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1
00:00:11,589 --> 00:00:09,910
welcome

2
00:00:13,589 --> 00:00:11,599
to nasa headquarters my name is dwayne

3
00:00:14,910 --> 00:00:13,599
brown with the office of communications

4
00:00:17,990 --> 00:00:14,920
here at

5
00:00:20,470 --> 00:00:18,000
nasa this is part two

6
00:00:23,590 --> 00:00:20,480
of the new horizons story

7
00:00:25,189 --> 00:00:23,600
connection with the voyager 2 story

8
00:00:26,790 --> 00:00:25,199
in panel one

9
00:00:28,870 --> 00:00:26,800
you heard about

10
00:00:31,029 --> 00:00:28,880
the mission to distant pluto and the

11
00:00:33,510 --> 00:00:31,039
connection with the voyager 2

12
00:00:35,270 --> 00:00:33,520
now we hear the behind the scenes

13
00:00:40,310 --> 00:00:35,280

stories

14
00:00:42,950 --> 00:00:40,320
and also bring the present

15
00:00:44,470 --> 00:00:42,960
the past and the future together

16
00:00:46,310 --> 00:00:44,480
we'll take questions

17
00:00:47,830 --> 00:00:46,320
from our phone lines and from social

18
00:00:50,389 --> 00:00:47,840
media

19
00:00:52,389 --> 00:00:50,399
and get those questions in at hashtag

20
00:00:53,670 --> 00:00:52,399
ask nasa there's a lot of buzz about

21
00:00:56,069 --> 00:00:53,680
this mission

22
00:00:57,670 --> 00:00:56,079
and for the students out there

23
00:01:00,630 --> 00:00:57,680
these stories

24
00:01:02,069 --> 00:01:00,640
will certainly inspire you because one

25
00:01:04,149 --> 00:01:02,079
day you could

26
00:01:05,189 --> 00:01:04,159
really be a part and you are a part

27
00:01:07,990 --> 00:01:05,199
right now

28
00:01:10,070 --> 00:01:08,000
of the pluto story

29
00:01:11,429 --> 00:01:10,080
all of this information

30
00:01:14,510 --> 00:01:11,439
and more

31
00:01:19,109 --> 00:01:14,520
can be available at the website at

32
00:01:20,710 --> 00:01:19,119
www.nasa.gov slash new horizons

33
00:01:23,030 --> 00:01:20,720
i enjoy

34
00:01:25,030 --> 00:01:23,040
this type of panel because i don't have

35
00:01:26,710 --> 00:01:25,040
to drive the bus i can be a

36
00:01:28,149 --> 00:01:26,720
passenger

37
00:01:30,310 --> 00:01:28,159
so what i'm going to do here is

38
00:01:31,590 --> 00:01:30,320

introduce the facilitator for this panel

39
00:01:33,749 --> 00:01:31,600
discussion

40
00:01:35,590 --> 00:01:33,759
and i'm going to be very short with his

41
00:01:38,149 --> 00:01:35,600
introduction because his

42
00:01:41,270 --> 00:01:38,159
resume is just too extraordinary and too

43
00:01:43,109 --> 00:01:41,280
long and would take up too much time so

44
00:01:46,630 --> 00:01:43,119
without further ado i'm going to toss it

45
00:01:48,710 --> 00:01:46,640
to david greenspoon who is a senior

46
00:01:50,469 --> 00:01:48,720
scientist at the planetary science

47
00:01:52,310 --> 00:01:50,479
institute and was also the bloomberg

48
00:01:55,910 --> 00:01:52,320
nasa library of congress chair in

49
00:01:56,950 --> 00:01:55,920
astrobiology in 2012 through 2013. so

50
00:01:58,870 --> 00:01:56,960
david

51
00:02:01,030 --> 00:01:58,880
you're driving

52
00:02:02,550 --> 00:02:01,040
all right thank you very much duane and

53
00:02:04,389 --> 00:02:02,560
thank you all so much for coming out

54
00:02:05,830 --> 00:02:04,399
this afternoon

55
00:02:08,150 --> 00:02:05,840
i'd like to say hello to everybody

56
00:02:10,790 --> 00:02:08,160
watching on nasa tv and a special big

57
00:02:12,550 --> 00:02:10,800
hello to anybody watching live from the

58
00:02:14,630 --> 00:02:12,560
burning man festival which is going on

59
00:02:16,150 --> 00:02:14,640
right now

60
00:02:17,910 --> 00:02:16,160
and you know i'm sure you're have all

61
00:02:19,830 --> 00:02:17,920
having a great time out there in black

62
00:02:20,949 --> 00:02:19,840
rock city i hope you are but i got to

63
00:02:24,070 --> 00:02:20,959

tell you

64
00:02:26,070 --> 00:02:24,080
that being a young scientist at the jet

65
00:02:28,470 --> 00:02:26,080
propulsion laboratory

66
00:02:30,229 --> 00:02:28,480
during a voyager encounter with one of

67
00:02:31,830 --> 00:02:30,239
the planets of the outer solar system

68
00:02:34,630 --> 00:02:31,840
now that was a party

69
00:02:35,509 --> 00:02:34,640
and a mind-blowing experience and one

70
00:02:37,830 --> 00:02:35,519
that

71
00:02:40,470 --> 00:02:37,840
just is unforgettable and has stuck with

72
00:02:42,229 --> 00:02:40,480
and and changed all of us who who had

73
00:02:44,390 --> 00:02:42,239
the fortune the good fortune of being

74
00:02:46,710 --> 00:02:44,400
part of that all of the panelists here

75
00:02:48,710 --> 00:02:46,720
this afternoon with me we all got to

76
00:02:50,550 --> 00:02:48,720
know each other as young scientists

77
00:02:52,869 --> 00:02:50,560
during the time that voyager was

78
00:02:54,470 --> 00:02:52,879
traveling through the outer solar system

79
00:02:55,990 --> 00:02:54,480
and

80
00:02:57,990 --> 00:02:56,000
we are here to share a little bit of

81
00:03:00,070 --> 00:02:58,000
what that experience was like and how

82
00:03:02,149 --> 00:03:00,080
that experience has informed us both

83
00:03:04,790 --> 00:03:02,159
scientifically and personally as we

84
00:03:06,949 --> 00:03:04,800
approach the new horizons encounter with

85
00:03:08,309 --> 00:03:06,959
pluto next year

86
00:03:09,990 --> 00:03:08,319
now the thing about the outer solar

87
00:03:12,550 --> 00:03:10,000
system is that the missions take a long

88
00:03:14,630 --> 00:03:12,560

time just all planetary missions take a

89
00:03:16,630 --> 00:03:14,640
long time the planning the execution the

90
00:03:17,990 --> 00:03:16,640
data analysis afterwards but with the

91
00:03:20,710 --> 00:03:18,000
outer solar system you have a lot of

92
00:03:22,149 --> 00:03:20,720
travel time so these are

93
00:03:24,630 --> 00:03:22,159
you know just just the travel time to

94
00:03:27,270 --> 00:03:24,640
get out there it takes years to get out

95
00:03:30,710 --> 00:03:27,280
to the uh the distant planets and so

96
00:03:31,990 --> 00:03:30,720
these are long-term missions and

97
00:03:36,229 --> 00:03:32,000
you

98
00:03:38,149 --> 00:03:36,239
progresses during these missions and

99
00:03:39,990 --> 00:03:38,159
especially with something like voyager

100
00:03:42,309 --> 00:03:40,000
where there were several encounters

101
00:03:44,470 --> 00:03:42,319
separated by many years encounters that

102
00:03:46,710 --> 00:03:44,480
were brief frenzies of activity and

103
00:03:49,350 --> 00:03:46,720
excitement separated by the the more

104
00:03:51,910 --> 00:03:49,360
quiet distant years while while the the

105
00:03:53,910 --> 00:03:51,920
spacecraft was navigating the the

106
00:03:56,789 --> 00:03:53,920
isolation of space getting ready for the

107
00:03:58,710 --> 00:03:56,799
next encounter and we all i think had

108
00:04:00,630 --> 00:03:58,720
this feeling of of sort of traveling

109
00:04:02,309 --> 00:04:00,640
through our lives as voyager traveled

110
00:04:04,229 --> 00:04:02,319
through the outer solar system

111
00:04:07,350 --> 00:04:04,239
personally for me voyager was launched

112
00:04:10,390 --> 00:04:07,360
in 1977 the year i graduated high school

113
00:04:12,390 --> 00:04:10,400

and in 1979 i was an undergraduate

114
00:04:14,550 --> 00:04:12,400
research assistant for the voyager

115
00:04:17,749 --> 00:04:14,560
encounter the i think the coolest summer

116
00:04:20,310 --> 00:04:17,759
job anybody ever had at jpl working with

117
00:04:21,430 --> 00:04:20,320
the imaging team during the the jupiter

118
00:04:22,950 --> 00:04:21,440
encounter

119
00:04:24,469 --> 00:04:22,960
of voyager

120
00:04:31,110 --> 00:04:24,479
by

121
00:04:34,310 --> 00:04:31,120
which we're really here to talk about i

122
00:04:36,469 --> 00:04:34,320
was there as a postdoc so

123
00:04:38,310 --> 00:04:36,479
these encounters were of course they

124
00:04:41,270 --> 00:04:38,320
were scientific bonanzas but they were

125
00:04:43,110 --> 00:04:41,280
also gatherings of people who had gotten

126
00:04:45,430 --> 00:04:43,120
to know each other over the years and so

127
00:04:47,670 --> 00:04:45,440
they also took on the feeling of family

128
00:04:50,230 --> 00:04:47,680
reunions and you know some people

129
00:04:52,629 --> 00:04:50,240
weren't with us any longer by by neptune

130
00:04:53,430 --> 00:04:52,639
who had been with us at

131
00:04:55,510 --> 00:04:53,440
uh

132
00:04:58,230 --> 00:04:55,520
at jupiter there was a personal aspect

133
00:05:01,110 --> 00:04:58,240
relationships formed marriages people

134
00:05:03,670 --> 00:05:01,120
had babies and so there was this really

135
00:05:06,150 --> 00:05:03,680
growing sense of of a family gathering

136
00:05:08,310 --> 00:05:06,160
at each of these encounters in addition

137
00:05:11,270 --> 00:05:08,320
to the scientific excitement of the

138
00:05:13,029 --> 00:05:11,280

encounter so i'm going to set the stage

139
00:05:15,430 --> 00:05:13,039
here by showing you a few um

140
00:05:16,790 --> 00:05:15,440
semi-embarrassing snapshots of

141
00:05:18,550 --> 00:05:16,800
of all of us

142
00:05:20,390 --> 00:05:18,560
at that time the time of voyager and

143
00:05:21,670 --> 00:05:20,400
then i want to introduce my wonderful

144
00:05:24,629 --> 00:05:21,680
panelists here and we'll hear their

145
00:05:26,390 --> 00:05:24,639
perspectives both on voyager and on new

146
00:05:28,710 --> 00:05:26,400
horizons and that will sort of time

147
00:05:30,790 --> 00:05:28,720
travel through the intervening 25 years

148
00:05:31,510 --> 00:05:30,800
so this first picture

149
00:05:35,510 --> 00:05:31,520
is

150
00:05:36,870 --> 00:05:35,520
summer 1979 the voyager imaging team

151
00:05:39,830 --> 00:05:36,880
when i as i mentioned i was an

152
00:05:41,909 --> 00:05:39,840
undergraduate assistant and i'm

153
00:05:44,469 --> 00:05:41,919
in the back there the fourth from the

154
00:05:47,110 --> 00:05:44,479
right in the back row

155
00:05:48,469 --> 00:05:47,120
and as you can see i had not yet i was

156
00:05:50,710 --> 00:05:48,479
learning a lot about science but i had

157
00:05:52,629 --> 00:05:50,720
not yet understood the concept of hair

158
00:05:54,790 --> 00:05:52,639
cutting and barbers at that time hey

159
00:05:57,430 --> 00:05:54,800
look it was the 70s you know what can i

160
00:05:58,870 --> 00:05:57,440
say and but i was there as a as a

161
00:06:01,430 --> 00:05:58,880
research assistant undergraduate

162
00:06:03,909 --> 00:06:01,440
research assistant hired by carl sagan

163
00:06:05,350 --> 00:06:03,919

and um mentored by all of these other

164
00:06:07,510 --> 00:06:05,360
wonderful scientists you can see i'm

165
00:06:09,830 --> 00:06:07,520
standing there next to um chris squires

166
00:06:12,070 --> 00:06:09,840
who i'm sorry steve squires who uh chris

167
00:06:14,790 --> 00:06:12,080
breyer is a bass player steve squires um

168
00:06:16,550 --> 00:06:14,800
from uh who is of of mars rover fame and

169
00:06:18,550 --> 00:06:16,560
and and all these other faces are sort

170
00:06:21,510 --> 00:06:18,560
of our uh you know we're like gods to us

171
00:06:22,710 --> 00:06:21,520
these these famous scientists then and

172
00:06:25,350 --> 00:06:22,720
um

173
00:06:27,430 --> 00:06:25,360
moving right along the uh the next

174
00:06:29,270 --> 00:06:27,440
picture i believe is a snapshot from the

175
00:06:31,909 --> 00:06:29,280
neptune encounter as you can see i've

176
00:06:35,590 --> 00:06:31,919
gotten a little bit more handle on my

177
00:06:38,150 --> 00:06:35,600
styling and um i'm there with dr dr nick

178
00:06:39,590 --> 00:06:38,160
schneider who is now a professor of um

179
00:06:41,830 --> 00:06:39,600
planetary science at the university of

180
00:06:43,510 --> 00:06:41,840
colorado and dr john spencer who's one

181
00:06:46,070 --> 00:06:43,520
of the panelists you'll meet here in a

182
00:06:48,390 --> 00:06:46,080
minute this afternoon and we're pointing

183
00:06:50,950 --> 00:06:48,400
at neptune as voyager as at neptune and

184
00:06:52,950 --> 00:06:50,960
we were all grad school buddies who were

185
00:06:54,550 --> 00:06:52,960
just amazed to find ourselves in the

186
00:06:57,589 --> 00:06:54,560
company of these senior scientists

187
00:07:00,390 --> 00:06:57,599
getting to work on voyager at neptune

188
00:07:01,670 --> 00:07:00,400

the next picture shows

189
00:07:03,830 --> 00:07:01,680
jeff moore who's another of our

190
00:07:05,830 --> 00:07:03,840
panelists and john spencer and myself

191
00:07:07,510 --> 00:07:05,840
with a few of the other scientists doing

192
00:07:09,589 --> 00:07:07,520
what we did a lot of during those

193
00:07:13,270 --> 00:07:09,599
encounters which is staring in wonder at

194
00:07:15,189 --> 00:07:13,280
a screen when the new pictures from

195
00:07:16,950 --> 00:07:15,199
in this case i believe it was triton

196
00:07:19,189 --> 00:07:16,960
were coming down for the first time and

197
00:07:21,510 --> 00:07:19,199
we were laying our eyes on these

198
00:07:23,830 --> 00:07:21,520
new bodies these new

199
00:07:25,830 --> 00:07:23,840
places these worlds that previous to

200
00:07:28,390 --> 00:07:25,840
that had just been these dots

201
00:07:30,070 --> 00:07:28,400
and um telescopic

202
00:07:31,749 --> 00:07:30,080
blurry

203
00:07:34,390 --> 00:07:31,759
bodies that we would wonder about and we

204
00:07:36,390 --> 00:07:34,400
were for the first time able to go ah so

205
00:07:38,469 --> 00:07:36,400
that's what that is we're really really

206
00:07:42,629 --> 00:07:38,479
just moments of of discovery that we'll

207
00:07:43,909 --> 00:07:42,639
never forget the next slide shows you

208
00:07:45,589 --> 00:07:43,919
one thing you have to realize is that

209
00:07:47,909 --> 00:07:45,599
celestial dynamics does not work on

210
00:07:49,350 --> 00:07:47,919
human time it works on solar system time

211
00:07:51,110 --> 00:07:49,360
so there were many nights when we were

212
00:07:52,950 --> 00:07:51,120
up all night getting the data down and

213
00:07:54,629 --> 00:07:52,960

things got a little bit giddy and here

214
00:07:56,070 --> 00:07:54,639
we are um at the end i think of one of

215
00:07:58,070 --> 00:07:56,080
those long nights in a conference room

216
00:08:00,710 --> 00:07:58,080
by the way in the foreground is dr paul

217
00:08:02,869 --> 00:08:00,720
shank who's one of the people who's

218
00:08:05,110 --> 00:08:02,879
done these amazing movies that you've

219
00:08:07,189 --> 00:08:05,120
all seen including one i think that we

220
00:08:09,909 --> 00:08:07,199
just saw in the last hour of putting

221
00:08:12,390 --> 00:08:09,919
together the images of of triton and

222
00:08:13,990 --> 00:08:12,400
other bodies into a beautiful movie

223
00:08:16,710 --> 00:08:14,000
sequences to help facilitate our

224
00:08:19,510 --> 00:08:16,720
imagination the next slide

225
00:08:21,990 --> 00:08:19,520
shows you the first of our panelists i

226
00:08:23,430 --> 00:08:22,000
want to introduce this afternoon as you

227
00:08:25,029 --> 00:08:23,440
can see we all had a little bit more

228
00:08:27,749 --> 00:08:25,039
hair back then

229
00:08:31,110 --> 00:08:27,759
and dr john spencer

230
00:08:33,029 --> 00:08:31,120
here to my far right is um an institute

231
00:08:34,310 --> 00:08:33,039
scientist at the southwest research

232
00:08:37,509 --> 00:08:34,320
institute

233
00:08:40,550 --> 00:08:37,519
and at voyager neptune during the time

234
00:08:43,829 --> 00:08:40,560
of this picture he was a postdoc

235
00:08:45,430 --> 00:08:43,839
a a young pursuit postdoc and you know i

236
00:08:47,829 --> 00:08:45,440
asked him i asked everybody to tell me

237
00:08:49,350 --> 00:08:47,839
what they remember about voyager neptune

238
00:08:50,470 --> 00:08:49,360

and i won't tell you most of what they

239
00:08:52,310 --> 00:08:50,480
said because you're going to hear about

240
00:08:54,470 --> 00:08:52,320
it this afternoon but john wrote to me i

241
00:08:56,710 --> 00:08:54,480
mostly remember a lot of gazing

242
00:08:58,550 --> 00:08:56,720
awestruck at tv screens

243
00:09:00,550 --> 00:08:58,560
and we certainly did a lot of that but

244
00:09:02,389 --> 00:09:00,560
uh you know john's selling himself short

245
00:09:05,110 --> 00:09:02,399
he helped at that time with some of the

246
00:09:06,630 --> 00:09:05,120
initial geological mapping of triton

247
00:09:08,310 --> 00:09:06,640
and he participated in a lot of the

248
00:09:10,230 --> 00:09:08,320
general science discussions about what

249
00:09:12,949 --> 00:09:10,240
it all meant and started thinking a lot

250
00:09:16,150 --> 00:09:12,959
about volatile migration by which we

251
00:09:18,470 --> 00:09:16,160
mean what happens to the gases and the

252
00:09:21,110 --> 00:09:18,480
solid surfaces the ices how they move

253
00:09:22,790 --> 00:09:21,120
around on a cold planet like that and

254
00:09:25,190 --> 00:09:22,800
from those discussions

255
00:09:27,190 --> 00:09:25,200
john developed models of triton which

256
00:09:28,870 --> 00:09:27,200
are still considered the important

257
00:09:31,590 --> 00:09:28,880
models that everybody uses and which are

258
00:09:34,150 --> 00:09:31,600
also very applicable to pluto and i

259
00:09:35,990 --> 00:09:34,160
think that work that he did at um at

260
00:09:37,670 --> 00:09:36,000
neptune and triton led directly to the

261
00:09:40,630 --> 00:09:37,680
work that he's now doing on the new

262
00:09:42,389 --> 00:09:40,640
horizons team john is an expert on the

263
00:09:44,070 --> 00:09:42,399

moons of the outer planets he's worked

264
00:09:46,470 --> 00:09:44,080
on a lot of spacecraft teams i won't

265
00:09:48,550 --> 00:09:46,480
tell you all of it now but uh in

266
00:09:50,470 --> 00:09:48,560
particular he's currently working on the

267
00:09:52,550 --> 00:09:50,480
cassini saturn orbiter mapping the

268
00:09:54,710 --> 00:09:52,560
temperatures of saturn's moons and john

269
00:09:56,470 --> 00:09:54,720
discovered the thermal anomaly at the

270
00:09:58,550 --> 00:09:56,480
south pole of enceladus which was the

271
00:10:00,550 --> 00:09:58,560
key to discovering the ice eruptions on

272
00:10:01,750 --> 00:10:00,560
saturn's moon's enceladus

273
00:10:02,870 --> 00:10:01,760
and he's made a lot of other cool

274
00:10:05,030 --> 00:10:02,880
discoveries which you'll just have to

275
00:10:07,750 --> 00:10:05,040
wait to hear about on new horizons he'll

276
00:10:09,750 --> 00:10:07,760
be coordinating the search for flyby

277
00:10:12,470 --> 00:10:09,760
targets beyond pluto or he is

278
00:10:15,750 --> 00:10:12,480
coordinating that search the uh hope

279
00:10:18,150 --> 00:10:15,760
that new that new horizons after pluto

280
00:10:20,150 --> 00:10:18,160
can visit more bodies in the kuiper belt

281
00:10:21,910 --> 00:10:20,160
depends of course on finding those

282
00:10:24,470 --> 00:10:21,920
bodies and john has been leading the

283
00:10:27,190 --> 00:10:24,480
charge and we're confident that he will

284
00:10:28,069 --> 00:10:27,200
find us a good place to go after pluto

285
00:10:29,430 --> 00:10:28,079
um

286
00:10:30,710 --> 00:10:29,440
there's more to say about john but i

287
00:10:32,069 --> 00:10:30,720
want to move on and introduce the rest

288
00:10:34,310 --> 00:10:32,079

of the panelists so you can hear what

289
00:10:37,509 --> 00:10:34,320
they have to say so sitting next to me

290
00:10:40,150 --> 00:10:37,519
here is um another fine scientist and my

291
00:10:42,470 --> 00:10:40,160
good old friend dr jeff moore jeff is a

292
00:10:43,990 --> 00:10:42,480
research scientist at the nasa ames

293
00:10:46,310 --> 00:10:44,000
research center

294
00:10:48,630 --> 00:10:46,320
and uh in this next picture you can see

295
00:10:50,710 --> 00:10:48,640
him during the voyager

296
00:10:53,430 --> 00:10:50,720
neptune and triton encounter along with

297
00:10:56,069 --> 00:10:53,440
john and myself he's jeff is the one on

298
00:10:58,470 --> 00:10:56,079
the left there and um this is he was

299
00:11:00,790 --> 00:10:58,480
actually in his last year at gra in grad

300
00:11:03,829 --> 00:11:00,800
school at asu arizona state

301
00:11:05,990 --> 00:11:03,839
and he managed to uh get invited to um

302
00:11:07,670 --> 00:11:06,000
the uh to participate in the neptune

303
00:11:09,829 --> 00:11:07,680
encounter and actually jeff and i drove

304
00:11:11,590 --> 00:11:09,839
down together from san francisco on

305
00:11:13,190 --> 00:11:11,600
highway one and i remember us as young

306
00:11:14,949 --> 00:11:13,200
nerdy scientists sort of calculating our

307
00:11:16,310 --> 00:11:14,959
velocity and when we would reach

308
00:11:17,990 --> 00:11:16,320
pasadena and calculating the

309
00:11:19,590 --> 00:11:18,000
spacecraft's velocity and make sure that

310
00:11:22,150 --> 00:11:19,600
we get there before the spacecraft got

311
00:11:24,069 --> 00:11:22,160
to neptune and everything anyways we did

312
00:11:25,829 --> 00:11:24,079
and we had a great time there jeff also

313
00:11:27,509 --> 00:11:25,839

participated in a lot of the real-time

314
00:11:30,949 --> 00:11:27,519
first discussions of what formed the

315
00:11:32,870 --> 00:11:30,959
landscapes of triton um and and a lot of

316
00:11:35,030 --> 00:11:32,880
that excitement of closest approach to

317
00:11:36,710 --> 00:11:35,040
triton and he began a discussion there

318
00:11:38,389 --> 00:11:36,720
among among other things with john

319
00:11:40,389 --> 00:11:38,399
spencer that led to the two of them

320
00:11:41,670 --> 00:11:40,399
writing a paper on the migration of

321
00:11:44,069 --> 00:11:41,680
volatiles

322
00:11:46,949 --> 00:11:44,079
on triton which uh a hypothesis that

323
00:11:48,870 --> 00:11:46,959
they called giannis moyu maybe we'll let

324
00:11:51,430 --> 00:11:48,880
jeff tell us more about that and again

325
00:11:53,750 --> 00:11:51,440
this work led directly to his work now

326
00:11:56,150 --> 00:11:53,760
on the new horizons team where he is the

327
00:11:58,389 --> 00:11:56,160
imaging node leader and i'm sure he can

328
00:12:00,069 --> 00:11:58,399
tell you more about what that entails on

329
00:12:02,470 --> 00:12:00,079
new horizons

330
00:12:05,750 --> 00:12:02,480
sitting next to me on my other side is

331
00:12:07,750 --> 00:12:05,760
dr bonnie baratti bonnie is a principal

332
00:12:10,230 --> 00:12:07,760
scientist at the jet propulsion

333
00:12:12,310 --> 00:12:10,240
laboratory where all this excitement

334
00:12:14,550 --> 00:12:12,320
first went down

335
00:12:17,190 --> 00:12:14,560
and here is a picture in the middle you

336
00:12:21,350 --> 00:12:17,200
can see bonnie as a postdoc

337
00:12:22,629 --> 00:12:21,360
during the time of voyager neptune and

338
00:12:25,030 --> 00:12:22,639

there she was working on the

339
00:12:28,150 --> 00:12:25,040
photopolarimeter team

340
00:12:31,190 --> 00:12:28,160
and again that work helped establish her

341
00:12:33,509 --> 00:12:31,200
and in her career where in the interim

342
00:12:36,150 --> 00:12:33,519
time she's had leadership positions on

343
00:12:38,870 --> 00:12:36,160
many nasa missions and many nasa

344
00:12:41,590 --> 00:12:38,880
advisory panels bonnie's the author of

345
00:12:43,350 --> 00:12:41,600
over 200 scientific papers and she was

346
00:12:45,990 --> 00:12:43,360
awarded a national exceptional

347
00:12:47,430 --> 00:12:46,000
achievement medal i could go on but uh

348
00:12:49,030 --> 00:12:47,440
oh and she has an asteroid named after

349
00:12:50,629 --> 00:12:49,040
her but um

350
00:12:52,310 --> 00:12:50,639
and currently she leads the planning

351
00:12:56,069 --> 00:12:52,320
effort for icy moons on the cassini

352
00:12:58,870 --> 00:12:56,079
mission but on the new horizons mission

353
00:13:01,350 --> 00:12:58,880
to pluto bonnie is um well she's a

354
00:13:03,590 --> 00:13:01,360
member of the geo geology of geophysics

355
00:13:04,550 --> 00:13:03,600
and imaging team but in particular she's

356
00:13:09,670 --> 00:13:04,560
the

357
00:13:12,629 --> 00:13:09,680
photometry means it's what we

358
00:13:15,190 --> 00:13:12,639
use to understand the nature of surfaces

359
00:13:15,829 --> 00:13:15,200
by the way they scatter light and that

360
00:13:19,829 --> 00:13:15,839
is

361
00:13:22,550 --> 00:13:19,839
so many places in the solar system and

362
00:13:23,750 --> 00:13:22,560
now she's going to get to do it at pluto

363
00:13:25,190 --> 00:13:23,760

finally

364
00:13:27,430 --> 00:13:25,200
on the far left

365
00:13:29,990 --> 00:13:27,440
we have fran bagenow franz a professor

366
00:13:32,389 --> 00:13:30,000
of astrophysical and planetary sciences

367
00:13:34,629 --> 00:13:32,399
at the university of colorado in boulder

368
00:13:37,509 --> 00:13:34,639
and

369
00:13:39,750 --> 00:13:37,519
at the time of new horizons

370
00:13:42,389 --> 00:13:39,760
at neptune triton here you can see a

371
00:13:45,509 --> 00:13:42,399
picture of fresh-faced friend at new

372
00:13:48,389 --> 00:13:45,519
horizons and um she did you void you i'm

373
00:13:49,829 --> 00:13:48,399
sorry we'll get to new horizons so many

374
00:13:51,670 --> 00:13:49,839
missions so little time

375
00:13:54,150 --> 00:13:51,680
at the time thank you at the time of

376
00:13:56,470 --> 00:13:54,160
voyager at neptune triton

377
00:13:57,990 --> 00:13:56,480
she had just started as a new faculty

378
00:13:59,269 --> 00:13:58,000
member at the university of colorado in

379
00:14:01,350 --> 00:13:59,279
fact she told me she was teaching her

380
00:14:04,710 --> 00:14:01,360
first class then

381
00:14:06,949 --> 00:14:04,720
um and she was working for voyager on

382
00:14:09,030 --> 00:14:06,959
plasma science that is looking at how

383
00:14:11,110 --> 00:14:09,040
the gas coming from the atmospheres of

384
00:14:13,509 --> 00:14:11,120
the satellites interacts with neptune's

385
00:14:16,230 --> 00:14:13,519
magnetic field and in fact on new

386
00:14:18,470 --> 00:14:16,240
horizons she will be leading the plasma

387
00:14:20,550 --> 00:14:18,480
and particles group and looking at the

388
00:14:23,670 --> 00:14:20,560

how how the solar wind interacts with

389
00:14:26,629 --> 00:14:23,680
pluto's escaping atmosphere so that's

390
00:14:28,069 --> 00:14:26,639
who they all are as scientists and now i

391
00:14:29,509 --> 00:14:28,079
like to uh

392
00:14:32,550 --> 00:14:29,519
have you get to know them as people a

393
00:14:35,189 --> 00:14:32,560
little bit as well so um

394
00:14:36,470 --> 00:14:35,199
i'm going to start off with um

395
00:14:37,990 --> 00:14:36,480
a question

396
00:14:40,310 --> 00:14:38,000
relating

397
00:14:41,910 --> 00:14:40,320
the experience of

398
00:14:43,670 --> 00:14:41,920
voyager with

399
00:14:46,550 --> 00:14:43,680
what we sort of expect for the

400
00:14:48,150 --> 00:14:46,560
experience of new horizons now

401
00:14:49,990 --> 00:14:48,160
in nasa with with all these different

402
00:14:53,269 --> 00:14:50,000
kinds of planetary missions that we've

403
00:14:54,949 --> 00:14:53,279
all been involved in since voyager

404
00:14:57,430 --> 00:14:54,959
uh there are a lot of different kinds of

405
00:15:00,629 --> 00:14:57,440
missions we do we do orbiters we do

406
00:15:02,949 --> 00:15:00,639
rovers we do entry probes but

407
00:15:05,430 --> 00:15:02,959
there's a particular

408
00:15:08,310 --> 00:15:05,440
experience to a flyby mission

409
00:15:10,069 --> 00:15:08,320
new horizons will be a flyby the first

410
00:15:12,790 --> 00:15:10,079
encounter with a new planet and it all

411
00:15:15,269 --> 00:15:12,800
happens pretty quickly you you can't

412
00:15:17,269 --> 00:15:15,279
stop you have like like uh in the wizard

413
00:15:18,629 --> 00:15:17,279

of oz as the wizard said dorothy i don't

414
00:15:20,550 --> 00:15:18,639
know how to stop it i've got to keep

415
00:15:21,750 --> 00:15:20,560
going so you only get

416
00:15:23,030 --> 00:15:21,760
or or

417
00:15:24,629 --> 00:15:23,040
sorry is

418
00:15:27,189 --> 00:15:24,639
as a great rapper once said you only get

419
00:15:29,269 --> 00:15:27,199
one shot so um so we have to do this

420
00:15:31,829 --> 00:15:29,279
this right and it all happens really

421
00:15:33,670 --> 00:15:31,839
quickly and what i want to ask you guys

422
00:15:36,230 --> 00:15:33,680
having been through it with voyager

423
00:15:37,350 --> 00:15:36,240
having been through repeated fly-bys

424
00:15:39,590 --> 00:15:37,360
um

425
00:15:41,829 --> 00:15:39,600
can you describe that experience what is

426
00:15:43,990 --> 00:15:41,839
it about a fly-by that's different from

427
00:15:46,870 --> 00:15:44,000
another kind of mission they expect not

428
00:15:49,110 --> 00:15:46,880
just scientifically but emotionally and

429
00:15:50,550 --> 00:15:49,120
and and how how does that how does it

430
00:15:52,069 --> 00:15:50,560
different tell us something about your

431
00:15:54,310 --> 00:15:52,079
experience with voyager and how that

432
00:15:55,829 --> 00:15:54,320
maybe prepares you for what we're

433
00:15:58,470 --> 00:15:55,839
expecting at new horizons john you want

434
00:16:00,470 --> 00:15:58,480
to start off um sure well as you say

435
00:16:01,749 --> 00:16:00,480
flybys are very intense

436
00:16:04,069 --> 00:16:01,759
um

437
00:16:05,509 --> 00:16:04,079
particularly when as often with flybys

438
00:16:07,110 --> 00:16:05,519

it's the first time you've been to that

439
00:16:08,389 --> 00:16:07,120
place and

440
00:16:10,550 --> 00:16:08,399
um

441
00:16:12,550 --> 00:16:10,560
you don't know what to expect you're

442
00:16:14,389 --> 00:16:12,560
trying to imagine but you can't possibly

443
00:16:17,189 --> 00:16:14,399
imagine what you're going to see and

444
00:16:20,230 --> 00:16:17,199
then it all happens so fast

445
00:16:23,749 --> 00:16:20,240
and you're just blown away and you're so

446
00:16:24,710 --> 00:16:23,759
dizzy for a long time afterwards um

447
00:16:29,829 --> 00:16:24,720
i

448
00:16:30,710 --> 00:16:29,839
neptune flyby

449
00:16:31,990 --> 00:16:30,720
being

450
00:16:33,590 --> 00:16:32,000
up at three o'clock in the morning and

451
00:16:34,949 --> 00:16:33,600
the pictures were coming down and every

452
00:16:38,389 --> 00:16:34,959
picture was just

453
00:16:40,550 --> 00:16:38,399
utterly unbelievable the level of detail

454
00:16:42,230 --> 00:16:40,560
we're seeing on on triton this world

455
00:16:45,110 --> 00:16:42,240
that we've had in our heads as just a

456
00:16:46,470 --> 00:16:45,120
point of light for a decade or more

457
00:16:49,509 --> 00:16:46,480
depending how long we've been thinking

458
00:16:52,710 --> 00:16:49,519
about it and

459
00:16:54,389 --> 00:16:52,720
suddenly it's this world and it's got

460
00:16:56,069 --> 00:16:54,399
an atmosphere you and we discovered the

461
00:16:57,829 --> 00:16:56,079
atmosphere that night just you could see

462
00:17:00,310 --> 00:16:57,839
these layers of haze off the

463
00:17:03,350 --> 00:17:00,320

off the edge of the disk we

464
00:17:05,029 --> 00:17:03,360
saw this completely bizarre um

465
00:17:06,789 --> 00:17:05,039
surface and i

466
00:17:07,990 --> 00:17:06,799
remember thinking this is like mars this

467
00:17:10,230 --> 00:17:08,000
is a world as

468
00:17:13,829 --> 00:17:10,240
complex as mars that we've been studying

469
00:17:15,990 --> 00:17:13,839
for decades and have gradually got into

470
00:17:17,510 --> 00:17:16,000
our head over this series of missions

471
00:17:18,949 --> 00:17:17,520
and we just get this one glimpse at it

472
00:17:19,909 --> 00:17:18,959
and it's gone

473
00:17:21,590 --> 00:17:19,919
and

474
00:17:23,429 --> 00:17:21,600
we're just going to spend the rest of

475
00:17:26,549 --> 00:17:23,439
our lives figuring out what that all

476
00:17:28,230 --> 00:17:26,559
means in that that one glimpse and

477
00:17:31,510 --> 00:17:28,240
um

478
00:17:35,350 --> 00:17:33,510
remember being

479
00:17:37,590 --> 00:17:35,360
uh

480
00:17:39,110 --> 00:17:37,600
yeah we were up all night and we crawled

481
00:17:40,549 --> 00:17:39,120
under a desk or something to get a

482
00:17:42,390 --> 00:17:40,559
couple of hours sleep and then going

483
00:17:43,350 --> 00:17:42,400
with you to a coffee shop in the morning

484
00:17:45,350 --> 00:17:43,360
and just

485
00:17:47,029 --> 00:17:45,360
so staring bleary-eyed at each other

486
00:17:48,789 --> 00:17:47,039
going oh wow

487
00:17:54,230 --> 00:17:48,799
that was intense

488
00:17:57,990 --> 00:17:55,669

that it's

489
00:18:00,070 --> 00:17:58,000
it's a once in a lifetime thing

490
00:18:01,430 --> 00:18:00,080
it's a once in the human lifetime thing

491
00:18:02,710 --> 00:18:01,440
that you get to do that for the first

492
00:18:04,549 --> 00:18:02,720
time and we're going to get to do that

493
00:18:06,230 --> 00:18:04,559
again at pluto and it's

494
00:18:07,750 --> 00:18:06,240
uh it's really been the first time since

495
00:18:09,830 --> 00:18:07,760
then we've had that kind of intense

496
00:18:13,029 --> 00:18:09,840
experience you know i'm going to beg to

497
00:18:14,470 --> 00:18:13,039
differ with you because i think that the

498
00:18:17,029 --> 00:18:14,480
people out there are going to have this

499
00:18:18,470 --> 00:18:17,039
experience again and again

500
00:18:20,470 --> 00:18:18,480
when we

501
00:18:21,190 --> 00:18:20,480
left neptune i remember this feeling

502
00:18:23,029 --> 00:18:21,200
that

503
00:18:25,190 --> 00:18:23,039
oh my golly we were so privileged

504
00:18:26,710 --> 00:18:25,200
privileged to be involved but the poor

505
00:18:29,750 --> 00:18:26,720
next generation they're not going to

506
00:18:31,350 --> 00:18:29,760
have this experience and i think we were

507
00:18:34,070 --> 00:18:31,360
completely wrong there i think that

508
00:18:35,750 --> 00:18:34,080
there will be not only pluto and the

509
00:18:37,909 --> 00:18:35,760
next kuiper belt whatever it is that we

510
00:18:39,990 --> 00:18:37,919
will fly by but there will be many more

511
00:18:41,430 --> 00:18:40,000
there's a whole world's out there i mean

512
00:18:43,990 --> 00:18:41,440
just think about the rosetta

513
00:18:45,909 --> 00:18:44,000

observations of that little um comet

514
00:18:47,990 --> 00:18:45,919
that it's just found you know the rubber

515
00:18:49,590 --> 00:18:48,000
ducky because i can't pronounce it it's

516
00:18:50,950 --> 00:18:49,600
a proper name

517
00:18:53,750 --> 00:18:50,960
there are going to be more and more and

518
00:18:55,990 --> 00:18:53,760
more of these i think we're wrong to say

519
00:18:59,430 --> 00:18:56,000
that we were special we were the only

520
00:19:01,430 --> 00:18:59,440
ones to have a flyby of a new object

521
00:19:03,350 --> 00:19:01,440
certainly discovery new discovery has

522
00:19:05,110 --> 00:19:03,360
been a continuous process through our

523
00:19:06,470 --> 00:19:05,120
lives i mean

524
00:19:07,669 --> 00:19:06,480
uh titan

525
00:19:09,350 --> 00:19:07,679
you know the huygens probe at titan

526
00:19:12,390 --> 00:19:09,360
there's been a lot of first yeah but a

527
00:19:15,029 --> 00:19:12,400
flyby is a kind of an unusual so you're

528
00:19:17,190 --> 00:19:15,039
absolutely right but i'm trying to uh

529
00:19:19,190 --> 00:19:17,200
also prepare people for the experience

530
00:19:21,350 --> 00:19:19,200
of this by like talking what's a flyby

531
00:19:22,710 --> 00:19:21,360
like so but i think i think we shouldn't

532
00:19:24,390 --> 00:19:22,720
oversell the fact that other people

533
00:19:26,070 --> 00:19:24,400
don't get to participate in amazing

534
00:19:28,230 --> 00:19:26,080
discoveries

535
00:19:30,789 --> 00:19:28,240
did bring up an important point about

536
00:19:33,190 --> 00:19:30,799
uh the expectation of what you might see

537
00:19:35,990 --> 00:19:33,200
i remember in the months before we

538
00:19:37,909 --> 00:19:36,000

approached triton there were like uh two

539
00:19:40,230 --> 00:19:37,919
different plan plan a and plan b for

540
00:19:42,390 --> 00:19:40,240
whether triton was the size of europa or

541
00:19:43,190 --> 00:19:42,400
triton was the size of

542
00:19:44,470 --> 00:19:43,200
of

543
00:19:45,990 --> 00:19:44,480
ganymede which is like one and a half

544
00:19:48,549 --> 00:19:46,000
times the size of europa so there was a

545
00:19:50,710 --> 00:19:48,559
big plan to mosaic a big moon a big a

546
00:19:52,549 --> 00:19:50,720
smaller plan to mosaic a small moon and

547
00:19:54,390 --> 00:19:52,559
there was a question whether

548
00:19:56,549 --> 00:19:54,400
triton would have an extremely dense

549
00:19:57,990 --> 00:19:56,559
atmosphere like titan that you couldn't

550
00:20:01,190 --> 00:19:58,000
see through or would it have a clear

551
00:20:03,510 --> 00:20:01,200
atmosphere there was a a popular theory

552
00:20:06,149 --> 00:20:03,520
at the time that titan a triton might

553
00:20:09,590 --> 00:20:06,159
have large seas of nitrogen on the

554
00:20:11,590 --> 00:20:09,600
surface um and so there were all these

555
00:20:12,630 --> 00:20:11,600
great expectations and and to some

556
00:20:14,470 --> 00:20:12,640
extent

557
00:20:15,990 --> 00:20:14,480
the the vast range of them simply

558
00:20:17,669 --> 00:20:16,000
shouldn't really know anything until we

559
00:20:20,549 --> 00:20:17,679
got there and and the whole idea of

560
00:20:21,750 --> 00:20:20,559
picking the small uh target versus large

561
00:20:23,669 --> 00:20:21,760
target was something people only knew in

562
00:20:25,430 --> 00:20:23,679
the last week before the encounter and

563
00:20:27,110 --> 00:20:25,440

the idea was going to be bright not dark

564
00:20:29,190 --> 00:20:27,120
all these basic things were like

565
00:20:31,909 --> 00:20:29,200
mysterious and the expectation and the

566
00:20:34,710 --> 00:20:31,919
anticipation of it was was very intense

567
00:20:36,230 --> 00:20:34,720
and so i i'm seeing and you can see in

568
00:20:38,630 --> 00:20:36,240
in papers that you're being published

569
00:20:41,270 --> 00:20:38,640
this year that same sort of intensity of

570
00:20:42,789 --> 00:20:41,280
speculation and diversity of ideas of

571
00:20:44,390 --> 00:20:42,799
what we might see

572
00:20:46,630 --> 00:20:44,400
in the pluto system

573
00:20:48,789 --> 00:20:46,640
i think in in many ways an encounter is

574
00:20:50,070 --> 00:20:48,799
almost like giving birth because you

575
00:20:53,350 --> 00:20:50,080
have you know in your mind first of all

576
00:20:55,190 --> 00:20:53,360
you have no control over the time

577
00:20:56,950 --> 00:20:55,200
it's going to come no matter what and

578
00:20:59,270 --> 00:20:56,960
you know you go from just an idea in

579
00:21:00,549 --> 00:20:59,280
your mind to a whole new person or a

580
00:21:02,149 --> 00:21:00,559
whole new world

581
00:21:04,549 --> 00:21:02,159
and you don't get a lot of sleep there's

582
00:21:06,149 --> 00:21:04,559
that's also true yes and here's here's

583
00:21:07,590 --> 00:21:06,159
actually a t-shirt from all three of my

584
00:21:09,430 --> 00:21:07,600
children were born during the voyager

585
00:21:11,110 --> 00:21:09,440
mission and here's a little shirt that i

586
00:21:11,990 --> 00:21:11,120
bought from my six-year-old then at the

587
00:21:14,149 --> 00:21:12,000
time

588
00:21:18,390 --> 00:21:14,159

from the encounter the neptune encounter

589
00:21:19,830 --> 00:21:18,400
doesn't still fit no no he's grown

590
00:21:21,510 --> 00:21:19,840
well um

591
00:21:23,909 --> 00:21:21,520
let me move on to a question about the

592
00:21:25,750 --> 00:21:23,919
um the change in technology since since

593
00:21:26,950 --> 00:21:25,760
voyager and uh

594
00:21:29,750 --> 00:21:26,960
how that maybe will change our

595
00:21:32,870 --> 00:21:29,760
experience of a flyby um and

596
00:21:34,789 --> 00:21:32,880
particularly the new horizons flyby um

597
00:21:36,950 --> 00:21:34,799
of course we didn't have the world wide

598
00:21:39,430 --> 00:21:36,960
web back then which is i know hard for

599
00:21:41,590 --> 00:21:39,440
some of you folks to imagine but it's

600
00:21:43,270 --> 00:21:41,600
it's true so every experience carries

601
00:21:45,110 --> 00:21:43,280
much more immediacy and that helps us

602
00:21:47,350 --> 00:21:45,120
get information out to the public for

603
00:21:50,070 --> 00:21:47,360
one thing really quickly and yet the new

604
00:21:53,430 --> 00:21:50,080
horizons spacecraft is so optimized for

605
00:21:56,070 --> 00:21:53,440
size it actually has a relatively small

606
00:21:57,830 --> 00:21:56,080
antenna and therefore it takes a while

607
00:21:59,350 --> 00:21:57,840
for all the information to get back so

608
00:22:00,710 --> 00:21:59,360
there's a sense of more immediacy but

609
00:22:02,710 --> 00:22:00,720
also a sense where things are going to

610
00:22:04,710 --> 00:22:02,720
be more drawn out than voyager because

611
00:22:06,710 --> 00:22:04,720
of necessity and of you know just the

612
00:22:09,110 --> 00:22:06,720
efficiency of that spacecraft it will

613
00:22:10,870 --> 00:22:09,120

take longer there'll be a

614
00:22:12,070 --> 00:22:10,880
there'll be months while information's

615
00:22:13,750 --> 00:22:12,080
coming

616
00:22:15,190 --> 00:22:13,760
that was used in the other previous

617
00:22:17,909 --> 00:22:15,200
press conference like having a christmas

618
00:22:19,190 --> 00:22:17,919
present um christmas present under the

619
00:22:20,789 --> 00:22:19,200
tree will in fact we're going to have

620
00:22:22,789 --> 00:22:20,799
christmas new christmas presents under

621
00:22:24,390 --> 00:22:22,799
the tree for months after the encounter

622
00:22:26,870 --> 00:22:24,400
uh some of the most important things

623
00:22:28,950 --> 00:22:26,880
that we that will really change our view

624
00:22:31,669 --> 00:22:28,960
of for instance the geology of

625
00:22:33,590 --> 00:22:31,679
pluto we really won't have in hand until

626
00:22:35,510 --> 00:22:33,600
many months after the encounter like the

627
00:22:36,630 --> 00:22:35,520
six months after the encounter so it's

628
00:22:38,470 --> 00:22:36,640
going to be the gift that keeps on

629
00:22:40,070 --> 00:22:38,480
giving yeah well so that's that's my

630
00:22:41,830 --> 00:22:40,080
question you know given all this how do

631
00:22:42,789 --> 00:22:41,840
you think the new horizons flyby will

632
00:22:45,909 --> 00:22:42,799
differ

633
00:22:47,350 --> 00:22:45,919
from the neptune flyby and in terms of

634
00:22:49,430 --> 00:22:47,360
the both the experience of the team

635
00:22:51,029 --> 00:22:49,440
members and the experience of the public

636
00:22:52,470 --> 00:22:51,039
following along and jeff has already

637
00:22:54,870 --> 00:22:52,480
made the analogy of

638
00:22:57,110 --> 00:22:54,880

an extended series of christmas mornings

639
00:22:59,990 --> 00:22:57,120
any any other thoughts about that um

640
00:23:02,390 --> 00:23:00,000
well i remember at triton

641
00:23:03,990 --> 00:23:02,400
we were frustrated in a way we we saw

642
00:23:05,669 --> 00:23:04,000
these beautiful color images and you see

643
00:23:07,590 --> 00:23:05,679
oh there's blue stuff over here and that

644
00:23:10,950 --> 00:23:07,600
area is kind of orange and

645
00:23:12,630 --> 00:23:10,960
it's beige down here and

646
00:23:14,549 --> 00:23:12,640
we knew from

647
00:23:16,390 --> 00:23:14,559
the observations taken from earth that

648
00:23:19,190 --> 00:23:16,400
triton has this wonderful mix of

649
00:23:22,549 --> 00:23:19,200
different frosts on the surface nitrogen

650
00:23:23,909 --> 00:23:22,559
and methane and carbon dioxide and so on

651
00:23:25,350 --> 00:23:23,919
and

652
00:23:26,789 --> 00:23:25,360
voyager took these beautiful color

653
00:23:28,470 --> 00:23:26,799
pictures but we didn't know which was

654
00:23:29,990 --> 00:23:28,480
the nitrogen which was the carbon

655
00:23:31,270 --> 00:23:30,000
dioxide

656
00:23:33,590 --> 00:23:31,280
because voyager did not have the

657
00:23:34,710 --> 00:23:33,600
instrumentation to allow us to determine

658
00:23:36,470 --> 00:23:34,720
those things

659
00:23:39,029 --> 00:23:36,480
um something we're very much looking

660
00:23:40,070 --> 00:23:39,039
forward to on new horizons is that we we

661
00:23:41,909 --> 00:23:40,080
have

662
00:23:44,630 --> 00:23:41,919
an infrared spectrometer that is going

663
00:23:45,990 --> 00:23:44,640

to tell us in exquisite detail what all

664
00:23:47,830 --> 00:23:46,000
those little bits of the surface which

665
00:23:49,110 --> 00:23:47,840
we know even from those very blurry

666
00:23:51,430 --> 00:23:49,120
hubble images

667
00:23:53,029 --> 00:23:51,440
are very different from each other what

668
00:23:54,310 --> 00:23:53,039
each of those little bits is made of and

669
00:23:56,310 --> 00:23:54,320
that's going to

670
00:23:57,990 --> 00:23:56,320
be a huge advancing over in our

671
00:23:59,190 --> 00:23:58,000
understanding of what we were able to do

672
00:24:01,110 --> 00:23:59,200
at voyager

673
00:24:02,950 --> 00:24:01,120
friend you haven't talked about changing

674
00:24:04,390 --> 00:24:02,960
yeah i think the biggest change is

675
00:24:06,549 --> 00:24:04,400
indeed the technology

676
00:24:09,190 --> 00:24:06,559
and you know i hate to be one of those

677
00:24:11,430 --> 00:24:09,200
old guys but um

678
00:24:13,510 --> 00:24:11,440
back in jupiter we were using punch

679
00:24:14,549 --> 00:24:13,520
cards and mag tapes you know and then by

680
00:24:17,750 --> 00:24:14,559
the time

681
00:24:20,549 --> 00:24:17,760
we got to uh neptune yes everything was

682
00:24:23,029 --> 00:24:20,559
on those tv screens but those tv screens

683
00:24:26,470 --> 00:24:23,039
were novel i mean that was amazing to be

684
00:24:28,549 --> 00:24:26,480
able to analyze data on actual computers

685
00:24:31,190 --> 00:24:28,559
that you could put you could fit in a

686
00:24:34,230 --> 00:24:31,200
room let alone put it on your desk and

687
00:24:37,750 --> 00:24:34,240
so big changes in technology just over

688
00:24:40,230 --> 00:24:37,760

the time um from those 12 years from uh

689
00:24:42,870 --> 00:24:40,240
jupiter through to neptune uh and of

690
00:24:45,029 --> 00:24:42,880
course there wasn't a worldwide web

691
00:24:46,710 --> 00:24:45,039
but everything was done with with very

692
00:24:48,950 --> 00:24:46,720
primitive technology

693
00:24:50,549 --> 00:24:48,960
and i was just amazed though that when

694
00:24:53,830 --> 00:24:50,559
we went to the press conference at the

695
00:24:55,990 --> 00:24:53,840
end of the voyager neptune uh encounter

696
00:24:58,789 --> 00:24:56,000
there was this fantastic movie that was

697
00:25:01,350 --> 00:24:58,799
shown flying over triton and you can go

698
00:25:04,149 --> 00:25:01,360
to youtube you can see it uh the flight

699
00:25:06,710 --> 00:25:04,159
over triton is amazing and i was just

700
00:25:08,870 --> 00:25:06,720
totally blown away that that nasa could

701
00:25:11,430 --> 00:25:08,880
put together the people that jpl could

702
00:25:13,350 --> 00:25:11,440
put together in a few days this flight

703
00:25:15,510 --> 00:25:13,360
from a few images and it was really that

704
00:25:17,269 --> 00:25:15,520
was mind-blowing

705
00:25:19,750 --> 00:25:17,279
yeah now we expect that kind of thing

706
00:25:22,149 --> 00:25:19,760
now we expect it we kill ourselves

707
00:25:24,070 --> 00:25:22,159
yes exactly yeah but i think that this

708
00:25:27,510 --> 00:25:24,080
issue can do it on their computer right

709
00:25:31,590 --> 00:25:29,190
and that what happened though was that

710
00:25:33,029 --> 00:25:31,600
came out over three or four days i think

711
00:25:34,950 --> 00:25:33,039
that this is going to be very different

712
00:25:37,029 --> 00:25:34,960
for new horizons the time delay that

713
00:25:39,110 --> 00:25:37,039

we're talking about here data coming in

714
00:25:40,710 --> 00:25:39,120
bit by bit over months and months is

715
00:25:43,029 --> 00:25:40,720
very different but i think the point

716
00:25:45,350 --> 00:25:43,039
that alan made that these data will be

717
00:25:47,110 --> 00:25:45,360
made available to the public immediately

718
00:25:48,789 --> 00:25:47,120
is very very different very very

719
00:25:51,190 --> 00:25:48,799
different you know we were a bit of an

720
00:25:54,149 --> 00:25:51,200
elitist small crew in the old days of

721
00:25:56,149 --> 00:25:54,159
voyager whereas i think new horizons is

722
00:25:58,070 --> 00:25:56,159
much more inclusive in bringing people

723
00:25:59,669 --> 00:25:58,080
in and allowing them to play with the

724
00:26:01,669 --> 00:25:59,679
data and see what they see there and

725
00:26:03,510 --> 00:26:01,679
interpret it and understand it so both

726
00:26:05,110 --> 00:26:03,520
the attitudes and the technology have

727
00:26:07,430 --> 00:26:05,120
changed in terms of transparency and

728
00:26:09,190 --> 00:26:07,440
immediacy absolutely yeah that's right

729
00:26:11,510 --> 00:26:09,200
yeah i mean the data belong to everybody

730
00:26:14,630 --> 00:26:11,520
it's everybody's data yep you paid for

731
00:26:17,029 --> 00:26:14,640
it you get to play too

732
00:26:19,669 --> 00:26:17,039
all right well this is uh now i want to

733
00:26:21,669 --> 00:26:19,679
talk about sort of scientific careers

734
00:26:24,470 --> 00:26:21,679
and how reflecting over this time

735
00:26:25,990 --> 00:26:24,480
interval since voyager um you know what

736
00:26:27,350 --> 00:26:26,000
thoughts that brings up we we all

737
00:26:29,909 --> 00:26:27,360
participated in voyager as young

738
00:26:31,750 --> 00:26:29,919

scientists just starting our careers and

739
00:26:33,990 --> 00:26:31,760
and assisting and watching the senior

740
00:26:35,510 --> 00:26:34,000
scientists on on the mission and

741
00:26:36,789 --> 00:26:35,520
i just remember thinking those senior

742
00:26:38,789 --> 00:26:36,799
scientists were

743
00:26:40,950 --> 00:26:38,799
you know i was in awe of them they

744
00:26:42,710 --> 00:26:40,960
seemed like they knew everything

745
00:26:44,549 --> 00:26:42,720
and now we're seeing your scientists and

746
00:26:45,830 --> 00:26:44,559
and we don't know everything so

747
00:26:47,110 --> 00:26:45,840
well they were smarter than we well

748
00:26:48,950 --> 00:26:47,120
that's what i'm asking has scientists

749
00:26:50,549 --> 00:26:48,960
gotten dumber or were they faking it no

750
00:26:52,070 --> 00:26:50,559
or but

751
00:26:53,830 --> 00:26:52,080
no

752
00:26:55,750 --> 00:26:53,840
part of the poignancy of the neptune

753
00:26:57,510 --> 00:26:55,760
encounter was a sense that that not only

754
00:27:00,070 --> 00:26:57,520
had voyager finally come to the end of

755
00:27:02,470 --> 00:27:00,080
its amazing run but not knowing if we

756
00:27:04,310 --> 00:27:02,480
would ever in our lifetimes again send a

757
00:27:06,549 --> 00:27:04,320
spaceship that far out into the outer

758
00:27:08,630 --> 00:27:06,559
solar system and yet here we are 25

759
00:27:10,549 --> 00:27:08,640
years later and we're reaching another

760
00:27:13,830 --> 00:27:10,559
new world even farther out than than

761
00:27:15,190 --> 00:27:13,840
voyager did so at that time

762
00:27:17,269 --> 00:27:15,200
would you have ever predicted that in

763
00:27:19,190 --> 00:27:17,279

your lifetime you not only helped to see

764
00:27:21,909 --> 00:27:19,200
but helped to manifest the pluto mission

765
00:27:23,350 --> 00:27:21,919
and and and how does that um you know

766
00:27:25,029 --> 00:27:23,360
when you think now of those senior

767
00:27:27,430 --> 00:27:25,039
scientists and yourself

768
00:27:28,870 --> 00:27:27,440
in the role that you're playing um

769
00:27:31,510 --> 00:27:28,880
how do how does that happen how do you

770
00:27:32,789 --> 00:27:31,520
how do you become how do you go someone

771
00:27:34,149 --> 00:27:32,799
who's being

772
00:27:36,149 --> 00:27:34,159
to somebody who's mentoring young

773
00:27:36,950 --> 00:27:36,159
scientists

774
00:27:38,710 --> 00:27:36,960
um

775
00:27:40,470 --> 00:27:38,720
anybody

776
00:27:42,630 --> 00:27:40,480
i know i still think that those guys are

777
00:27:44,950 --> 00:27:42,640
the gods and we're still really just the

778
00:27:46,710 --> 00:27:44,960
the kids and the fact we're actually as

779
00:27:48,950 --> 00:27:46,720
old as they were then is something that

780
00:27:50,710 --> 00:27:48,960
i haven't really internalized so boring

781
00:27:52,549 --> 00:27:50,720
i think i think one thing that i really

782
00:27:54,149 --> 00:27:52,559
learned from the encounter was i think

783
00:27:55,590 --> 00:27:54,159
this gets back to your question you know

784
00:27:58,710 --> 00:27:55,600
didn't they know everything no

785
00:28:00,149 --> 00:27:58,720
scientists don't agree on stuff and you

786
00:28:01,990 --> 00:28:00,159
know this is in fact what propels

787
00:28:03,830 --> 00:28:02,000
science it's because we disagree and we

788
00:28:06,230 --> 00:28:03,840

have different theories that that

789
00:28:07,909 --> 00:28:06,240
propels more data to be collected and

790
00:28:10,070 --> 00:28:07,919
for us to finally get it the truth or

791
00:28:11,110 --> 00:28:10,080
the truth of the moment and this is what

792
00:28:13,190 --> 00:28:11,120
i really learned there were

793
00:28:15,510 --> 00:28:13,200
disagreements on the teams and there

794
00:28:17,430 --> 00:28:15,520
were some you know friendly fighting and

795
00:28:19,190 --> 00:28:17,440
you know that just you know it

796
00:28:21,029 --> 00:28:19,200
encouraged people to learn more and do

797
00:28:23,669 --> 00:28:21,039
more that's what i think i learned from

798
00:28:26,149 --> 00:28:23,679
the encounter

799
00:28:28,950 --> 00:28:26,159
we were actually starting to work on

800
00:28:31,190 --> 00:28:28,960
pluto mission about the time

801
00:28:33,190 --> 00:28:31,200
there was a scientific conference uh

802
00:28:34,149 --> 00:28:33,200
that we had in the the summer of that

803
00:28:36,789 --> 00:28:34,159
year

804
00:28:39,190 --> 00:28:36,799
where there was a uh presentation on on

805
00:28:41,190 --> 00:28:39,200
uh presentations on pluto we're starting

806
00:28:43,029 --> 00:28:41,200
to work on that alan stern was

807
00:28:45,590 --> 00:28:43,039
recruiting and galvanizing a group of

808
00:28:47,909 --> 00:28:45,600
people to work on on pluto and so we

809
00:28:49,510 --> 00:28:47,919
were starting to think i actually

810
00:28:52,149 --> 00:28:49,520
remember thinking

811
00:28:55,029 --> 00:28:52,159
ah voyage is over now what do we do this

812
00:28:56,870 --> 00:28:55,039
is about the end of it isn't it

813
00:28:58,630 --> 00:28:56,880

about to give up and we didn't think

814
00:29:01,029 --> 00:28:58,640
that there would be more more missions i

815
00:29:03,909 --> 00:29:01,039
mean there was galileo and as sort of

816
00:29:05,350 --> 00:29:03,919
smell of cassini on the horizons but the

817
00:29:07,750 --> 00:29:05,360
idea that we would have multiple

818
00:29:09,830 --> 00:29:07,760
missions and keep going was very hard

819
00:29:13,350 --> 00:29:09,840
i i think that really what we have to

820
00:29:15,350 --> 00:29:13,360
think about now is that um we have to

821
00:29:17,990 --> 00:29:15,360
take on those roles of trying to get the

822
00:29:21,110 --> 00:29:18,000
next missions going the missions to go

823
00:29:23,590 --> 00:29:21,120
back to tri titan the mission to go to

824
00:29:25,669 --> 00:29:23,600
europa the missions to go back to venus

825
00:29:27,669 --> 00:29:25,679
your planet i'd love to go back it

826
00:29:29,750 --> 00:29:27,679
doesn't have a magnetic field but let's

827
00:29:31,750 --> 00:29:29,760
go back to venus and things like that

828
00:29:34,149 --> 00:29:31,760
many places uranus and neptune let's go

829
00:29:37,190 --> 00:29:34,159
back there um there are plenty of places

830
00:29:38,870 --> 00:29:37,200
and i think our job now is to try and

831
00:29:41,190 --> 00:29:38,880
get those missions going and off the

832
00:29:42,789 --> 00:29:41,200
ground so that the next generation can

833
00:29:45,269 --> 00:29:42,799
take over and be

834
00:29:47,350 --> 00:29:45,279
there doing the work down the road 25

835
00:29:48,950 --> 00:29:47,360
years from now talk about mentoring

836
00:29:50,789 --> 00:29:48,960
mentoring seems to be something that

837
00:29:54,149 --> 00:29:50,799
comes

838
00:29:56,710 --> 00:29:54,159

at least gradually if not naturally

839
00:29:58,630 --> 00:29:56,720
because it takes so long has taken so

840
00:30:00,870 --> 00:29:58,640
long from the last major encounter 25

841
00:30:02,070 --> 00:30:00,880
years ago to now that as we pass through

842
00:30:03,669 --> 00:30:02,080
our careers

843
00:30:04,950 --> 00:30:03,679
you know we reach a point where we begin

844
00:30:06,470 --> 00:30:04,960
to take on graduate students and

845
00:30:09,430 --> 00:30:06,480
post-docs

846
00:30:13,029 --> 00:30:09,440
we begin to show them the ropes and

847
00:30:15,350 --> 00:30:13,039
exchange ideas and form intellectual uh

848
00:30:16,870 --> 00:30:15,360
salons that we keep with each other

849
00:30:18,310 --> 00:30:16,880
and we develop a rapport not only

850
00:30:20,549 --> 00:30:18,320
amongst ourselves but amongst the

851
00:30:22,630 --> 00:30:20,559
younger generation and they have great

852
00:30:24,789 --> 00:30:22,640
ideas we bounce ideas off of each other

853
00:30:26,710 --> 00:30:24,799
and so it seems almost naturally

854
00:30:28,470 --> 00:30:26,720
especially if it takes 25 years from one

855
00:30:32,149 --> 00:30:28,480
major encounter to the next that you

856
00:30:37,350 --> 00:30:34,389
acquired a relationship with the younger

857
00:30:39,029 --> 00:30:37,360
generation and it's easy to say hey

858
00:30:40,950 --> 00:30:39,039
let's get these guys involved let's

859
00:30:42,389 --> 00:30:40,960
don't let's ask them to work on this you

860
00:30:43,990 --> 00:30:42,399
know they have lots of great ideas

861
00:30:45,669 --> 00:30:44,000
they're full of energy you know let's

862
00:30:46,950 --> 00:30:45,679
let's you know bring everybody on board

863
00:30:48,870 --> 00:30:46,960

it didn't seem like you had to put a lot

864
00:30:51,510 --> 00:30:48,880
of deep thought on how you're going to

865
00:30:53,430 --> 00:30:51,520
do it it just came naturally i mean one

866
00:30:54,710 --> 00:30:53,440
striking thing is that a fair number of

867
00:30:57,909 --> 00:30:54,720
those people that were the senior

868
00:30:59,990 --> 00:30:57,919
scientists at voyager neptune are still

869
00:31:01,830 --> 00:31:00,000
involved and still some of the key

870
00:31:03,190 --> 00:31:01,840
people working in our field so i don't

871
00:31:05,669 --> 00:31:03,200
know what that means maybe it's good for

872
00:31:07,430 --> 00:31:05,679
your health planetary encounters or it's

873
00:31:10,310 --> 00:31:07,440
just good good to be engaged in a

874
00:31:11,990 --> 00:31:10,320
long-term endeavor um i've got a

875
00:31:13,430 --> 00:31:12,000
question that maybe bonnie you'd take a

876
00:31:15,830 --> 00:31:13,440
first crack at and then anybody else

877
00:31:17,990 --> 00:31:15,840
could chime in wha what was the biggest

878
00:31:21,110 --> 00:31:18,000
surprise for you about voyager at

879
00:31:23,110 --> 00:31:21,120
neptune and at triton and um what would

880
00:31:24,630 --> 00:31:23,120
surprise you the most about the pluto

881
00:31:27,029 --> 00:31:24,640
system okay i would say the biggest

882
00:31:29,590 --> 00:31:27,039
surprise at neptune was the plumes on

883
00:31:32,389 --> 00:31:29,600
triton here is this

884
00:31:35,350 --> 00:31:32,399
really you know very cold so cold that

885
00:31:38,070 --> 00:31:35,360
it's about minus 400 degrees 400 degrees

886
00:31:40,070 --> 00:31:38,080
fahrenheit i mean it gets about one

887
00:31:42,710 --> 00:31:40,080
tenth of one percent of the radiation

888
00:31:45,110 --> 00:31:42,720

that the earth gets solar radiation and

889
00:31:47,990 --> 00:31:45,120
here when we approached we saw these

890
00:31:50,310 --> 00:31:48,000
polar caps that were sublimating away

891
00:31:52,230 --> 00:31:50,320
disappearing and these plumes were

892
00:31:54,710 --> 00:31:52,240
spouting out this dark material that was

893
00:31:56,789 --> 00:31:54,720
totally unexpected nobody predicted this

894
00:31:58,950 --> 00:31:56,799
and this is what i would be surprised at

895
00:32:01,190 --> 00:31:58,960
pluto if we didn't see something like

896
00:32:03,269 --> 00:32:01,200
that because we have been watching pluto

897
00:32:04,870 --> 00:32:03,279
as a little pinpoint of light in the sky

898
00:32:07,430 --> 00:32:04,880
that we see from the telescope we've

899
00:32:09,350 --> 00:32:07,440
been looking at that for really decades

900
00:32:11,909 --> 00:32:09,360
now and it looks like there's

901
00:32:14,149 --> 00:32:11,919
the frost patterns are changing and i

902
00:32:15,990 --> 00:32:14,159
think the polar caps are sublimating

903
00:32:17,830 --> 00:32:16,000
away and we're going to see plumes i

904
00:32:20,870 --> 00:32:17,840
think i'd be surprised if we did not see

905
00:32:23,750 --> 00:32:20,880
the same types of plumes on pluto that

906
00:32:25,909 --> 00:32:23,760
we saw on triton

907
00:32:27,590 --> 00:32:25,919
i like that i hope you're right i think

908
00:32:29,750 --> 00:32:27,600
so too

909
00:32:32,630 --> 00:32:29,760
anybody else surprises from neptune

910
00:32:35,029 --> 00:32:32,640
triton and what would surprise you at

911
00:32:37,110 --> 00:32:35,039
pluto the most surprising thing to me

912
00:32:40,310 --> 00:32:37,120
was the so-called cantaloupe terrain it

913
00:32:42,070 --> 00:32:40,320

was a a whole region of triton which

914
00:32:44,230 --> 00:32:42,080
looked like nothing we'd ever seen

915
00:32:45,590 --> 00:32:44,240
anyplace else in the solar system and we

916
00:32:47,509 --> 00:32:45,600
had just come off ten years of

917
00:32:50,310 --> 00:32:47,519
exploration of the outer solar system

918
00:32:51,990 --> 00:32:50,320
and its uh and its satellites with uh

919
00:32:53,430 --> 00:32:52,000
voyagers one and two and so we thought

920
00:32:55,110 --> 00:32:53,440
we'd seen at least a little bit of

921
00:32:56,870 --> 00:32:55,120
everything no we hadn't really was

922
00:32:58,950 --> 00:32:56,880
something and now for something

923
00:33:00,389 --> 00:32:58,960
completely different cantaloupe terrain

924
00:33:02,710 --> 00:33:00,399
and i guess the one thing i would be

925
00:33:07,350 --> 00:33:02,720
truly surprised if we got to pluto was

926
00:33:13,590 --> 00:33:09,269
well i'll be truly surprised if we see

927
00:33:17,830 --> 00:33:16,950
really setting the bar there friend

928
00:33:19,990 --> 00:33:17,840
well

929
00:33:22,070 --> 00:33:20,000
speaking of the dangerous art of

930
00:33:24,870 --> 00:33:22,080
prediction

931
00:33:26,710 --> 00:33:24,880
i think it's clear that really nobody is

932
00:33:28,630 --> 00:33:26,720
any good at predicting the future i mean

933
00:33:30,870 --> 00:33:28,640
you think of the movie 2001 as space

934
00:33:32,470 --> 00:33:30,880
odyssey it was 33 years from the making

935
00:33:35,509 --> 00:33:32,480
of that movie until

936
00:33:36,310 --> 00:33:35,519
the year 2001 and look how far off the

937
00:33:38,470 --> 00:33:36,320
mark

938
00:33:40,230 --> 00:33:38,480

that future was i mean it's not even

939
00:33:43,750 --> 00:33:40,240
here yet right

940
00:33:45,590 --> 00:33:43,760
here we have 2014. um so um but i want

941
00:33:47,909 --> 00:33:45,600
to take i want you all to take a stab at

942
00:33:51,350 --> 00:33:47,919
anyways or anybody who any among you who

943
00:33:53,430 --> 00:33:51,360
dare in another 25 years from now

944
00:33:56,070 --> 00:33:53,440
what will we be doing in the solar

945
00:33:58,070 --> 00:33:56,080
system um and of course we'll all gather

946
00:34:02,070 --> 00:33:58,080
here together in this room and watch

947
00:34:08,069 --> 00:34:05,190
any thoughts 25 years from now i

948
00:34:10,389 --> 00:34:08,079
i want to go back to triton damn it

949
00:34:12,470 --> 00:34:10,399
yes oh i'm sorry yes titan or triton

950
00:34:14,710 --> 00:34:12,480
that's right try try this yes

951
00:34:16,869 --> 00:34:14,720
um i want that glimpse that wonderful

952
00:34:18,950 --> 00:34:16,879
glimpse we got 25 years ago not to be

953
00:34:20,869 --> 00:34:18,960
the last we see of triton in

954
00:34:22,869 --> 00:34:20,879
in our lifetimes i

955
00:34:25,829 --> 00:34:22,879
uh

956
00:34:29,030 --> 00:34:25,839
i i have this emotional connection to to

957
00:34:32,230 --> 00:34:30,869
it's a beautiful planet it looks kind of

958
00:34:35,909 --> 00:34:32,240
like the earth it's blue with white

959
00:34:37,909 --> 00:34:35,919
clouds um it's an incredibly rich system

960
00:34:40,470 --> 00:34:37,919
with uh

961
00:34:42,550 --> 00:34:40,480
all these amazing phenomena on on triton

962
00:34:44,710 --> 00:34:42,560
that we didn't get to

963
00:34:46,790 --> 00:34:44,720

uh really understand with

964
00:34:49,430 --> 00:34:46,800
even the amazing discoveries of voyager

965
00:34:51,109 --> 00:34:49,440
and so i'm

966
00:34:53,430 --> 00:34:51,119
i don't know if we'll get back in 25

967
00:34:55,510 --> 00:34:53,440
years but i'm hoping we get back there

968
00:34:57,270 --> 00:34:55,520
someday um

969
00:34:59,109 --> 00:34:57,280
but there's just so many

970
00:35:01,430 --> 00:34:59,119
uh amazing places in the outer solar

971
00:35:02,950 --> 00:35:01,440
system that we can explore and

972
00:35:04,150 --> 00:35:02,960
it's hard getting to the outer solar

973
00:35:06,950 --> 00:35:04,160
system it takes

974
00:35:09,109 --> 00:35:06,960
a lot of time as we've seen here it

975
00:35:11,190 --> 00:35:09,119
takes a lot of technology but we can do

976
00:35:12,630 --> 00:35:11,200
this and i really

977
00:35:13,990 --> 00:35:12,640
hope that we're going to go back and

978
00:35:16,390 --> 00:35:14,000
follow up on some of the amazing

979
00:35:18,150 --> 00:35:16,400
discoveries that we've made okay john's

980
00:35:19,430 --> 00:35:18,160
predicting a neptune orbiter you all

981
00:35:20,550 --> 00:35:19,440
heard it here

982
00:35:22,470 --> 00:35:20,560
jeff

983
00:35:24,710 --> 00:35:22,480
well of course i'm very excited about

984
00:35:26,630 --> 00:35:24,720
the possibility that we'll be soon going

985
00:35:30,310 --> 00:35:26,640
uh back to europa and understanding

986
00:35:32,630 --> 00:35:30,320
europa which is amazing uh ice world

987
00:35:35,990 --> 00:35:32,640
it's a basically a global ocean that has

988
00:35:38,310 --> 00:35:36,000

about 10 or 15 miles of a global ice

989
00:35:39,430 --> 00:35:38,320
pack over maybe a 50 or 60 miles deep

990
00:35:40,710 --> 00:35:39,440
ocean

991
00:35:42,310 --> 00:35:40,720
it's probably

992
00:35:44,390 --> 00:35:42,320
one of the best candidates about the

993
00:35:46,470 --> 00:35:44,400
best canada in the solar system for

994
00:35:47,670 --> 00:35:46,480
extent life if it's any place other than

995
00:35:49,829 --> 00:35:47,680
on the earth

996
00:35:51,829 --> 00:35:49,839
and i think the opportunity to learn

997
00:35:53,829 --> 00:35:51,839
about the its surface has to be you know

998
00:35:55,349 --> 00:35:53,839
something i'm looking forward to and i

999
00:35:56,790 --> 00:35:55,359
think many people i feel are looking

1000
00:35:58,790 --> 00:35:56,800
forward to then after that i'd love to

1001
00:36:00,069 --> 00:35:58,800
see titan again titanium is such an

1002
00:36:01,670 --> 00:36:00,079
amazing world and you know you really

1003
00:36:03,829 --> 00:36:01,680
want it's so earth-like on its surface

1004
00:36:05,510 --> 00:36:03,839
as far as the geological processes which

1005
00:36:07,430 --> 00:36:05,520
operate there you really want to go back

1006
00:36:09,829 --> 00:36:07,440
and and study it and much more to tell

1007
00:36:11,910 --> 00:36:09,839
them we've been able to do with cassini

1008
00:36:13,349 --> 00:36:11,920
thank you any other thoughts about 25

1009
00:36:15,829 --> 00:36:13,359
years from now well i think we have to

1010
00:36:17,349 --> 00:36:15,839
focus on habitable zones areas where

1011
00:36:19,190 --> 00:36:17,359
life could potentially exist so that's

1012
00:36:22,150 --> 00:36:19,200
obviously mars that's obvious but

1013
00:36:23,829 --> 00:36:22,160

there's enceladus europa and titan and i

1014
00:36:25,910 --> 00:36:23,839
think in many respects i agree with jeff

1015
00:36:27,190 --> 00:36:25,920
that titan is really you know the most

1016
00:36:29,349 --> 00:36:27,200
earth-like it's the only place where

1017
00:36:31,910 --> 00:36:29,359
there's currently standing liquid there

1018
00:36:34,950 --> 00:36:31,920
are all sorts of you know uh drainage

1019
00:36:37,510 --> 00:36:34,960
patterns and clouds and seasons it looks

1020
00:36:39,510 --> 00:36:37,520
very seas of liquid methane exactly so

1021
00:36:40,550 --> 00:36:39,520
bigger than the great lakes yeah it

1022
00:36:41,829 --> 00:36:40,560
would be a great place to go aren't

1023
00:36:44,230 --> 00:36:41,839
there models of

1024
00:36:45,750 --> 00:36:44,240
pluto that have had a liquid interior

1025
00:36:47,430 --> 00:36:45,760
correct yes you have liquid interior but

1026
00:36:49,109 --> 00:36:47,440
probably many of the ice swirls that are

1027
00:36:52,470 --> 00:36:49,119
at least the size of the earth's moon or

1028
00:36:54,790 --> 00:36:52,480
larger probably even today have a liquid

1029
00:36:57,109 --> 00:36:54,800
layer someplace deep inside

1030
00:37:00,150 --> 00:36:57,119
the planet even the so-called boring

1031
00:37:02,870 --> 00:37:00,160
moon callisto which is a huge moon the

1032
00:37:05,349 --> 00:37:02,880
size of the planet mercury that orbits

1033
00:37:08,230 --> 00:37:05,359
uh jupiter apparently has a small liquid

1034
00:37:10,150 --> 00:37:08,240
layer so liquid layers alone are not

1035
00:37:11,829 --> 00:37:10,160
that uncommon so i'm the only one who's

1036
00:37:14,069 --> 00:37:11,839
going to advocate for life on pluto

1037
00:37:15,990 --> 00:37:14,079
friend go ahead no i'm not yes you are

1038
00:37:19,670 --> 00:37:16,000

the only one i'm going to advocate for

1039
00:37:21,109 --> 00:37:19,680
um i want to push your planet venus

1040
00:37:22,790 --> 00:37:21,119
i'm not interested in venus because it

1041
00:37:24,069 --> 00:37:22,800
doesn't have a magnetic field i study

1042
00:37:26,470 --> 00:37:24,079
magnetic fields

1043
00:37:28,390 --> 00:37:26,480
but personally i actually think i would

1044
00:37:30,150 --> 00:37:28,400
like to go back to our sister planet

1045
00:37:31,109 --> 00:37:30,160
it's our nearest neighbor it's the one

1046
00:37:33,109 --> 00:37:31,119
that is

1047
00:37:34,790 --> 00:37:33,119
boy it has a different atmosphere

1048
00:37:36,230 --> 00:37:34,800
totally different atmosphere and if we

1049
00:37:38,230 --> 00:37:36,240
want to study atmospheres and

1050
00:37:40,550 --> 00:37:38,240
atmospheric change which i think here on

1051
00:37:42,790 --> 00:37:40,560
earth we do want to know and understand

1052
00:37:45,109 --> 00:37:42,800
venus is one of the places we should go

1053
00:37:47,430 --> 00:37:45,119
huge technological challenge very very

1054
00:37:49,910 --> 00:37:47,440
difficult we'll need those rtgs to go

1055
00:37:52,550 --> 00:37:49,920
there to cool down the spacecraft so we

1056
00:37:54,550 --> 00:37:52,560
can get into this very hot place um

1057
00:37:56,790 --> 00:37:54,560
let's go to our sister planet as well

1058
00:37:58,150 --> 00:37:56,800
these are all very exciting places of

1059
00:37:59,430 --> 00:37:58,160
course i'd love to go to these places

1060
00:38:00,870 --> 00:37:59,440
it's place the size of the earth that

1061
00:38:02,870 --> 00:38:00,880
has a completely radically different

1062
00:38:05,430 --> 00:38:02,880
geology which we really don't understand

1063
00:38:08,470 --> 00:38:05,440

very well well you're not going to hear

1064
00:38:09,750 --> 00:38:08,480
me argue with that at all um clearly

1065
00:38:10,950 --> 00:38:09,760
there are a lot of there's a lot of

1066
00:38:12,550 --> 00:38:10,960
exploring left to do we're just

1067
00:38:14,310 --> 00:38:12,560
scratching the surface of the solar

1068
00:38:16,150 --> 00:38:14,320
system i haven't heard anybody abdicate

1069
00:38:18,150 --> 00:38:16,160
yet for uh amongst at least this

1070
00:38:19,910 --> 00:38:18,160
afternoon for for for the next pluto

1071
00:38:22,230 --> 00:38:19,920
mission after new horizons but i guess i

1072
00:38:24,390 --> 00:38:22,240
would point out that before

1073
00:38:25,670 --> 00:38:24,400
net before voyager at triton you

1074
00:38:28,230 --> 00:38:25,680
wouldn't have thought about the next

1075
00:38:29,589 --> 00:38:28,240
mission to triton it's once you discover

1076
00:38:31,190 --> 00:38:29,599
what these places are like that you

1077
00:38:33,829 --> 00:38:31,200
start thinking about the next step and

1078
00:38:36,630 --> 00:38:33,839
so uh we'll we'll wait and see what

1079
00:38:39,030 --> 00:38:36,640
pluto has in store for us we could keep

1080
00:38:40,390 --> 00:38:39,040
talking amongst ourselves uh for for

1081
00:38:41,990 --> 00:38:40,400
hours i can tell we're just getting

1082
00:38:44,069 --> 00:38:42,000
going with the stories but i feel like

1083
00:38:45,589 --> 00:38:44,079
we ought to involve also the audience

1084
00:38:47,670 --> 00:38:45,599
both here in the room and on social

1085
00:38:49,670 --> 00:38:47,680
media in the conversation so what i'd

1086
00:38:52,069 --> 00:38:49,680
like to do now is to turn it back over

1087
00:38:55,030 --> 00:38:52,079
to duane and he'll moderate the the q

1088
00:38:57,270 --> 00:38:55,040

and a portion of this thank you david

1089
00:38:58,630 --> 00:38:57,280
okay yeah um we're going to start with

1090
00:39:00,790 --> 00:38:58,640
social media

1091
00:39:02,710 --> 00:39:00,800
in the audience i see a lot of new faces

1092
00:39:04,630 --> 00:39:02,720
and so i'm going to open it up to the

1093
00:39:08,550 --> 00:39:04,640
floor to anyone

1094
00:39:10,950 --> 00:39:08,560
visiting us or involved in science or

1095
00:39:13,430 --> 00:39:10,960
in the schools that are here

1096
00:39:15,190 --> 00:39:13,440
even the nasa employees feel free to

1097
00:39:16,470 --> 00:39:15,200
wait for the mic and ask your question

1098
00:39:18,550 --> 00:39:16,480
but we're going to go to social media

1099
00:39:20,230 --> 00:39:18,560
and jd harrington you've got the con

1100
00:39:21,910 --> 00:39:20,240
here sir what's going on in the twitter

1101
00:39:24,230 --> 00:39:21,920
world

1102
00:39:25,430 --> 00:39:24,240
yes we do have a few questions the first

1103
00:39:27,510 --> 00:39:25,440
one is

1104
00:39:28,550 --> 00:39:27,520
how will the new horizons pictures of

1105
00:39:31,190 --> 00:39:28,560
pluto

1106
00:39:35,270 --> 00:39:31,200
compared to the voyager 2 flyby pictures

1107
00:39:39,430 --> 00:39:37,190
john but either one of you guys

1108
00:39:41,589 --> 00:39:39,440
it's uh there'll be an over an order of

1109
00:39:44,630 --> 00:39:41,599
magnitude better there'll be more than

1110
00:39:48,470 --> 00:39:44,640
10 times better than the best pictures

1111
00:39:52,310 --> 00:39:48,480
of triton taken by voyager 2.

1112
00:39:53,109 --> 00:39:52,320
i i think one measure of that is

1113
00:39:58,670 --> 00:39:53,119

the

1114
00:40:01,910 --> 00:39:58,680
camera on voyager was about

1115
00:40:03,990 --> 00:40:01,920
0.6.7 megapixels in modern digital

1116
00:40:05,430 --> 00:40:04,000
camera technology and it took these

1117
00:40:07,750 --> 00:40:05,440
fabulous pictures

1118
00:40:11,990 --> 00:40:07,760
we have the equivalent of a 25 megapixel

1119
00:40:13,430 --> 00:40:12,000
color camera on new horizons and so

1120
00:40:14,710 --> 00:40:13,440
that gives you an idea of the level of

1121
00:40:16,470 --> 00:40:14,720
detail we're going to see in these

1122
00:40:20,150 --> 00:40:16,480
pictures it's it's going to be amazing

1123
00:40:24,790 --> 00:40:22,630
excellent something to look forward to

1124
00:40:26,790 --> 00:40:24,800
our next question says

1125
00:40:31,990 --> 00:40:26,800
uh will new horizons be able to gather

1126
00:40:37,829 --> 00:40:33,910
good job yeah um

1127
00:40:39,589 --> 00:40:37,839
indeed we uh we discovered uh the two

1128
00:40:41,750 --> 00:40:39,599
moons nixon hydra just about at launch

1129
00:40:44,069 --> 00:40:41,760
so we've had plenty of time to

1130
00:40:47,990 --> 00:40:44,079
plan our observations of those as we go

1131
00:40:50,150 --> 00:40:48,000
past we come fairly close to hydra and

1132
00:40:52,230 --> 00:40:50,160
i'm sorry we come fairly close to nyx

1133
00:40:53,670 --> 00:40:52,240
and so we'll get our best pictures of

1134
00:40:55,829 --> 00:40:53,680
knicks we should have pictures of nick's

1135
00:40:58,710 --> 00:40:55,839
that are a couple hundred pixels across

1136
00:41:00,390 --> 00:40:58,720
something like that um hydra we'll we'll

1137
00:41:02,710 --> 00:41:00,400
also get uh

1138
00:41:05,349 --> 00:41:02,720

more distant pictures of uh the two new

1139
00:41:06,950 --> 00:41:05,359
moon sticks sticks and kerberos will be

1140
00:41:07,829 --> 00:41:06,960
looking at but

1141
00:41:11,109 --> 00:41:07,839
from

1142
00:41:12,390 --> 00:41:11,119
quite distant uh range because we we

1143
00:41:13,910 --> 00:41:12,400
found them

1144
00:41:15,829 --> 00:41:13,920
late enough that the encounter had

1145
00:41:18,069 --> 00:41:15,839
mostly been sequenced at that point but

1146
00:41:19,349 --> 00:41:18,079
will even those will be get good enough

1147
00:41:21,190 --> 00:41:19,359
pictures that we can tell their shapes

1148
00:41:23,510 --> 00:41:21,200
and their sizes and their colors and

1149
00:41:25,109 --> 00:41:23,520
we're very much looking forward to that

1150
00:41:26,550 --> 00:41:25,119
katie we'll take one more i'll see if we

1151
00:41:27,670 --> 00:41:26,560
have any questions here in the audience

1152
00:41:29,829 --> 00:41:27,680
and then

1153
00:41:32,309 --> 00:41:29,839
we'll begin to wrap up here

1154
00:41:36,710 --> 00:41:32,319
one more uh yes stand by for just a

1155
00:41:41,510 --> 00:41:39,349
here's a question about a future you

1156
00:41:43,829 --> 00:41:41,520
talked about 25 years from now

1157
00:41:46,309 --> 00:41:43,839
what new what new technologies are

1158
00:41:48,069 --> 00:41:46,319
needed for future outer planet missions

1159
00:41:51,109 --> 00:41:48,079
better power sources communications

1160
00:41:55,750 --> 00:41:52,870
all of those three those are the three

1161
00:41:57,829 --> 00:41:55,760
biggies right propulsion communication

1162
00:41:59,349 --> 00:41:57,839
and power absolutely those are the big

1163
00:42:02,069 --> 00:41:59,359

tough ones to do in the outer solar

1164
00:42:04,309 --> 00:42:02,079
system so we're very dependent on as jim

1165
00:42:06,790 --> 00:42:04,319
green described in the first section

1166
00:42:09,270 --> 00:42:06,800
uh we're very dependent on using our

1167
00:42:10,870 --> 00:42:09,280
radioisotope thermoelectric generators

1168
00:42:12,630 --> 00:42:10,880
rtgs to

1169
00:42:14,710 --> 00:42:12,640
power our spacecraft in the outer sole

1170
00:42:17,430 --> 00:42:14,720
system and we very much depend on our

1171
00:42:20,150 --> 00:42:17,440
doe colleagues here in helping us a

1172
00:42:22,150 --> 00:42:20,160
great partnership between doe and nasa

1173
00:42:24,470 --> 00:42:22,160
in to make this happen and we really are

1174
00:42:26,550 --> 00:42:24,480
dependent on this to be able to get to

1175
00:42:29,109 --> 00:42:26,560
the outer sole system

1176
00:42:31,750 --> 00:42:29,119
one hopes that maybe communication can

1177
00:42:34,630 --> 00:42:31,760
become more efficient but you're just

1178
00:42:37,510 --> 00:42:34,640
fighting distance and the fact that we

1179
00:42:40,309 --> 00:42:37,520
use uh electromagnetic waves to

1180
00:42:42,309 --> 00:42:40,319
communicate and so we have a limitation

1181
00:42:44,950 --> 00:42:42,319
of the forces of nature that tell us

1182
00:42:47,270 --> 00:42:44,960
this is how light and electromagnetic

1183
00:42:50,550 --> 00:42:47,280
and electromagnetic radiation works

1184
00:42:52,390 --> 00:42:50,560
radio works i don't think we can move to

1185
00:42:53,990 --> 00:42:52,400
anything else uh we're stuck with that

1186
00:42:55,990 --> 00:42:54,000
we don't have warp drive you know it'll

1187
00:42:58,150 --> 00:42:56,000
be nice to have warp drive but we don't

1188
00:43:00,150 --> 00:42:58,160

yet and so we're kind of limited with

1189
00:43:01,990 --> 00:43:00,160
how we we do things although nasa has

1190
00:43:04,550 --> 00:43:02,000
investigated things like using lasers

1191
00:43:05,750 --> 00:43:04,560
for communication

1192
00:43:07,589 --> 00:43:05,760
yeah

1193
00:43:11,990 --> 00:43:07,599
i think we've got a tuffy there trying

1194
00:43:14,790 --> 00:43:12,000
to talk with uh triton and uh and pluto

1195
00:43:16,870 --> 00:43:14,800
uh with lasers but you know we have to

1196
00:43:18,630 --> 00:43:16,880
think about how to move forward i think

1197
00:43:21,589 --> 00:43:18,640
one of the very exciting things that

1198
00:43:22,790 --> 00:43:21,599
i've noticed is the ability to do more

1199
00:43:24,710 --> 00:43:22,800
with less

1200
00:43:26,870 --> 00:43:24,720
so if we think about how we've moved

1201
00:43:30,790 --> 00:43:26,880
with new horizons to these

1202
00:43:32,870 --> 00:43:30,800
uh very lightweight low power systems

1203
00:43:34,710 --> 00:43:32,880
and i think we just we're just

1204
00:43:38,150 --> 00:43:34,720
going in that direction more and more as

1205
00:43:40,069 --> 00:43:38,160
we design instruments and spacecraft so

1206
00:43:41,670 --> 00:43:40,079
i think doing more with less is really

1207
00:43:44,550 --> 00:43:41,680
the way we're going rather than we can

1208
00:43:46,150 --> 00:43:44,560
expect radically new technologies but

1209
00:43:47,510 --> 00:43:46,160
who knows you know could be completely

1210
00:43:49,670 --> 00:43:47,520
wrong

1211
00:43:50,950 --> 00:43:49,680
yeah um there are there are certainly

1212
00:43:52,630 --> 00:43:50,960
some technologies that have been talked

1213
00:43:54,790 --> 00:43:52,640

about for a long time that can help us

1214
00:43:56,309 --> 00:43:54,800
with the outer solar system one of which

1215
00:43:58,790 --> 00:43:56,319
is aero capture

1216
00:44:00,710 --> 00:43:58,800
if we're a good one going to go back to

1217
00:44:01,829 --> 00:44:00,720
titan maybe going to orbit around titan

1218
00:44:04,630 --> 00:44:01,839
we can use

1219
00:44:06,870 --> 00:44:04,640
titan's extended atmosphere to slow us

1220
00:44:08,950 --> 00:44:06,880
down and take us into orbit or lose a

1221
00:44:11,510 --> 00:44:08,960
lot of the energy the speed it took us

1222
00:44:13,750 --> 00:44:11,520
to get there so uh people are working on

1223
00:44:15,910 --> 00:44:13,760
these this might also be a way we could

1224
00:44:18,470 --> 00:44:15,920
get back to neptune if we can use skim

1225
00:44:21,030 --> 00:44:18,480
the atmosphere of neptune or uranus if

1226
00:44:23,510 --> 00:44:21,040
we're going back there to to slow us

1227
00:44:25,349 --> 00:44:23,520
down and so people are working all these

1228
00:44:27,430 --> 00:44:25,359
angles trying to figure out which are

1229
00:44:29,990 --> 00:44:27,440
the most practical to develop further

1230
00:44:31,829 --> 00:44:30,000
and and and fly to get us to these

1231
00:44:33,510 --> 00:44:31,839
amazing places i mean just looking at

1232
00:44:34,870 --> 00:44:33,520
the difference in the new horizons

1233
00:44:36,390 --> 00:44:34,880
spacecraft compared to the voyager

1234
00:44:38,309 --> 00:44:36,400
spacecraft you really see this doing

1235
00:44:40,069 --> 00:44:38,319
more with less and

1236
00:44:42,069 --> 00:44:40,079
it's hard for us to extrapolate that

1237
00:44:43,670 --> 00:44:42,079
completely 25 years into the future but

1238
00:44:46,710 --> 00:44:43,680

one can imagine we might have some very

1239
00:44:48,630 --> 00:44:46,720
small very fast very capable spacecraft

1240
00:44:50,790 --> 00:44:48,640
one thing i also want to mention is very

1241
00:44:53,750 --> 00:44:50,800
hot topic is cubesats these are the

1242
00:44:55,109 --> 00:44:53,760
small little things and um working with

1243
00:44:57,349 --> 00:44:55,119
grad students at the university of

1244
00:44:59,670 --> 00:44:57,359
colorado they've got really exciting

1245
00:45:01,750 --> 00:44:59,680
ideas about sending a whole flotilla of

1246
00:45:03,510 --> 00:45:01,760
little cubesats out into the outer

1247
00:45:05,190 --> 00:45:03,520
planets exploring the magnetosphere of

1248
00:45:07,349 --> 00:45:05,200
jupiter for example

1249
00:45:09,430 --> 00:45:07,359
and sending back data across a big

1250
00:45:11,430 --> 00:45:09,440
volume of space you know with a mother

1251
00:45:13,750 --> 00:45:11,440
ship communicating back these are great

1252
00:45:17,430 --> 00:45:13,760
ideas that are coming out from the world

1253
00:45:22,150 --> 00:45:20,309
oh we have a couple of questions uh

1254
00:45:24,150 --> 00:45:22,160
from our audience um

1255
00:45:26,150 --> 00:45:24,160
let's uh take the young man uh if he

1256
00:45:29,109 --> 00:45:26,160
could stand up

1257
00:45:35,030 --> 00:45:31,990
what made you so interested in the

1258
00:45:39,190 --> 00:45:36,630
wow

1259
00:45:41,910 --> 00:45:39,200
what made us so interested in the

1260
00:45:43,910 --> 00:45:41,920
planets that cool that cool we live on

1261
00:45:45,109 --> 00:45:43,920
one they're fun they're fun to go

1262
00:45:47,510 --> 00:45:45,119
explore you don't know what you're going

1263
00:45:49,829 --> 00:45:47,520

to see you know when when i was about

1264
00:45:53,829 --> 00:45:49,839
your age they were sending the first

1265
00:45:56,230 --> 00:45:53,839
missions to uh to mars and to venus and

1266
00:45:58,470 --> 00:45:56,240
i was also really into science fiction

1267
00:46:00,309 --> 00:45:58,480
and just fantasies about space and the

1268
00:46:01,829 --> 00:46:00,319
two kind of blended together in my mind

1269
00:46:03,510 --> 00:46:01,839
just like traveling through space and

1270
00:46:05,270 --> 00:46:03,520
seeing new worlds i just couldn't

1271
00:46:06,950 --> 00:46:05,280
imagine anything cooler and then i

1272
00:46:09,750 --> 00:46:06,960
discovered that you could actually do

1273
00:46:11,510 --> 00:46:09,760
that as a job when you grew up it wasn't

1274
00:46:13,589 --> 00:46:11,520
just something that you like sort of did

1275
00:46:15,190 --> 00:46:13,599
for fun and saw in the movies and so i i

1276
00:46:16,150 --> 00:46:15,200
couldn't imagine wanting to do anything

1277
00:46:17,589 --> 00:46:16,160
else

1278
00:46:20,390 --> 00:46:17,599
that's a very good answer i can't do

1279
00:46:25,589 --> 00:46:22,790
yeah it's it's it is science fiction

1280
00:46:28,390 --> 00:46:25,599
come to life we actually get to fly

1281
00:46:30,870 --> 00:46:28,400
to other planets i mean

1282
00:46:33,430 --> 00:46:30,880
it's it's unimaginable that we we we get

1283
00:46:35,030 --> 00:46:33,440
to do these amazing things that this

1284
00:46:37,270 --> 00:46:35,040
nation gets to do these amazing and it's

1285
00:46:39,109 --> 00:46:37,280
funny john used the the phrase we get to

1286
00:46:41,030 --> 00:46:39,119
fly to other planets of course we don't

1287
00:46:43,109 --> 00:46:41,040
we sit here and we send spacecraft but

1288
00:46:44,550 --> 00:46:43,119

it feels like we get to fly to other

1289
00:46:46,870 --> 00:46:44,560
planets when you work with these

1290
00:46:48,390 --> 00:46:46,880
spacecraft you start to really identify

1291
00:46:50,630 --> 00:46:48,400
with them and you almost feel like

1292
00:46:53,109 --> 00:46:50,640
you've been like with voyager it felt

1293
00:46:54,630 --> 00:46:53,119
like we were going to jupiter and saturn

1294
00:46:56,470 --> 00:46:54,640
and neptune and now it feels like we're

1295
00:46:58,950 --> 00:46:56,480
going to pluto so even though we're just

1296
00:47:00,230 --> 00:46:58,960
sending spacecraft it's very real and it

1297
00:47:01,670 --> 00:47:00,240
really does feel like you're traveling

1298
00:47:03,030 --> 00:47:01,680
through these places but it's even

1299
00:47:05,349 --> 00:47:03,040
better because they have eyes they can

1300
00:47:07,190 --> 00:47:05,359
see in the infrared and the ultraviolet

1301
00:47:08,630 --> 00:47:07,200
and detect all the magnetic fields and

1302
00:47:10,790 --> 00:47:08,640
the particles so it's actually better

1303
00:47:11,990 --> 00:47:10,800
than being there you don't have to worry

1304
00:47:13,510 --> 00:47:12,000
about humans you have to worry about

1305
00:47:15,589 --> 00:47:13,520
wearing spacesuits yeah we have

1306
00:47:17,670 --> 00:47:15,599
superhuman bionic spacecraft yeah

1307
00:47:20,230 --> 00:47:17,680
exactly that's right

1308
00:47:21,750 --> 00:47:20,240
yeah i know for me i was

1309
00:47:22,630 --> 00:47:21,760
captivated by

1310
00:47:23,990 --> 00:47:22,640
uh

1311
00:47:27,430 --> 00:47:24,000
looking at the planets through a little

1312
00:47:29,190 --> 00:47:27,440
telescope in my backyard um as a kid and

1313
00:47:31,030 --> 00:47:29,200

i remember my first view of saturn and

1314
00:47:32,390 --> 00:47:31,040
there it was with you know you could see

1315
00:47:34,309 --> 00:47:32,400
the rings it looked just like those

1316
00:47:35,670 --> 00:47:34,319
pictures in the books and

1317
00:47:38,069 --> 00:47:35,680
um

1318
00:47:41,510 --> 00:47:38,079
it's just enthralled me ever since and

1319
00:47:44,470 --> 00:47:42,950
yes sir

1320
00:47:46,390 --> 00:47:44,480
so i was thinking there perhaps is

1321
00:47:48,790 --> 00:47:46,400
another connection between new horizons

1322
00:47:51,990 --> 00:47:48,800
um flyby of pluto and

1323
00:47:54,069 --> 00:47:52,000
the voyager flyby of the neptune system

1324
00:47:56,230 --> 00:47:54,079
and that's really with triton

1325
00:47:59,109 --> 00:47:56,240
and that is um do you think

1326
00:48:01,829 --> 00:47:59,119
triton is potentially a captured kuiper

1327
00:48:03,670 --> 00:48:01,839
belt object and more akin to what pluto

1328
00:48:06,309 --> 00:48:03,680
might look like than anything else and

1329
00:48:08,390 --> 00:48:06,319
how would that how would that uh fit in

1330
00:48:11,190 --> 00:48:08,400
our ideas of the origin and evolution of

1331
00:48:14,069 --> 00:48:11,200
our solar system

1332
00:48:16,390 --> 00:48:14,079
anybody yeah i can go ahead john

1333
00:48:18,710 --> 00:48:16,400
um i i remember at the neptune encounter

1334
00:48:21,270 --> 00:48:18,720
thinking boy this is the closest this is

1335
00:48:23,030 --> 00:48:21,280
almost like seeing pluto

1336
00:48:25,190 --> 00:48:23,040
because we

1337
00:48:27,349 --> 00:48:25,200
we do believe uh i think most scientists

1338
00:48:29,670 --> 00:48:27,359

now believe that neptune

1339
00:48:31,109 --> 00:48:29,680
sorry that triton and pluto were both

1340
00:48:33,910 --> 00:48:31,119
formed in the same part of the solar

1341
00:48:35,910 --> 00:48:33,920
system and triton came close to neptune

1342
00:48:37,829 --> 00:48:35,920
got captured whereas pluto continued in

1343
00:48:40,950 --> 00:48:37,839
its own way around the solar system they

1344
00:48:42,549 --> 00:48:40,960
are siblings um and they have so much in

1345
00:48:46,549 --> 00:48:42,559
common in terms of their composition

1346
00:48:48,150 --> 00:48:46,559
their size their density and um

1347
00:48:50,710 --> 00:48:48,160
we were very aware during the whole

1348
00:48:52,230 --> 00:48:50,720
voyager mission that we got to go all

1349
00:48:54,470 --> 00:48:52,240
these places that we then knew about in

1350
00:48:56,150 --> 00:48:54,480
the outer solar system except pluto but

1351
00:48:58,230 --> 00:48:56,160
at least we got to see triton which was

1352
00:48:59,109 --> 00:48:58,240
the next best thing to getting to pluto

1353
00:49:00,069 --> 00:48:59,119
itself

1354
00:49:02,710 --> 00:49:00,079
um

1355
00:49:03,510 --> 00:49:02,720
and so it's a very big question that

1356
00:49:06,950 --> 00:49:03,520
we're

1357
00:49:09,670 --> 00:49:06,960
fascinated to learn the answer to is is

1358
00:49:12,230 --> 00:49:09,680
triton going to have this sorry is pluto

1359
00:49:13,990 --> 00:49:12,240
going to have this very exotic weird

1360
00:49:17,990 --> 00:49:14,000
cantaloupe

1361
00:49:19,750 --> 00:49:18,000
a leaky plumey surface that triton has

1362
00:49:21,910 --> 00:49:19,760
or is it going to look

1363
00:49:24,309 --> 00:49:21,920

like a much quieter less active world

1364
00:49:26,150 --> 00:49:24,319
and we don't know why triton is looks

1365
00:49:27,829 --> 00:49:26,160
the way it does and when we

1366
00:49:30,470 --> 00:49:27,839
see pluto and we see whether it has

1367
00:49:31,990 --> 00:49:30,480
those similar uh kind of patterns we

1368
00:49:33,829 --> 00:49:32,000
will learn a lot not just about pluto

1369
00:49:35,829 --> 00:49:33,839
but about triton so we'll be returning

1370
00:49:38,069 --> 00:49:35,839
the favor and pluto will then be telling

1371
00:49:39,190 --> 00:49:38,079
us about triton as well

1372
00:49:40,470 --> 00:49:39,200
okay we're going to take one more

1373
00:49:42,630 --> 00:49:40,480
question here and then we're going to

1374
00:49:44,630 --> 00:49:42,640
take one last question from social media

1375
00:49:46,230 --> 00:49:44,640
and ladies and gentlemen here in the

1376
00:49:48,309 --> 00:49:46,240
audience i think you're going to

1377
00:49:50,470 --> 00:49:48,319
recognize the name on the social media

1378
00:49:52,390 --> 00:49:50,480
question good sir

1379
00:49:54,790 --> 00:49:52,400
how excited how excited are you to see

1380
00:49:56,549 --> 00:49:54,800
the first images on a high definition tv

1381
00:49:58,710 --> 00:49:56,559
as opposed to a high-definition computer

1382
00:50:00,069 --> 00:49:58,720
screen as opposed to a tv and then can

1383
00:50:02,309 --> 00:50:00,079
you tell us about some of the lessons

1384
00:50:03,990 --> 00:50:02,319
you learned from the earlier flybys that

1385
00:50:05,510 --> 00:50:04,000
you're now applying to the new horizons

1386
00:50:07,109 --> 00:50:05,520
flyby

1387
00:50:09,510 --> 00:50:07,119
bonnie

1388
00:50:10,790 --> 00:50:09,520

um well the images are a lot better you

1389
00:50:12,710 --> 00:50:10,800
know that we're getting now so that is

1390
00:50:14,470 --> 00:50:12,720
that's pretty exciting and

1391
00:50:16,309 --> 00:50:14,480
you know what what lessons have we

1392
00:50:17,829 --> 00:50:16,319
learned

1393
00:50:19,670 --> 00:50:17,839
i think first of all as was pointed out

1394
00:50:21,430 --> 00:50:19,680
to get as many people involved get the

1395
00:50:24,069 --> 00:50:21,440
younger generation involved to welcome

1396
00:50:25,910 --> 00:50:24,079
new ideas to not be judgmental about

1397
00:50:27,829 --> 00:50:25,920
crazy ideas that people may have i mean

1398
00:50:30,230 --> 00:50:27,839
who would have predicted you know plumes

1399
00:50:31,990 --> 00:50:30,240
on on triton but i think like to open up

1400
00:50:33,589 --> 00:50:32,000
and also to communicate we really want

1401
00:50:35,750 --> 00:50:33,599
to communicate because we are supported

1402
00:50:37,670 --> 00:50:35,760
by the taxpayers and it's your data it's

1403
00:50:38,950 --> 00:50:37,680
not our data it's your data so we want

1404
00:50:40,790 --> 00:50:38,960
to make that clear that this is the

1405
00:50:44,069 --> 00:50:40,800
heritage of the american people and we

1406
00:50:47,430 --> 00:50:45,990
jd who do we have

1407
00:50:49,270 --> 00:50:47,440
well here's a question from someone

1408
00:50:51,670 --> 00:50:49,280
who's traveled the universe at least on

1409
00:50:52,790 --> 00:50:51,680
television william shatner from star

1410
00:50:55,030 --> 00:50:52,800
trek fame

1411
00:50:56,950 --> 00:50:55,040
asks what can we do to get pluto's

1412
00:50:59,349 --> 00:50:56,960
planetary status back

1413
00:51:02,870 --> 00:50:59,359

there can't be more just there can't be

1414
00:51:04,950 --> 00:51:02,880
just eight planets on our solar system

1415
00:51:07,510 --> 00:51:04,960
well

1416
00:51:10,950 --> 00:51:07,520
a question from captain captain kirk

1417
00:51:13,510 --> 00:51:10,960
um you know i mean the thing about um

1418
00:51:16,790 --> 00:51:13,520
the whole planet debate it was only

1419
00:51:19,589 --> 00:51:16,800
necessary because we've learned amazing

1420
00:51:22,470 --> 00:51:19,599
things about pluto as alan stern said

1421
00:51:24,150 --> 00:51:22,480
earlier we're exploring this new realm

1422
00:51:26,549 --> 00:51:24,160
of the solar system that we haven't

1423
00:51:29,190 --> 00:51:26,559
explored before the realm of dwarf

1424
00:51:30,470 --> 00:51:29,200
planets and dwarf planets are this

1425
00:51:31,990 --> 00:51:30,480
amazing

1426
00:51:34,710 --> 00:51:32,000
new kind of body

1427
00:51:37,109 --> 00:51:34,720
that uh you know that we're about to

1428
00:51:39,750 --> 00:51:37,119
learn a lot more about than than we have

1429
00:51:41,510 --> 00:51:39,760
you know take us into orbit captain um

1430
00:51:46,230 --> 00:51:41,520
beam us up to pluto

1431
00:51:47,829 --> 00:51:46,240
we we um you know the whole thing

1432
00:51:50,549 --> 00:51:47,839
as silly as it is comes down to whether

1433
00:51:52,630 --> 00:51:50,559
you think a dwarf planet is a planet why

1434
00:51:55,190 --> 00:51:52,640
not and that's kind of semantic people

1435
00:51:57,910 --> 00:51:55,200
are people right dwarf planets are

1436
00:51:59,750 --> 00:51:57,920
planets right come on so i mean i i

1437
00:52:01,990 --> 00:51:59,760
almost feel like we we don't need to

1438
00:52:04,150 --> 00:52:02,000

dignify ourselves with that um because

1439
00:52:05,589 --> 00:52:04,160
it's it's actually rather silly you know

1440
00:52:07,990 --> 00:52:05,599
we all agree that this is one of the

1441
00:52:10,710 --> 00:52:08,000
most fascinating places to explore we

1442
00:52:12,630 --> 00:52:10,720
all agree that um pluto is a dwarf

1443
00:52:14,150 --> 00:52:12,640
planet which is a new class of object

1444
00:52:16,230 --> 00:52:14,160
that we're going to visit and whether

1445
00:52:18,230 --> 00:52:16,240
you add that a dwarf planet is not a

1446
00:52:19,190 --> 00:52:18,240
planet that i don't know to me that's

1447
00:52:21,510 --> 00:52:19,200
personally i just think it's kind of

1448
00:52:22,710 --> 00:52:21,520
silly any other thoughts

1449
00:52:24,069 --> 00:52:22,720
actually it's interesting that william

1450
00:52:26,790 --> 00:52:24,079
shatner should ask the question because

1451
00:52:29,030 --> 00:52:26,800
there's a metaphor known as the star

1452
00:52:31,109 --> 00:52:29,040
trek bridge monitor effect in which you

1453
00:52:32,950 --> 00:52:31,119
know captain kirk you know they approach

1454
00:52:34,950 --> 00:52:32,960
an object it appears on this on the

1455
00:52:36,630 --> 00:52:34,960
bridge screen it doesn't turn to mr

1456
00:52:38,230 --> 00:52:36,640
spock and say is that a planet it's

1457
00:52:39,589 --> 00:52:38,240
immediately obvious when you see it it's

1458
00:52:41,829 --> 00:52:39,599
a planet so

1459
00:52:44,069 --> 00:52:41,839
uh next uh um that's a good point next

1460
00:52:46,950 --> 00:52:44,079
summer if something looked like pluto

1461
00:52:48,309 --> 00:52:46,960
came up on kirk's view screen

1462
00:52:49,990 --> 00:52:48,319
he wouldn't say

1463
00:52:51,829 --> 00:52:50,000

i'm sorry spock that take us somewhere

1464
00:52:53,910 --> 00:52:51,839
else that's a dwarf planet he'd say

1465
00:52:55,430 --> 00:52:53,920
that's a planet so well you know if

1466
00:52:57,030 --> 00:52:55,440
you're if you're an alien spaceship

1467
00:52:58,790 --> 00:52:57,040
coming into the solar system the only

1468
00:52:59,589 --> 00:52:58,800
four planets you would see are that you

1469
00:53:01,430 --> 00:52:59,599
know

1470
00:53:04,710 --> 00:53:01,440
jupiter saturn uranus and neptune the

1471
00:53:06,710 --> 00:53:04,720
earth mercury venus and pluto would all

1472
00:53:08,309 --> 00:53:06,720
look like you know kind of like rock so

1473
00:53:10,309 --> 00:53:08,319
if you're going to promote pluto why not

1474
00:53:12,549 --> 00:53:10,319
demote the other three you know smaller

1475
00:53:14,790 --> 00:53:12,559
planets so it really is quite arbitrary

1476
00:53:15,510 --> 00:53:14,800
it is arbitrary but i think the reason

1477
00:53:17,750 --> 00:53:15,520
this

1478
00:53:19,829 --> 00:53:17,760
question even comes up is

1479
00:53:21,510 --> 00:53:19,839
because pluto is

1480
00:53:23,510 --> 00:53:21,520
something else it's something different

1481
00:53:25,510 --> 00:53:23,520
it doesn't fit into our nice orderly

1482
00:53:27,910 --> 00:53:25,520
scheme of the rest of the solar system

1483
00:53:30,150 --> 00:53:27,920
that's telling us that the fact that we

1484
00:53:31,829 --> 00:53:30,160
have trouble classifying it giving it a

1485
00:53:34,549 --> 00:53:31,839
name tells us that it's something weird

1486
00:53:36,710 --> 00:53:34,559
and wonderful and new and exciting it's

1487
00:53:38,309 --> 00:53:36,720
it's it's not going to fit into our our

1488
00:53:39,750 --> 00:53:38,319

nice neat categories it's something

1489
00:53:41,589 --> 00:53:39,760
completely new and we can't wait to get

1490
00:53:42,710 --> 00:53:41,599
there we better go check it out let's do

1491
00:53:44,390 --> 00:53:42,720
that

1492
00:53:46,870 --> 00:53:44,400
all right well actually this is a great

1493
00:53:47,910 --> 00:53:46,880
segue before i close out i'm going to

1494
00:53:50,150 --> 00:53:47,920
ask

1495
00:53:52,470 --> 00:53:50,160
dr alan stern the new horizons principal

1496
00:53:55,349 --> 00:53:52,480
investigator from software research

1497
00:54:09,589 --> 00:53:55,359
institute in bola colorado to uh come to

1498
00:54:12,710 --> 00:54:11,109
well it's been a pleasure for all of us

1499
00:54:15,349 --> 00:54:12,720
to begin to tell you the new horizons

1500
00:54:16,870 --> 00:54:15,359
story today and to start to involve you

1501
00:54:19,030 --> 00:54:16,880
in this great

1502
00:54:21,190 --> 00:54:19,040
mission of exploration

1503
00:54:23,190 --> 00:54:21,200
uh you know new horizons

1504
00:54:24,710 --> 00:54:23,200
has so many aspects it's it's about

1505
00:54:27,829 --> 00:54:24,720
high-tech

1506
00:54:29,510 --> 00:54:27,839
uh and it's about exploration and as i

1507
00:54:33,030 --> 00:54:29,520
said at the outset

1508
00:54:35,190 --> 00:54:33,040
uh it's also about a a generational

1509
00:54:37,030 --> 00:54:35,200
change it's it's a handoff

1510
00:54:39,270 --> 00:54:37,040
from voyager exploring the middle zone

1511
00:54:42,710 --> 00:54:39,280
of the solar system to new horizons

1512
00:54:44,390 --> 00:54:42,720
going even farther and faster to explore

1513
00:54:45,190 --> 00:54:44,400

pluto and dwarf planets for the first

1514
00:54:47,109 --> 00:54:45,200
time

1515
00:54:48,150 --> 00:54:47,119
and in this wonderful panel that

1516
00:54:50,309 --> 00:54:48,160
david

1517
00:54:52,309 --> 00:54:50,319
just ran you had a chance to hear from

1518
00:54:53,670 --> 00:54:52,319
people who at the beginnings of their

1519
00:54:56,549 --> 00:54:53,680
career

1520
00:54:58,710 --> 00:54:56,559
were young scientists taking part in

1521
00:55:00,549 --> 00:54:58,720
cutting-edge exploration

1522
00:55:02,950 --> 00:55:00,559
at the neptune system

1523
00:55:05,430 --> 00:55:02,960
in their 20s and early 30s

1524
00:55:07,190 --> 00:55:05,440
scientists who had whole new worlds to

1525
00:55:08,950 --> 00:55:07,200
explore they were seeing them for the

1526
00:55:10,950 --> 00:55:08,960
first time and applying all the

1527
00:55:13,990 --> 00:55:10,960
technical skills and physics and

1528
00:55:15,829 --> 00:55:14,000
chemistry and programming skills and

1529
00:55:17,510 --> 00:55:15,839
other things that they had learned

1530
00:55:20,549 --> 00:55:17,520
to make the most of all the ones and

1531
00:55:22,390 --> 00:55:20,559
zeros the data coming down from space

1532
00:55:24,309 --> 00:55:22,400
and then you've had a chance to hear

1533
00:55:26,230 --> 00:55:24,319
what it's like

1534
00:55:28,870 --> 00:55:26,240
two and a half decades later as senior

1535
00:55:31,670 --> 00:55:28,880
scientists to be a part of new horizons

1536
00:55:35,349 --> 00:55:31,680
having a second chance to be on a

1537
00:55:37,270 --> 00:55:35,359
mission of raw exploration like this

1538
00:55:39,829 --> 00:55:37,280

but one thing about planetary science

1539
00:55:42,230 --> 00:55:39,839
and about space exploration is that it

1540
00:55:43,829 --> 00:55:42,240
is truly generational and it truly is

1541
00:55:46,789 --> 00:55:43,839
not just about the machines and the

1542
00:55:48,309 --> 00:55:46,799
technology but also about the people

1543
00:55:49,910 --> 00:55:48,319
and just as we have heard from young

1544
00:55:51,829 --> 00:55:49,920
scientists who have now become senior

1545
00:55:54,390 --> 00:55:51,839
scientists

1546
00:55:55,510 --> 00:55:54,400
young young people from the 1980s and

1547
00:55:56,309 --> 00:55:55,520
90s

1548
00:55:58,950 --> 00:55:56,319
who

1549
00:56:01,990 --> 00:55:58,960
started their careers exploring the

1550
00:56:03,990 --> 00:56:02,000
giant planets and who are now in full

1551
00:56:05,990 --> 00:56:04,000
bloom in their careers

1552
00:56:08,150 --> 00:56:06,000
exploring pluto and the kuiper belt for

1553
00:56:10,390 --> 00:56:08,160
the first time

1554
00:56:11,910 --> 00:56:10,400
we also have with us today

1555
00:56:14,230 --> 00:56:11,920
a set of young scientists who are the

1556
00:56:16,069 --> 00:56:14,240
postdocs on new horizons

1557
00:56:18,390 --> 00:56:16,079
they don't have as long a hair as the

1558
00:56:20,710 --> 00:56:18,400
voyager team did in the 80s

1559
00:56:23,829 --> 00:56:20,720
but they are at least as talented and

1560
00:56:25,910 --> 00:56:23,839
every bit as energetic and and as much

1561
00:56:27,910 --> 00:56:25,920
excited by the chance to be a part of

1562
00:56:29,990 --> 00:56:27,920
something larger than life

1563
00:56:31,750 --> 00:56:30,000

like this as these scientists were at

1564
00:56:33,030 --> 00:56:31,760
the start of their career

1565
00:56:34,470 --> 00:56:33,040
ladies and gentlemen i'd like to

1566
00:56:37,109 --> 00:56:34,480
introduce to you

1567
00:56:38,950 --> 00:56:37,119
another part of the core of discovery

1568
00:56:48,150 --> 00:56:38,960
meet the postdocs of new horizons please

1569
00:56:52,150 --> 00:56:50,150
and i'll close

1570
00:56:55,829 --> 00:56:52,160
by posing a question

1571
00:56:59,829 --> 00:56:58,390
think about the next 25 years and ask

1572
00:57:01,589 --> 00:56:59,839
yourself

1573
00:57:03,910 --> 00:57:01,599
what missions will these scientists be

1574
00:57:06,150 --> 00:57:03,920
principal investigator of in the 2040s

1575
00:57:07,510 --> 00:57:06,160
what will nasa and the united states and

1576
00:57:08,950 --> 00:57:07,520
the world be doing to explore the

1577
00:57:11,589 --> 00:57:08,960
universe then

1578
00:57:13,430 --> 00:57:11,599
with these scientists at the helm

1579
00:57:14,950 --> 00:57:13,440
thank you again everyone we've really

1580
00:57:16,950 --> 00:57:14,960
enjoyed the afternoon and we look

1581
00:57:18,710 --> 00:57:16,960
forward to bringing you this encounter

1582
00:57:27,030 --> 00:57:18,720
with pluto next year

1583
00:57:30,470 --> 00:57:28,710
thank you alan and thank you all for

1584
00:57:33,750 --> 00:57:30,480
joining us today on our double header

1585
00:57:36,150 --> 00:57:33,760
about new horizons 2015.