finale

953
00:46:34,757 --> 00:46:37,327
will we receive any last photos,

954
00:46:37,360 --> 00:46:40,397
and how long will it
take for us to get them?

955
00:46:40,430 --> 00:46:42,232
- Well, actually we're gonna
be getting our last photos

956
00:46:42,265 --> 00:46:46,136
a fairly great distance away,
basically several hours,

957
00:46:46,169 --> 00:46:48,104
or 12 hours before
we're actually gonna

958

00:46:48,137 --> 00:46:50,040
point the high-gain
antenna at the Earth

959
00:46:50,073 --> 00:46:51,842
and just sit in
that configuration,

960
00:46:51,875 --> 00:46:54,110
and that will be the end
of sending any images.

961
00:46:54,143 --> 00:46:55,745
Other data will
continue to come back,

962
00:46:55,778 --> 00:46:57,080
iron and neutral
mass spectrometers,

963
00:46:57,113 --> 00:46:59,316
field and particles, so
you're looking at maybe

964
00:46:59,349 --> 00:47:02,219
half a day or more out,
maybe even a day out

965
00:47:02,252 --> 00:47:03,887
for the last pictures.

966
00:47:03,920 --> 00:47:06,223
We are gonna take a
really beautiful mosaic

967
00:47:06,256 --> 00:47:09,025
of the planet and the
rings in that final day

968
00:47:09,058 --> 00:47:10,527

of the mission.

969
00:47:10,560 --> 00:47:13,864
- And what's the
one way lag time?

970
00:47:13,897 --> 00:47:16,600
- [Earl] About an
hour, about 80 minutes.

971
00:47:16,633 --> 00:47:20,303
- Jim, I think you're gonna
be out here at JPL with us,

972
00:47:20,336 --> 00:47:24,508
excitedly waiting for those
images as well, right?

973
00:47:25,842 --> 00:47:28,812
- Oh, absolutely, you
couldn't tear me away.

974
00:47:28,845 --> 00:47:31,681
But I did want to make
mention of what I think

975
00:47:31,714 --> 00:47:35,085
is my favorite image, and
there are so many of them.

976
00:47:35,118 --> 00:47:38,855
It's really one where
we had a fabulous view

977
00:47:38,888 --> 00:47:42,993
of Enceladus and a detailed
look at the geysers.

978
00:47:43,026 --> 00:47:46,730
And what surprised

me immediately is

979
00:47:46,763 --> 00:47:50,934
in the dark portion, we
could see material coming up,

980
00:47:52,468 --> 00:47:55,105
indicating that it's
not just a geyser,

981
00:47:55,138 --> 00:47:58,976
but a literal wall of
water leaving that body,

982
00:48:00,977 --> 00:48:02,479
flying into space.

983
00:48:03,947 --> 00:48:07,651
This means these cracks
all along the entire length

984
00:48:07,684 --> 00:48:10,787
are very active,
pouring liquid water

985
00:48:11,921 --> 00:48:15,258
and other elements
that's in that ocean,

986
00:48:15,291 --> 00:48:16,960
out for us to taste.

987
00:48:18,328 --> 00:48:20,830
This gives us a
great feeling about

988
00:48:20,863 --> 00:48:25,669
potentially sampling those
plumes with future mission.

989
00:48:25,702 --> 00:48:28,538
You know, Enceladus
really was to me

990
00:48:28,571 --> 00:48:32,809
that first ocean world
that got us thinking

991
00:48:32,842 --> 00:48:36,847
about a brand new paradigm
of where bodies could

992
00:48:38,247 --> 00:48:42,018
be habitable for life
well beyond our knowledge

993
00:48:42,051 --> 00:48:44,688
of our terrestrial planets.

994
00:48:44,721 --> 00:48:48,892
So it's just an exciting
image every time I see it.

995
00:48:50,193 --> 00:48:51,761
- Thanks, Jim, back
here in the room,

996
00:48:51,794 --> 00:48:54,397
any other reporters
with questions?

997
00:48:54,430 --> 00:48:57,767
Hands raised, in the back there.

998
00:48:57,800 --> 00:49:00,404
Wait for the mic, if you would.

999
00:49:04,340 --> 00:49:06,276
- Paul Vercammen, CNN,

based on the success

1000
00:49:06,309 --> 00:49:09,346
of Cassini-Huygens,
any missions that you

1001
00:49:09,379 --> 00:49:11,314
never envisioned decades ago

1002
00:49:11,347 --> 00:49:15,018
that you now think
might be possible?

1003
00:49:15,051 --> 00:49:17,053
- Oh, lots of
possibilities there.

1004
00:49:17,086 --> 00:49:20,090
Certainly a mission to
Enceladus, perhaps to orbit,

1005
00:49:20,123 --> 00:49:24,094
maybe even land and go into
one of the cracks on Enceladus.

1006
00:49:24,127 --> 00:49:27,030
A lake lander on Titan,
to take a craft down

1007
00:49:27,063 --> 00:49:29,032
and land in one of
the lakes or seas

1008
00:49:29,065 --> 00:49:31,968
and actually look for
a possibility of life

1009
00:49:32,001 --> 00:49:34,437
that we couldn't
have even imagined.

1010
00:49:34,470 --> 00:49:36,306
So those are just two.

1011
00:49:39,208 --> 00:49:40,944
- I think we have another
call on the phone.

1012
00:49:40,977 --> 00:49:43,179
I think we have Dave Mosher
from Business Insider.

1013
00:49:43,212 --> 00:49:45,215
Dave, are you there?

1014
00:49:45,248 --> 00:49:46,649
- [Dave] Yes, I'm
here, can you hear me?

1015
00:49:46,682 --> 00:49:47,851
- We sure can.

1016
00:49:49,018 --> 00:49:50,320
- [Dave] Great, I
have a mean question

1017
00:49:50,353 --> 00:49:52,155
and a follow up
question to that.

1018
00:49:52,188 --> 00:49:55,158
As I understand it,
plutonium-238 and radioactive

1019
00:49:55,191 --> 00:49:57,961
isotope power sources made
this mission possible.

1020
00:49:57,994 --> 00:50:00,563

Earl, first of all, I'd
just love if you could

1021
00:50:00,596 --> 00:50:03,299
speak to that a
little bit and how

1022
00:50:03,332 --> 00:50:06,503
that technology made
this mission possible.

1023
00:50:06,536 --> 00:50:09,406
And as I also understand
it, the Department

1024
00:50:09,439 --> 00:50:12,042
of Energy is
producing plutonium,

1025
00:50:12,075 --> 00:50:14,411
and I've spoken with those
people, but it seems like

1026
00:50:14,444 --> 00:50:17,414
that program is a few
years behind schedule.

1027
00:50:17,447 --> 00:50:19,315
Jim, I was curious
if that might hamper

1028
00:50:19,348 --> 00:50:21,785
the announcement of opportunity
you were talking about

1029
00:50:21,818 --> 00:50:25,155
for the Titan Enceladus
mission, thanks.

1030
00:50:26,355 --> 00:50:29,025

- Well, I'll let Jim
answer the second part,

1031
00:50:29,058 --> 00:50:32,462
as you appropriately
pointed out, that's his,

1032
00:50:32,495 --> 00:50:36,666
but yeah, the RTGs, or
radioisotope thermal generators

1033
00:50:37,967 --> 00:50:40,570
for Cassini absolutely
enabled the mission.

1034
00:50:40,603 --> 00:50:43,506
We could not have carried
the kind of attitude

1035
00:50:43,539 --> 00:50:46,876
control system that
would have been required

1036
00:50:46,909 --> 00:50:48,545
if we had solar panels.

1037
00:50:48,578 --> 00:50:50,447
We've often been quoted as
saying that solar panels

1038
00:50:50,480 --> 00:50:52,482
would be the size
of football fields.

1039
00:50:52,515 --> 00:50:54,451
That's probably not a
little bit of a hyperbole,

1040
00:50:54,484 --> 00:50:56,252
but it's not far

off, and to try to do

1041
00:50:56,285 --> 00:50:58,088
what we've done
with this spacecraft

1042
00:50:58,121 --> 00:50:59,823
with all these fixed parts,

1043
00:50:59,856 --> 00:51:01,624
it just would not
have been conceivable.

1044
00:51:01,657 --> 00:51:04,594
So they essentially
enabled the mission.

1045
00:51:04,627 --> 00:51:06,529
I know that Europa's
going to use solar panels

1046
00:51:06,562 --> 00:51:08,832
at Jupiter and Juno is
doing that right now,

1047
00:51:08,865 --> 00:51:13,269
but at 10 AU, it is so, it's
a hundredth the Sun out there,

1048
00:51:13,302 --> 00:51:15,371
and we just didn't have
any other alternative.

1049
00:51:15,404 --> 00:51:18,708
And frankly, the RTGs
are still going strong.

1050
00:51:18,741 --> 00:51:22,712
We have enough power for
another decade at least,

1051
00:51:22,745 --> 00:51:25,482
but we don't have
the propellant.

1052
00:51:26,782 --> 00:51:29,519
And Jim, the second
part's yours.

1053
00:51:31,521 --> 00:51:35,158
- Okay, so indeed we work
with the Department of Energy,

1054
00:51:35,191 --> 00:51:38,528
which manages the
stockpile of radioisotopes

1055
00:51:38,561 --> 00:51:41,331
for the country, and
in that stockpile

1056
00:51:41,364 --> 00:51:43,800
is a significant
amount of plutonium.

1057
00:51:43,833 --> 00:51:47,070
Not only for our next
mission, which we'll need

1058
00:51:47,103 --> 00:51:51,474
plutonium-238, which
is the Mars 2020 rover

1059
00:51:51,507 --> 00:51:55,378
that will launch in
2020, land in '21,

1060
00:51:55,411 --> 00:51:57,414
to core samples on Mars,

1061
00:51:59,615 --> 00:52:02,018
but also it's enough
for us to be able

1062
00:52:02,051 --> 00:52:03,920
in our announcement
of opportunity

1063
00:52:03,953 --> 00:52:06,123
for the New Frontiers set,

1064
00:52:07,323 --> 00:52:11,060
to be able to offer
radioisotope power.

1065
00:52:11,093 --> 00:52:13,029
Our work with
Department of Energy

1066
00:52:13,062 --> 00:52:15,064
is going extremely well.

1067
00:52:15,097 --> 00:52:17,634
They're just a
wonderful partner.

1068
00:52:17,667 --> 00:52:19,769
And indeed, we've been
approved by Congress

1069
00:52:19,802 --> 00:52:21,571
and the administration
to move forward

1070
00:52:21,604 --> 00:52:24,240
with making
additional plutonium.

1071
00:52:24,273 --> 00:52:27,610

So that means between NASA
and Department of Energy,

1072
00:52:27,643 --> 00:52:30,146
we are really going
to be good stewards

1073
00:52:30,179 --> 00:52:34,250
of the planetary program,
providing enough plutonium

1074
00:52:34,283 --> 00:52:36,653
for these missions I mentioned,

1075
00:52:36,686 --> 00:52:39,422
but many future
missions to come.

1076
00:52:40,590 --> 00:52:42,158
- Thanks, Jim, I think
we have a quick followup

1077
00:52:42,191 --> 00:52:46,129
from Traci Watson at USA
Today, go ahead, Traci.

1078
00:52:46,162 --> 00:52:48,164
- [Traci] Yes, thanks,
how long do you expect

1079
00:52:48,197 --> 00:52:51,000
the spacecraft to
last once it plunges

1080
00:52:51,033 --> 00:52:53,970
into the atmosphere
on the final rev?

1081
00:52:54,003 --> 00:52:56,839
And what are you going

to do to commemorate

1082
00:52:56,872 --> 00:52:58,408
or toast your mission?

1083
00:52:58,441 --> 00:52:59,309
Thanks.

1084
00:52:59,342 --> 00:53:02,345
(audience laughing)

1085
00:53:03,813 --> 00:53:05,715
- I think we're gonna,
the spacecraft is expected

1086
00:53:05,748 --> 00:53:09,819
to survive kind of intact
for about three minutes.

1087
00:53:09,852 --> 00:53:12,088
And then it will be
just disassociated

1088
00:53:12,121 --> 00:53:13,890
very soon thereafter.

1089
00:53:15,725 --> 00:53:19,429
As to the second question,
I'm gonna pass that one along.

1090
00:53:19,462 --> 00:53:21,497
- Yeah, I can imagine
that we'll be gathered

1091
00:53:21,530 --> 00:53:24,534
with our Cassini
family here at JPL,

1092
00:53:25,568 --> 00:53:27,337

waiting for that final moment.

1093
00:53:27,370 --> 00:53:29,272
And I think once
the signal is lost,

1094
00:53:29,305 --> 00:53:31,908
that heartbeat of
Cassini is gone.

1095
00:53:31,941 --> 00:53:34,744
I think there'll be a
tremendous cheer and applause

1096
00:53:34,777 --> 00:53:39,449
for the completion of an
absolutely incredible mission.

1097
00:53:39,482 --> 00:53:43,419
Hugs, tears, the kleenex
box'll get passed around.

1098
00:53:43,452 --> 00:53:45,822
And we'll just sort of
rejoice in being part

1099
00:53:45,855 --> 00:53:47,991
of such a wonderful mission.

1100
00:53:48,024 --> 00:53:49,892
- And there is a
laboratory policy

1101
00:53:49,925 --> 00:53:52,962
but maybe we'll find
something to toast with.

1102
00:53:52,995 --> 00:53:55,565
(audience laughing)

1103
00:53:55,598 --> 00:53:57,000
- All right, with that
we'll take one more question

1104
00:53:57,033 --> 00:53:58,935
from social media,
Steph, if you've got one.

1105
00:53:58,968 --> 00:54:01,037
- All right, this is
about the heritage

1106
00:54:01,070 --> 00:54:03,439
and legacy of Cassini.

1107
00:54:03,472 --> 00:54:05,441
Thomas Schuman on Twitter
would like to know,

1108
00:54:05,474 --> 00:54:08,611
what can we learn about
building future space probes

1109
00:54:08,644 --> 00:54:12,716
from the 20 years that
Cassini has been in space?

1110
00:54:14,150 --> 00:54:16,819
- Well, I think we can take
advantage of new technologies

1111
00:54:16,852 --> 00:54:19,055
and could build better
instruments now.

1112
00:54:19,088 --> 00:54:21,157
We can tailor the
kinds of instruments

1113

00:54:21,190 --> 00:54:23,293
for the science we'd
like to collect.

1114
00:54:23,326 --> 00:54:24,761
A good example is Enceladus.

1115
00:54:24,794 --> 00:54:27,430
If you want to go back,
fly through those plumes

1116
00:54:27,463 --> 00:54:29,832
and collect free
samples, you'd now know

1117
00:54:29,865 --> 00:54:32,435
what kinds of mass
spectrometers, what
kinds of instruments

1118
00:54:32,468 --> 00:54:35,305
that you'd want
to carry and just,

1119
00:54:36,605 --> 00:54:39,309
we can really build spacecraft,
NASA does a great job.

1120
00:54:39,342 --> 00:54:41,144
And they can last a long time.

1121
00:54:41,177 --> 00:54:42,545
So that's part of
the excitement.

1122
00:54:42,578 --> 00:54:44,647
The other two worlds,
Uranus and Neptune.

1123
00:54:44,680 --> 00:54:46,549

We need to visit
those, maybe we need

1124
00:54:46,582 --> 00:54:48,951
additional
Cassini-like spacecraft

1125
00:54:48,984 --> 00:54:52,955
to continue pushing out that
frontier in our solar system.

1126
00:54:52,988 --> 00:54:54,524
- And Jim, do you have
anything to add to that?

1127
00:54:54,557 --> 00:54:56,226
I imagine you would.

1128
00:54:58,094 --> 00:55:01,431
- I do indeed, right
now we are planning

1129
00:55:03,099 --> 00:55:05,802
a mission back to Jupiter.

1130
00:55:05,835 --> 00:55:08,871
It's called the Europa
Clipper, and it's one

1131
00:55:08,904 --> 00:55:12,008
that's now going to
interrogate Europa,

1132
00:55:12,041 --> 00:55:15,778
which is a very large
moon, it's about the size

1133
00:55:15,811 --> 00:55:20,016
of our own moon that has hardly
any craters on the surface.

1134
00:55:21,350 --> 00:55:23,753
We believe from
Hubble observations

1135
00:55:23,786 --> 00:55:26,289
that it also has plume material

1136
00:55:26,322 --> 00:55:29,225
where the ocean is
communicating with the surface.

1137
00:55:29,258 --> 00:55:32,495
This is just a tremendously
exciting mission.

1138
00:55:32,528 --> 00:55:35,398
But what we've done
with that mission,

1139
00:55:35,431 --> 00:55:38,468
because the radiation
environment around Europa

1140
00:55:38,501 --> 00:55:42,038
is so difficult is, we're
really taking a page

1141
00:55:42,071 --> 00:55:44,774
out of Cassini's
book, and that is,

1142
00:55:44,807 --> 00:55:48,812
we really understand
globally a lot about Titan.

1143
00:55:50,112 --> 00:55:52,682
Because of those
multiple flybys,

1144
00:55:52,715 --> 00:55:57,520
we understand the distribution
of the methane lakes,

1145
00:55:57,553 --> 00:56:00,990
its cloud structure,
it's not just a one pass,

1146
00:56:01,023 --> 00:56:05,328
but it's been multiple
passes, just like an orbiter.

1147
00:56:05,361 --> 00:56:09,632
And so for Europa, the
Europa Clipper mission,

1148
00:56:09,665 --> 00:56:13,669
we're going to orbit Jupiter,
but make multiple flybys

1149
00:56:13,702 --> 00:56:16,873
of Europa and get
that global picture.

1150
00:56:18,574 --> 00:56:21,677
So already we're
learning so many things

1151
00:56:21,710 --> 00:56:26,048
about Cassini that we could
use on other missions.

1152
00:56:26,081 --> 00:56:29,185
And there'll be more
like that to follow.

1153
00:56:29,218 --> 00:56:31,921
- If I might add
just a brief moment.

1154
00:56:31,954 --> 00:56:36,292
The Cassini, I believe, has
also revalidated the concept

1155
00:56:36,325 --> 00:56:38,528
of a flagship, a mission that is

1156
00:56:38,561 --> 00:56:40,830
absolutely bristling
with instruments.

1157
00:56:40,863 --> 00:56:43,065
We've covered the
entire spectrum,

1158
00:56:43,098 --> 00:56:45,268
from deep infrared
to far ultraviolet.

1159
00:56:45,301 --> 00:56:47,437
We have radar, we have
fuels and particles,

1160
00:56:47,470 --> 00:56:49,839
insouciant instrumentation,
and some of Cassini's

1161
00:56:49,872 --> 00:56:52,208
most surprising
results have come

1162
00:56:52,241 --> 00:56:55,945
from unexpected
places, and that value

1163
00:56:55,978 --> 00:56:58,347
of not knowing exactly
what you're going to find

1164

00:56:58,380 --> 00:57:01,651
but being ready for anything,
taking that technology

1165
00:57:01,684 --> 00:57:04,720
to the next level I think
is just absolutely critical.

1166
00:57:04,753 --> 00:57:08,491
It's expensive, but the
payoff is well worth it.

1167
00:57:08,524 --> 00:57:10,793
- All right, well, that's
all the time we have.

1168
00:57:10,826 --> 00:57:12,195
Thank you again to our speakers

1169
00:57:12,228 --> 00:57:13,930
and to Dr. Green
from Washington.

1170
00:57:13,963 --> 00:57:16,666
Thanks to everyone who
submitted questions.

1171
00:57:16,699 --> 00:57:19,101
More information about
Cassini's Grand Finale,

1172
00:57:19,134 --> 00:57:20,837
including links to the
graphics and videos

1173
00:57:20,870 --> 00:57:23,439
we shared with you here
is available online.

1174
00:57:23,472 --> 00:57:28,377

Go to
saturn.jpl.nasa.gov/grandfinale.

1175
00:57:28,410 --> 00:57:30,880
Head over there and look
under mission resources.

1176
00:57:30,913 --> 00:57:32,582
We'll also post a link
to an archive video

1177
00:57:32,615 --> 00:57:34,383
of this briefing
when it's available.