1
00:00:09,200 --> 00:00:06,710
well good afternoon and welcome back to

2
00:00:12,169 --> 00:00:09,210
NASA headquarters for part two of the

3
00:00:13,910 --> 00:00:12,179
Pluto New Horizons encounter briefing

4
00:00:16,340 --> 00:00:13,920
I'm Dwane Brown with the Office of

5
00:00:18,500 --> 00:00:16,350
Communications and a first briefing you

6
00:00:23,349 --> 00:00:18,510
heard about the incredible science and

7
00:00:26,660 --> 00:00:23,359
data the timeline of history-making

8
00:00:32,450 --> 00:00:26,670
spacecraft and it prepares to encounter

9
00:00:34,580 --> 00:00:32,460
the Pluto system in July now you were

10
00:00:39,049 --> 00:00:34,590
here in more detail about the unique

11
00:00:42,590 --> 00:00:39,059
spacecraft and some challenges that they

12
00:00:44,660 --> 00:00:42,600
will be closely monitoring we'll have

13
00:00:48,110 --> 00:00:44,670

brief presentations from our panel then

14
00:00:50,029 --> 00:00:48,120
we're opening up questions starting here

15
00:00:52,189 --> 00:00:50,039
our phone lines and of course social

16
00:00:55,160 --> 00:00:52,199
media social media is abuzz with this

17
00:00:59,000 --> 00:00:55,170
upcoming encounter and flyby send those

18
00:01:01,160 --> 00:00:59,010
questions in at hashtag ask NASA and as

19
00:01:04,910 --> 00:01:01,170
always you can get updates on this

20
00:01:07,460 --> 00:01:04,920
mission the data images and a whole host

21
00:01:09,260 --> 00:01:07,470
of other outreach and communications

22
00:01:13,700 --> 00:01:09,270
activities that will be accompanying

23
00:01:16,820 --> 00:01:13,710
this worldwide interests at WWDC gov

24
00:01:19,100 --> 00:01:16,830
slash New Horizons before we get started

25
00:01:22,940 --> 00:01:19,110
let me introduce you to the panel for

26
00:01:26,420 --> 00:01:22,950
our second part briefing first up Jim

27
00:01:32,320 --> 00:01:26,430
Green director of planetary science NASA

28
00:01:34,990 --> 00:01:32,330
headquarters Glen fountain

29
00:01:37,870 --> 00:01:35,000
New Horizons project manager Johns

30
00:01:43,240 --> 00:01:37,880
Hopkins University Applied Physics

31
00:01:45,730 --> 00:01:43,250
Laboratory in Laurel Maryland Allen

32
00:01:47,830 --> 00:01:45,740
Stern New Horizons principal

33
00:01:53,800 --> 00:01:47,840
investigator Southwest Research

34
00:01:54,370 --> 00:01:53,810
Institute Louisville Colorado and how

35
00:01:56,830 --> 00:01:54,380
Weaver

36
00:01:59,980 --> 00:01:56,840
New Horizons project scientists from

37
00:02:03,010 --> 00:01:59,990
Johns Hopkins University Applied Physics

38
00:02:04,870 --> 00:02:03,020

Laboratory in Lowell Merlin and with

39
00:02:07,510 --> 00:02:04,880
that yeah that's yours

40
00:02:11,890 --> 00:02:07,520
thank you very much Duane New Horizons

41
00:02:14,760 --> 00:02:11,900
was launched in 2006 and so it's been

42
00:02:17,620 --> 00:02:14,770
more than nine and a half years in space

43
00:02:20,290 --> 00:02:17,630
but I want to congratulate the team for

44
00:02:22,330 --> 00:02:20,300
getting it here you know for many more

45
00:02:24,070 --> 00:02:22,340
years prior to that all the hard work

46
00:02:26,740 --> 00:02:24,080
that they've went into to be able to

47
00:02:29,500 --> 00:02:26,750
design build and get it onto the launch

48
00:02:33,130 --> 00:02:29,510
pad and then get it launched and what a

49
00:02:36,880 --> 00:02:33,140
marvelous machine it is here's a 1/8

50
00:02:40,900 --> 00:02:36,890
scale model of New Horizons now this is

51
00:02:44,140 --> 00:02:40,910
about the size of a baby grand piano but

52
00:02:46,449 --> 00:02:44,150
it is carrying a beautiful symphony of

53
00:02:49,810 --> 00:02:46,459
instruments with it that will play

54
00:02:52,990 --> 00:02:49,820
together all during this encounter this

55
00:02:56,740 --> 00:02:53,000
is truly a remarkable machine but this

56
00:03:00,250 --> 00:02:56,750
is no simple flyby you know Pluto is

57
00:03:04,000 --> 00:03:00,260
more than four and a half light hours

58
00:03:07,990 --> 00:03:04,010
away from the earth with round-trip time

59
00:03:10,690 --> 00:03:08,000
of nine hours the spacecraft has got to

60
00:03:13,210 --> 00:03:10,700
work flawlessly in a very automated

61
00:03:15,790 --> 00:03:13,220
fashion it's perhaps one of our most

62
00:03:19,060 --> 00:03:15,800
automated planetary spacecraft ever

63
00:03:21,759 --> 00:03:19,070

launched I also want to take special

64
00:03:25,810 --> 00:03:21,769
note that we're flying into the unknown

65
00:03:28,539 --> 00:03:25,820
and it's really because of that that we

66
00:03:31,570 --> 00:03:28,549
have to anticipate not only what we

67
00:03:34,509 --> 00:03:31,580
think we'll observe but also what we

68
00:03:36,729 --> 00:03:34,519
cannot see right now but will will be

69
00:03:38,350 --> 00:03:36,739
illuminated to us as we get closer and

70
00:03:41,320 --> 00:03:38,360
closer to the Pluto system

71
00:03:43,180 --> 00:03:41,330
now that means exciting new things will

72
00:03:45,640 --> 00:03:43,190
come about that will want to take

73
00:03:47,770 --> 00:03:45,650
advantage of but we also have to

74
00:03:51,449 --> 00:03:47,780
be very careful that those exciting new

75
00:03:55,119 --> 00:03:51,459
things don't present hazards and cause

76
00:03:57,789 --> 00:03:55,129
submission problems along the way so our

77
00:04:00,850 --> 00:03:57,799
plan for today is really very simple I

78
00:04:03,399 --> 00:04:00,860
want to have everyone take a glimpse of

79
00:04:05,530 --> 00:04:03,409
not only a spacecrafts fantastic

80
00:04:08,890 --> 00:04:05,540
capabilities and how it's going to

81
00:04:11,920 --> 00:04:08,900
execute this mission but also introduce

82
00:04:13,960 --> 00:04:11,930
some of the major challenges that we may

83
00:04:16,719 --> 00:04:13,970
have to face to be able to make this

84
00:04:20,289 --> 00:04:16,729
mission successful and to start off

85
00:04:23,260 --> 00:04:20,299
let's have Glen fountain the New

86
00:04:26,110 --> 00:04:23,270
Horizons project manager from Johns

87
00:04:28,990 --> 00:04:26,120
Hopkins Glen thank you Jim

88
00:04:31,719 --> 00:04:29,000

well it's my pleasure today to spend a

89
00:04:33,939 --> 00:04:31,729
little time with you and tell you some

90
00:04:36,159 --> 00:04:33,949
more details about the spacecraft you

91
00:04:38,969 --> 00:04:36,169
heard a little bit about it from Jim

92
00:04:41,830 --> 00:04:38,979
earlier today you heard about the

93
00:04:44,200 --> 00:04:41,840
wonderful instrument package that we're

94
00:04:47,260 --> 00:04:44,210
carrying and it's the spacecraft's job

95
00:04:50,740 --> 00:04:47,270
to get those instruments to the right

96
00:04:55,029 --> 00:04:50,750
place in the Pluto system at the right

97
00:04:56,980 --> 00:04:55,039
time to point them toward the system and

98
00:04:59,080 --> 00:04:56,990
to be able to observe the parts of the

99
00:05:04,089 --> 00:04:59,090
system that we are going to investigate

100
00:05:07,570 --> 00:05:04,099
and then to get the data back so we had

101
00:05:10,060 --> 00:05:07,580
a number of challenges as we went in and

102
00:05:12,969 --> 00:05:10,070
to design this and fabricate the

103
00:05:14,379 --> 00:05:12,979
spacecraft first is it's a long way to

104
00:05:17,170 --> 00:05:14,389
Pluto as you've heard three billion

105
00:05:19,899 --> 00:05:17,180
miles and to get there in a reasonable

106
00:05:22,029 --> 00:05:19,909
time reasonable for us was nine and a

107
00:05:25,300 --> 00:05:22,039
half years you had to make the

108
00:05:28,570 --> 00:05:25,310
spacecraft light and you had to make the

109
00:05:30,909 --> 00:05:28,580
spacecraft be on a rocket and be able to

110
00:05:34,689 --> 00:05:30,919
withstand the environment of that rocket

111
00:05:37,060 --> 00:05:34,699
that went very fast to get us there so

112
00:05:39,909 --> 00:05:37,070
we built a spacecraft that was about a

113
00:05:43,510 --> 00:05:39,919

thousand pounds the sizes you heard of a

114
00:05:47,170 --> 00:05:43,520
grand piano and here is a graphic that

115
00:05:48,939 --> 00:05:47,180
you see of that with a person standing

116
00:05:52,810 --> 00:05:48,949
by it almost as though he's playing that

117
00:05:55,540 --> 00:05:52,820
grand piano and it also has this big

118
00:05:57,760 --> 00:05:55,550
salad bowl looking thin on the top of it

119
00:05:59,320 --> 00:05:57,770
our high gain antenna while Charles

120
00:06:03,070 --> 00:05:59,330
speak to more about

121
00:06:07,529 --> 00:06:03,080
later in my next graphic I want to talk

122
00:06:11,679 --> 00:06:07,539
about the next challenge we're operating

123
00:06:14,499 --> 00:06:11,689
so far from the Sun that the intensity

124
00:06:18,610 --> 00:06:14,509
of the light is one one thousandth of

125
00:06:22,689 --> 00:06:18,620
its intensity here at earth solar rays

126
00:06:24,670 --> 00:06:22,699
do not work they're lucky for us the

127
00:06:28,270 --> 00:06:24,680
Department of Energy early in the Space

128
00:06:30,159 --> 00:06:28,280
Age developed a power system that would

129
00:06:32,070 --> 00:06:30,169
operate in these conditions is called a

130
00:06:35,080 --> 00:06:32,080
radioisotope thermoelectric generator

131
00:06:41,409 --> 00:06:35,090
are an ort gyah that you see here

132
00:06:45,790 --> 00:06:41,419
pointed to it carries uses 24 pounds of

133
00:06:48,550 --> 00:06:45,800
plutonium which in its decayed generates

134
00:06:51,999 --> 00:06:48,560
heat and that heat is turned into

135
00:06:54,339 --> 00:06:52,009
electricity we use 200 watts is what it

136
00:06:56,680 --> 00:06:54,349
produces at Pluto and it's that 200

137
00:07:02,800 --> 00:06:56,690
Watts we used to operate the spacecraft

138
00:07:05,559 --> 00:07:02,810

in the next image is how to keep the

139
00:07:07,540 --> 00:07:05,569
instruments and the operating the

140
00:07:11,619 --> 00:07:07,550
electronics and all the components of

141
00:07:14,170 --> 00:07:11,629
the spacecraft reasonably warm so we

142
00:07:16,450 --> 00:07:14,180
have designed a very efficient thermal

143
00:07:18,670 --> 00:07:16,460
blanket that's our own thermos bottle if

144
00:07:20,469 --> 00:07:18,680
you will so that the inside of the

145
00:07:24,059 --> 00:07:20,479
spacecraft is operating at room

146
00:07:28,119 --> 00:07:24,069
temperature it is hardly deviated from

147
00:07:29,649 --> 00:07:28,129
about 22 degrees for nine years as we've

148
00:07:33,399 --> 00:07:29,659
flown across the solar system

149
00:07:34,689 --> 00:07:33,409
while external temperatures first near

150
00:07:37,420 --> 00:07:34,699
the Sun you were getting a lot of

151
00:07:40,570 --> 00:07:37,430
sunlight but at Pluto as we go by Pluto

152
00:07:44,439 --> 00:07:40,580
is minus 400 degrees Fahrenheit yet the

153
00:07:48,779 --> 00:07:44,449
spacecraft remains quite warm so in the

154
00:07:51,879 --> 00:07:48,789
next image we go back to the salad bowl

155
00:07:53,920 --> 00:07:51,889
the high gain antenna which is the

156
00:07:57,700 --> 00:07:53,930
principal means of communicating between

157
00:08:02,350 --> 00:07:57,710
the spacecraft and earth communication

158
00:08:04,540 --> 00:08:02,360
system uses 12 watt transmitters think

159
00:08:06,670 --> 00:08:04,550
of it as the power of two night lights

160
00:08:09,040 --> 00:08:06,680
for night look three night lights I'll

161
00:08:12,420 --> 00:08:09,050
get it right there right that is the

162
00:08:14,939 --> 00:08:12,430
power that we are using to signal back

163
00:08:18,780 --> 00:08:14,949

transmit the data from the spacecraft to

164
00:08:22,740 --> 00:08:18,790
earth over those three billion miles 12

165
00:08:26,159 --> 00:08:22,750
watts and with that we get data rates

166
00:08:29,640 --> 00:08:26,169
back at 2 kilobits per second in our

167
00:08:32,370 --> 00:08:29,650
fastest rates and we to do that we have

168
00:08:36,180 --> 00:08:32,380
to point the antenna at the earth to

169
00:08:38,190 --> 00:08:36,190
within 7 tenths of a degree for much of

170
00:08:39,899 --> 00:08:38,200
its journey across the solar system we

171
00:08:42,510 --> 00:08:39,909
have operated the spacecraft in a

172
00:08:45,240 --> 00:08:42,520
spinning mode we spun it up like a top

173
00:08:47,970 --> 00:08:45,250
with the antenna pointed toward the

174
00:08:50,610 --> 00:08:47,980
earth or where the earth will be in a

175
00:08:51,600 --> 00:08:50,620
few months we would then operate the

176
00:08:53,160 --> 00:08:51,610
spacecraft on what we call the

177
00:08:55,710 --> 00:08:53,170
hibernation mode for most of this period

178
00:08:59,519 --> 00:08:55,720
of time we turn most of the systems off

179
00:09:02,280 --> 00:08:59,529
and we let it just fly through the space

180
00:09:04,470 --> 00:09:02,290
and that keeps the wear and tear down if

181
00:09:06,000 --> 00:09:04,480
you will on the spacecraft and every

182
00:09:07,860 --> 00:09:06,010
month we would listen to the spacecraft

183
00:09:11,550 --> 00:09:07,870
get telemetry back from the spacecraft

184
00:09:15,900 --> 00:09:11,560
and we've been operating operating that

185
00:09:18,030 --> 00:09:15,910
way for these nine years the mid-game

186
00:09:20,670 --> 00:09:18,040
the mga that there is the mid gain

187
00:09:23,730 --> 00:09:20,680
antenna that allows us to have a little

188
00:09:26,340 --> 00:09:23,740

wider field of view for the antenna so

189
00:09:28,740 --> 00:09:26,350
that as we point several degrees to

190
00:09:31,470 --> 00:09:28,750
where the earth will be later we can

191
00:09:33,300 --> 00:09:31,480
still communicate at low bit rates to

192
00:09:34,829 --> 00:09:33,310
the spacecraft so we can continually

193
00:09:38,430 --> 00:09:34,839
keep in communication with the

194
00:09:40,940 --> 00:09:38,440
spacecraft as you heard earlier it's

195
00:09:45,600 --> 00:09:40,950
four and a half hours one-way light time

196
00:09:47,699 --> 00:09:45,610
so all of our observing programs have to

197
00:09:50,910 --> 00:09:47,709
be pre-programmed onto the spacecraft

198
00:09:53,460 --> 00:09:50,920
and they're stored in an on-board

199
00:09:56,329 --> 00:09:53,470
computer and then they operate the

200
00:10:00,300 --> 00:09:56,339
spacecraft as we fly through the system

201
00:10:03,600 --> 00:10:00,310
the main part of the observing programme

202
00:10:06,810 --> 00:10:03,610
is in a nine day period seven days prior

203
00:10:09,420 --> 00:10:06,820
to in two days after closest approach we

204
00:10:13,620 --> 00:10:09,430
call that the core load that's where we

205
00:10:15,990 --> 00:10:13,630
get the primary science and then we will

206
00:10:19,650 --> 00:10:16,000
later store that data as we go through

207
00:10:22,140 --> 00:10:19,660
the system on our 64 gigabit solid-state

208
00:10:24,840 --> 00:10:22,150
recorders and then play it back slowly

209
00:10:26,120 --> 00:10:24,850
over 16 months once we get the data on

210
00:10:28,400 --> 00:10:26,130
so we we gather

211
00:10:30,020 --> 00:10:28,410
the data very very quickly because we're

212
00:10:32,300 --> 00:10:30,030
only we're going through the system and

213
00:10:35,420 --> 00:10:32,310

and the majority of the data is only a

214
00:10:37,100 --> 00:10:35,430
few hours around closest approach so

215
00:10:39,770 --> 00:10:37,110
that data is stored on the recorders and

216
00:10:43,010 --> 00:10:39,780
then we spool it back over the next 16

217
00:10:45,680 --> 00:10:43,020
months in the next chart I'll talk a

218
00:10:48,350 --> 00:10:45,690
little bit about how we point so this is

219
00:10:50,480 --> 00:10:48,360
a model of the spacecraft and as we've

220
00:10:52,690 --> 00:10:50,490
been flying we've been flying with the

221
00:10:56,630 --> 00:10:52,700
antenna mostly pointed to the earth and

222
00:11:00,020 --> 00:10:56,640
then we will can rotate the spacecraft

223
00:11:02,750 --> 00:11:00,030
toss it to D spend and then operate it

224
00:11:05,270 --> 00:11:02,760
in a three axis mode so we can point the

225
00:11:06,830 --> 00:11:05,280
instruments here's Laurie the long-range

226
00:11:09,770 --> 00:11:06,840
reconnaissance imager that you're going

227
00:11:12,500 --> 00:11:09,780
to hear a lot about at various objects

228
00:11:14,720 --> 00:11:12,510
we can then point using these thrusters

229
00:11:16,790 --> 00:11:14,730
that you see here in this image so they

230
00:11:20,300 --> 00:11:16,800
allow us to slowly move the spacecraft

231
00:11:23,540 --> 00:11:20,310
back and forth on the next chart you'll

232
00:11:26,300 --> 00:11:23,550
see also two star trackers there right

233
00:11:29,300 --> 00:11:26,310
here and they allow us to determine

234
00:11:31,820 --> 00:11:29,310
where the spacecraft is pointing we also

235
00:11:34,310 --> 00:11:31,830
use an inertial measurement unit which

236
00:11:37,250 --> 00:11:34,320
is inside the spacecraft it consists of

237
00:11:40,970 --> 00:11:37,260
a laser ring ring laser gyro with mazes

238
00:11:43,430 --> 00:11:40,980

rates very precisely and it has an

239
00:11:45,530 --> 00:11:43,440
accelerometer so we can measure when we

240
00:11:47,930 --> 00:11:45,540
want to make a trajectory correction of

241
00:11:51,170 --> 00:11:47,940
the acceleration we're putting on the

242
00:11:53,750 --> 00:11:51,180
spacecraft with these components and a

243
00:11:56,180 --> 00:11:53,760
guidance control computer we can point

244
00:11:59,600 --> 00:11:56,190
the spacecraft to better than a tenth of

245
00:12:02,800 --> 00:11:59,610
a degree and we can control the rates of

246
00:12:06,040 --> 00:12:02,810
motion to one one thousandth of a degree

247
00:12:08,660 --> 00:12:06,050
per second so we get very precise

248
00:12:11,660 --> 00:12:08,670
pointing and that's how we take the data

249
00:12:14,870 --> 00:12:11,670
as we go through the system so next

250
00:12:18,710 --> 00:12:14,880
chart I want to talk a little bit about

251
00:12:21,200 --> 00:12:18,720
the resiliency of the spacecraft we're

252
00:12:24,800 --> 00:12:21,210
going a long way this takes us a long

253
00:12:27,470 --> 00:12:24,810
time to get there so we built a lot of

254
00:12:32,450 --> 00:12:27,480
redundancy in the spacecraft just in

255
00:12:35,540 --> 00:12:32,460
case some component fails so far nothing

256
00:12:39,140 --> 00:12:35,550
has failed so but we're prepared just in

257
00:12:40,400 --> 00:12:39,150
case something does fail for instance in

258
00:12:42,110 --> 00:12:40,410
this diagram you see

259
00:12:44,360 --> 00:12:42,120
that we have two integrated electronics

260
00:12:46,639 --> 00:12:44,370
modules those contains our guidance

261
00:12:48,530 --> 00:12:46,649
control computer are commanded data

262
00:12:51,470 --> 00:12:48,540
handling computer or solid state

263
00:12:54,079 --> 00:12:51,480

recorder and some other electronics on

264
00:12:55,970 --> 00:12:54,089
the next chart you'll see the

265
00:12:59,780 --> 00:12:55,980
transmitters we have two transmitters

266
00:13:03,650 --> 00:12:59,790
and two receivers in the next chart you

267
00:13:06,499 --> 00:13:03,660
see that we've got two inter I am use

268
00:13:08,420 --> 00:13:06,509
inertial measurement units and the next

269
00:13:11,629 --> 00:13:08,430
chart the two star trackers I talked

270
00:13:13,400 --> 00:13:11,639
about and in the next chart you see a

271
00:13:16,129 --> 00:13:13,410
number of thrusters we have sufficient

272
00:13:18,710 --> 00:13:16,139
thrusters on the spacecraft so any one

273
00:13:21,290 --> 00:13:18,720
thruster could fail and we can still

274
00:13:23,660 --> 00:13:21,300
complete the missions successfully so

275
00:13:26,329 --> 00:13:23,670
all those systems we've carried along

276
00:13:28,369 --> 00:13:26,339
and still maintaining the mass we needed

277
00:13:32,470 --> 00:13:28,379
the weight we needed to get there in

278
00:13:34,460 --> 00:13:32,480
nine and a half years on the next chart

279
00:13:37,189 --> 00:13:34,470
they'll want to talk about the other

280
00:13:39,679 --> 00:13:37,199
part of how you make use of this

281
00:13:42,199 --> 00:13:39,689
redundancy it's called the autonomy

282
00:13:44,509 --> 00:13:42,209
system for fault protection so we have a

283
00:13:46,970 --> 00:13:44,519
computer program that runs on one of our

284
00:13:48,860 --> 00:13:46,980
computers and it checks the system to

285
00:13:52,429 --> 00:13:48,870
see if any component is having a problem

286
00:13:55,090 --> 00:13:52,439
if a component is starting to fail it

287
00:13:58,429 --> 00:13:55,100
will switch the system to the other

288
00:14:01,999 --> 00:13:58,439

redundant component and it will then

289
00:14:03,949 --> 00:14:02,009
send a signal back to earth and say hey

290
00:14:06,769 --> 00:14:03,959
something's gone wrong you know yeah I

291
00:14:08,269 --> 00:14:06,779
intervene and and see what you need to

292
00:14:09,949 --> 00:14:08,279
do it and be sure I'm doing everything

293
00:14:13,850 --> 00:14:09,959
right as far as the spacecraft is

294
00:14:17,210 --> 00:14:13,860
concerned however when we're in that

295
00:14:19,670 --> 00:14:17,220
nine days around closest approach we

296
00:14:21,800 --> 00:14:19,680
want to take data stay to the

297
00:14:23,179 --> 00:14:21,810
observation plan that's already been

298
00:14:25,549 --> 00:14:23,189
pre-programmed that you heard about

299
00:14:28,400 --> 00:14:25,559
earlier to be sure we get the data

300
00:14:31,009 --> 00:14:28,410
because in that period of time getting

301
00:14:33,139 --> 00:14:31,019
the data is more important than than

302
00:14:35,990 --> 00:14:33,149
having the spacecraft operators

303
00:14:37,970 --> 00:14:36,000
intervene we believe that the spacecraft

304
00:14:41,090 --> 00:14:37,980
can perfectly well take care of itself

305
00:14:44,150 --> 00:14:41,100
during that period of time so that's how

306
00:14:46,790 --> 00:14:44,160
we carry fault protection and have

307
00:14:50,420 --> 00:14:46,800
enough onboard autonomy to assure that

308
00:14:52,429 --> 00:14:50,430
when we get there we get the goods so

309
00:14:54,410 --> 00:14:52,439
I'd like to then talk a little bit about

310
00:15:03,300 --> 00:14:54,420
the

311
00:15:06,660 --> 00:15:03,310
process that's been used classically and

312
00:15:10,410 --> 00:15:06,670
over these nine and a half years we've

313
00:15:14,160 --> 00:15:10,420

had to make seven small corrections to

314
00:15:17,460 --> 00:15:14,170
our trajectory the last one was last

315
00:15:19,440 --> 00:15:17,470
March and so give you some perspective

316
00:15:23,310 --> 00:15:19,450
we're traveling over thirty thousand

317
00:15:26,190 --> 00:15:23,320
miles an hour and we made a change in

318
00:15:28,200 --> 00:15:26,200
the velocity of the spacecraft of about

319
00:15:30,690 --> 00:15:28,210
three miles per hour

320
00:15:34,290 --> 00:15:30,700
that's the kind of correction we've had

321
00:15:36,450 --> 00:15:34,300
to make to be sure we get to the target

322
00:15:38,430 --> 00:15:36,460
that we're going after getting to the

323
00:15:40,770 --> 00:15:38,440
polluter system and we had to fly

324
00:15:44,820 --> 00:15:40,780
through the system at exactly the right

325
00:15:47,940 --> 00:15:44,830
point up until this point we have been

326
00:15:50,100 --> 00:15:47,950
using what is the classical doppler

327
00:15:51,890 --> 00:15:50,110
navigation techniques we've been looking

328
00:15:53,970 --> 00:15:51,900
at the changes in the frequency

329
00:15:57,240 --> 00:15:53,980
transmitted from the spacecraft to

330
00:15:59,340 --> 00:15:57,250
determine its velocity and that is how

331
00:16:02,850 --> 00:15:59,350
we've been navigating the spacecraft

332
00:16:05,220 --> 00:16:02,860
until this last summer when we begin

333
00:16:08,940 --> 00:16:05,230
using another technique called optical

334
00:16:10,770 --> 00:16:08,950
navigation optical navigation allows us

335
00:16:14,310 --> 00:16:10,780
to use the onboard instruments

336
00:16:17,460 --> 00:16:14,320
particularly Lori to observe the system

337
00:16:19,950 --> 00:16:17,470
and then compute on the ground with our

338
00:16:23,400 --> 00:16:19,960

navigators where the spacecraft is

339
00:16:26,280 --> 00:16:23,410
precisely with respect to Pluto and I'd

340
00:16:28,620 --> 00:16:26,290
like to run an animation that give you a

341
00:16:31,290 --> 00:16:28,630
little sense of that so in this the

342
00:16:34,110 --> 00:16:31,300
animation you see the spacecraft moving

343
00:16:35,850 --> 00:16:34,120
along the trajectory the green line is

344
00:16:39,270 --> 00:16:35,860
where we bend the red line is where

345
00:16:41,520 --> 00:16:39,280
we're going and we then take images like

346
00:16:44,520 --> 00:16:41,530
you see here with Laurie so this is an

347
00:16:49,110 --> 00:16:44,530
image of Pluto and we observed the star

348
00:16:51,780 --> 00:16:49,120
pattern behind Pluto and as we move

349
00:16:54,180 --> 00:16:51,790
along the trajectory you'll see the

350
00:16:55,890 --> 00:16:54,190
Stars move relative to Pluto the

351
00:16:58,079 --> 00:16:55,900
apparent motion just like when you drive

352
00:17:00,720 --> 00:16:58,089
down the road and you watch the

353
00:17:03,449 --> 00:17:00,730
telephone poles move relative to the

354
00:17:05,699 --> 00:17:03,459
background and then we get a little bit

355
00:17:07,480 --> 00:17:05,709
further along we take another image and

356
00:17:10,840 --> 00:17:07,490
we can use those images

357
00:17:13,059 --> 00:17:10,850
to work out the geometry and compute

358
00:17:16,120 --> 00:17:13,069
exactly where the spacecraft is and

359
00:17:19,210 --> 00:17:16,130
where we need to send it now we need to

360
00:17:22,120 --> 00:17:19,220
send it to a very precise point as we

361
00:17:27,100 --> 00:17:22,130
fly by Pluto we need to hit a target a

362
00:17:29,830 --> 00:17:27,110
target that's 60 by 19 miles and we need

363
00:17:33,460 --> 00:17:29,840

to hit that target as keyhole if you

364
00:17:36,070 --> 00:17:33,470
will within 100 seconds so we're flying

365
00:17:39,250 --> 00:17:36,080
three billion miles we have to hit a

366
00:17:41,560 --> 00:17:39,260
target 60 by 90 miles and we have to hit

367
00:17:43,539 --> 00:17:41,570
it within 100 seconds after nine and a

368
00:17:46,870 --> 00:17:43,549
half years that's the kind of precision

369
00:17:48,789 --> 00:17:46,880
we have to navigate to then we fly

370
00:17:51,399 --> 00:17:48,799
through the system and with this next

371
00:17:54,399 --> 00:17:51,409
graphic you'll see the path through the

372
00:17:56,889 --> 00:17:54,409
system here you see the Pluto system

373
00:17:58,810 --> 00:17:56,899
which is inclined at about 46 degrees

374
00:18:01,360 --> 00:17:58,820
with respect to the path we take through

375
00:18:04,419 --> 00:18:01,370
the system so not only do we have to hit

376
00:18:07,060 --> 00:18:04,429
this one point in the system as we fly

377
00:18:09,909 --> 00:18:07,070
by a closest approach but we have to

378
00:18:11,620 --> 00:18:09,919
also fly through in such a way we have

379
00:18:14,580 --> 00:18:11,630
to thread the needle so that we've

380
00:18:17,500 --> 00:18:14,590
passed through the shadow of Pluto and

381
00:18:18,970 --> 00:18:17,510
then the shadow of Charon just to make

382
00:18:21,010 --> 00:18:18,980
it just a little more difficult and

383
00:18:23,980 --> 00:18:21,020
that's what our navigators and our

384
00:18:26,200 --> 00:18:23,990
mission design team have to do and with

385
00:18:29,649 --> 00:18:26,210
that we collect the data and then we

386
00:18:32,139 --> 00:18:29,659
turn around and we get it home and with

387
00:18:33,610 --> 00:18:32,149
that I'll tell turn it over to Alan and

388
00:18:36,159 --> 00:18:33,620

he can tell you about some of the things

389
00:18:39,460 --> 00:18:36,169
we're gonna worry about on approach that

390
00:18:41,200 --> 00:18:39,470
I haven't talked about yet Glenn just

391
00:18:43,450 --> 00:18:41,210
did a great job of telling you about

392
00:18:45,279 --> 00:18:43,460
some of the design challenges that we

393
00:18:48,610 --> 00:18:45,289
had in building a spacecraft to fly so

394
00:18:50,860 --> 00:18:48,620
far from the earth to operate it's so

395
00:18:54,120 --> 00:18:50,870
far from home as well as so far from the

396
00:18:57,070 --> 00:18:54,130
Sun to take care of itself autonomously

397
00:18:58,630 --> 00:18:57,080
etc and and that was a great one-on-one

398
00:18:59,830 --> 00:18:58,640
on the engineering challenges what I

399
00:19:02,649 --> 00:18:59,840
want to tell you about are some of the

400
00:19:05,289 --> 00:19:02,659
environmental challenges that is playing

401
00:19:07,779 --> 00:19:05,299
off a Jim Greene's terminology we are as

402
00:19:10,570 --> 00:19:07,789
a mission of exploration flying into the

403
00:19:13,120 --> 00:19:10,580
unknown and the Pluto system itself can

404
00:19:16,779 --> 00:19:13,130
present hazards to the spacecraft now

405
00:19:18,639 --> 00:19:16,789
this is not entirely new in the first

406
00:19:20,830 --> 00:19:18,649
missions to cross the asteroid belt or

407
00:19:21,310 --> 00:19:20,840
to explore Saturn's rings in the Saturn

408
00:19:23,710 --> 00:19:21,320
system

409
00:19:26,800 --> 00:19:23,720
the first missions to go into a

410
00:19:30,880 --> 00:19:26,810
Jupiter's intense radiation fields there

411
00:19:33,850 --> 00:19:30,890
were hazards of various types that

412
00:19:36,550 --> 00:19:33,860
spacecraft teams had to deal with in our

413
00:19:38,920 --> 00:19:36,560

case with New Horizons our primary

414
00:19:41,650 --> 00:19:38,930
concern is about the possibility of

415
00:19:44,170 --> 00:19:41,660
collisions with small debris in the

416
00:19:47,080 --> 00:19:44,180
Pluto system now when the spacecraft was

417
00:19:49,510 --> 00:19:47,090
first designed it was designed with a

418
00:19:52,690 --> 00:19:49,520
Kevlar jacket to protect it from micro

419
00:19:54,280 --> 00:19:52,700
meteorite impacts and and that's a very

420
00:19:58,000 --> 00:19:54,290
good shield for crossing the solar

421
00:19:59,620 --> 00:19:58,010
system but with Pluto we have a little

422
00:20:00,880 --> 00:19:59,630
bit different challenge and I want to

423
00:20:02,740 --> 00:20:00,890
tell you some of the background about

424
00:20:06,100 --> 00:20:02,750
that but let me first stress a

425
00:20:07,930 --> 00:20:06,110
difference between New Horizons and some

426
00:20:10,050 --> 00:20:07,940
of the early exploration missions that

427
00:20:13,540 --> 00:20:10,060
had their own challenges as I just said

428
00:20:16,380 --> 00:20:13,550
in in the case of New Horizons we have

429
00:20:20,650 --> 00:20:16,390
precisely one spacecraft in one chance

430
00:20:21,040 --> 00:20:20,660
at returning the science from the Pluto

431
00:20:24,010 --> 00:20:21,050
system

432
00:20:27,160 --> 00:20:24,020
there's no Voyager 2 equivalent there's

433
00:20:29,740 --> 00:20:27,170
no Pioneer 10 and 11 pair here it's just

434
00:20:31,690 --> 00:20:29,750
one spacecraft that has to get it right

435
00:20:33,370 --> 00:20:31,700
and that needs to make it through the

436
00:20:37,330 --> 00:20:33,380
system so that it can transmit its data

437
00:20:38,560 --> 00:20:37,340
back to the earth so let me begin with a

438
00:20:41,230 --> 00:20:38,570

little bit of the astronomy and the

439
00:20:43,600 --> 00:20:41,240
Pluto system and very quickly illustrate

440
00:20:45,580 --> 00:20:43,610
what the concerns are and the challenges

441
00:20:48,850 --> 00:20:45,590
are that we're dealing with on your

442
00:20:51,190 --> 00:20:48,860
screen is a view of one of the discovery

443
00:20:54,340 --> 00:20:51,200
images from 2005 made by the Hubble

444
00:20:57,520 --> 00:20:54,350
Space Telescope of the first of two of

445
00:21:00,310 --> 00:20:57,530
two of Clio's four small moons that have

446
00:21:02,110 --> 00:21:00,320
been discovered Nix and Hydra and at the

447
00:21:05,040 --> 00:21:02,120
time that we used Hubble to make those

448
00:21:08,080 --> 00:21:05,050
discoveries we actually scoured the data

449
00:21:10,840 --> 00:21:08,090
that was available to see if there were

450
00:21:13,030 --> 00:21:10,850
additional moons in the system and we

451
00:21:16,900 --> 00:21:13,040
didn't find any we found Nix and Hydra

452
00:21:19,510 --> 00:21:16,910
but no more and and that persisted for

453
00:21:20,080 --> 00:21:19,520
about six years then if I can have the

454
00:21:25,720 --> 00:21:20,090
next slide

455
00:21:27,520 --> 00:21:25,730
in 2011 Hubble was used again with even

456
00:21:30,040 --> 00:21:27,530
more observing time that allowed us to

457
00:21:33,460 --> 00:21:30,050
penetrate deeper and lo and behold we

458
00:21:34,720 --> 00:21:33,470
found another moon and then next next

459
00:21:37,930 --> 00:21:34,730
view graph

460
00:21:40,840 --> 00:21:37,940
in 2012 we looked with Hubble again and

461
00:21:43,000 --> 00:21:40,850
we found yet another total of five moons

462
00:21:44,920 --> 00:21:43,010
for small moons and it seemed through

463
00:21:48,910 --> 00:21:44,930

our team that every time we look harder

464
00:21:51,370 --> 00:21:48,920
we find more satellites now our concern

465
00:21:53,710 --> 00:21:51,380
is not that we might hit a satellite um

466
00:21:55,660 --> 00:21:53,720
we can do those calculations and even if

467
00:21:57,550 --> 00:21:55,670
there were a very large number of

468
00:22:00,910 --> 00:21:57,560
satellites in the system the odds of

469
00:22:03,160 --> 00:22:00,920
hitting anyone are very very low the

470
00:22:05,170 --> 00:22:03,170
problem is this the Pluto system is

471
00:22:06,820 --> 00:22:05,180
flying through the Kuiper belt at about

472
00:22:09,280 --> 00:22:06,830
the speed of a bullet that's Pluto's

473
00:22:12,430 --> 00:22:09,290
orbital speed and the corporate belt

474
00:22:15,130 --> 00:22:12,440
itself is filled with debris which

475
00:22:17,350 --> 00:22:15,140
strikes Pluto no problem because when it

476
00:22:19,600 --> 00:22:17,360
does it makes a crater and Pluto's

477
00:22:21,250 --> 00:22:19,610
gravity just causes all the spray that

478
00:22:23,950 --> 00:22:21,260
comes out to fall somewhere on Pluto's

479
00:22:26,650 --> 00:22:23,960
surface that same quite per belt

480
00:22:28,900 --> 00:22:26,660
cratering process strikes Charon the big

481
00:22:32,320 --> 00:22:28,910
texas-sized satellite and it has enough

482
00:22:34,420 --> 00:22:32,330
gravity that the ejecta also just flies

483
00:22:37,180 --> 00:22:34,430
suborbital around Charon and land

484
00:22:40,270 --> 00:22:37,190
somewhere else like on our Moon or like

485
00:22:42,910 --> 00:22:40,280
on other icy satellites but the small

486
00:22:45,460 --> 00:22:42,920
moons because they're low mass have very

487
00:22:47,680 --> 00:22:45,470
low escape speeds and when they're

488
00:22:50,770 --> 00:22:47,690

cratered the eject of the spray that

489
00:22:55,120 --> 00:22:50,780
comes out of the crater gets into orbit

490
00:22:57,670 --> 00:22:55,130
around Pluto and tiny particles even the

491
00:22:59,440 --> 00:22:57,680
size of rice pellets can be lethal to

492
00:23:02,320 --> 00:22:59,450
the new Horizons spacecraft because

493
00:23:03,520 --> 00:23:02,330
we're traveling so fast thirty thousand

494
00:23:09,490 --> 00:23:03,530
plus miles an hour

495
00:23:12,430 --> 00:23:09,500
so we developed a concern that the Pluto

496
00:23:14,260 --> 00:23:12,440
system may have unseen debris either due

497
00:23:16,150 --> 00:23:14,270
to satellites we haven't discovered due

498
00:23:19,000 --> 00:23:16,160
to rings that are consisting of small

499
00:23:21,010 --> 00:23:19,010
particles or due to ejecta that comes

500
00:23:23,980 --> 00:23:21,020
out of the craters on the satellites

501
00:23:25,840 --> 00:23:23,990
that we do see and this was back in the

502
00:23:28,720 --> 00:23:25,850
twenty eleven timeframe about four years

503
00:23:30,790 --> 00:23:28,730
ago and so we put together a hazard

504
00:23:33,610 --> 00:23:30,800
analysis team within the New Horizons

505
00:23:36,070 --> 00:23:33,620
project and they began to analyze this

506
00:23:38,140 --> 00:23:36,080
problem they also went back and took

507
00:23:40,020 --> 00:23:38,150
spare parts left over from the

508
00:23:41,830 --> 00:23:40,030
construction phase of the spacecraft and

509
00:23:44,440 --> 00:23:41,840
retested them to determine their

510
00:23:48,610 --> 00:23:44,450
hardness against impacts if I can have

511
00:23:50,080 --> 00:23:48,620
the next chart the basic problem is

512
00:23:52,570 --> 00:23:50,090
alleged sword when you find small

513
00:23:53,890 --> 00:23:52,580

satellites as a scientist you're very

514
00:23:56,170 --> 00:23:53,900
happy that there are more things to

515
00:23:58,240 --> 00:23:56,180
study in the system but because those

516
00:24:02,380 --> 00:23:58,250
small satellites can generate hazards of

517
00:24:05,140 --> 00:24:02,390
their own there's also a concern

518
00:24:07,420 --> 00:24:05,150
generated by the same thing that can be

519
00:24:10,660 --> 00:24:07,430
a scientific bonanza if you look at the

520
00:24:13,840 --> 00:24:10,670
the next time step you'll be able to see

521
00:24:17,049 --> 00:24:13,850
a graph with time along the horizontal

522
00:24:19,480 --> 00:24:17,059
axis going from 2011 to the present day

523
00:24:22,990 --> 00:24:19,490
and then all on a logarithmic scale

524
00:24:25,000 --> 00:24:23,000
factors of 10 are our estimates from

525
00:24:28,020 --> 00:24:25,010
modelling and testing of what the

526
00:24:31,120 --> 00:24:28,030
probability of a loss of mission or a

527
00:24:34,090 --> 00:24:31,130
severe impact on to the spacecraft might

528
00:24:36,700 --> 00:24:34,100
be and you can see back in 2011 the

529
00:24:37,810 --> 00:24:36,710
earliest simplest calculations led us to

530
00:24:40,690 --> 00:24:37,820
believe that this could be a real

531
00:24:43,150 --> 00:24:40,700
concern but as we added more and more

532
00:24:45,790 --> 00:24:43,160
fidelity more physics to the models and

533
00:24:48,340 --> 00:24:45,800
as we did more testing of the spacecraft

534
00:24:50,950 --> 00:24:48,350
components back on earth to determine

535
00:24:52,840 --> 00:24:50,960
their hardness our our degree of concern

536
00:24:55,090 --> 00:24:52,850
declined with time and you can see that

537
00:24:57,180 --> 00:24:55,100
directly in the plot in fact the very

538
00:25:00,220 --> 00:24:57,190

best model estimates that we have today

539
00:25:02,169 --> 00:25:00,230
indicate that the probability of

540
00:25:05,620 --> 00:25:02,179
something severe happening to New

541
00:25:09,640 --> 00:25:05,630
Horizons is very low significantly less

542
00:25:13,090 --> 00:25:09,650
than 1% in fact around 1 in 10,000 is

543
00:25:16,600 --> 00:25:13,100
our best estimate but nonetheless even

544
00:25:19,360 --> 00:25:16,610
though we predict that the chance of

545
00:25:21,460 --> 00:25:19,370
something untoward happening is very low

546
00:25:24,070 --> 00:25:21,470
we want to make sure that we've taken

547
00:25:26,919 --> 00:25:24,080
every precaution to have a successful

548
00:25:29,200 --> 00:25:26,929
mission with New Horizons particularly

549
00:25:31,630 --> 00:25:29,210
if we discover things that we don't

550
00:25:35,140 --> 00:25:31,640
expect it at the models such as in this

551
00:25:37,150 --> 00:25:35,150
graph don't predict so I'll step to the

552
00:25:38,740 --> 00:25:37,160
next time chart and tell you about what

553
00:25:41,799 --> 00:25:38,750
we've done and I want to summarize

554
00:25:44,380 --> 00:25:41,809
several things first we put in place

555
00:25:47,049 --> 00:25:44,390
plans which will begin in May next month

556
00:25:48,640 --> 00:25:47,059
to image the Pluto system with the Lorri

557
00:25:51,460 --> 00:25:48,650
imager very intensively

558
00:25:54,160 --> 00:25:51,470
to make very deep images from on the

559
00:25:56,530 --> 00:25:54,170
scene on approach to Pluto to look for

560
00:25:58,630 --> 00:25:56,540
new satellites or possible rings that

561
00:26:01,870 --> 00:25:58,640
could present hazards I'll say more

562
00:26:02,450 --> 00:26:01,880
about that in a in a minute we also put

563
00:26:05,240 --> 00:26:02,460

in place

564
00:26:07,220 --> 00:26:05,250
plans to be able to divert from our

565
00:26:09,620 --> 00:26:07,230
nominal path through the Pluto system

566
00:26:12,500 --> 00:26:09,630
the green path shown in this graphic to

567
00:26:14,900 --> 00:26:12,510
one of the neighboring yellow pathways

568
00:26:18,340 --> 00:26:14,910
that give us alternatives through the

569
00:26:21,470 --> 00:26:18,350
system so that we can move over and and

570
00:26:23,570 --> 00:26:21,480
redirect the spacecraft if if we find

571
00:26:26,600 --> 00:26:23,580
something in those hazard images now

572
00:26:28,520 --> 00:26:26,610
those don't come for free

573
00:26:31,160 --> 00:26:28,530
the alternative trajectories call

574
00:26:34,900 --> 00:26:31,170
Shabbat the yellow ones which are called

575
00:26:37,460 --> 00:26:34,910
sure BOTS have less science potential

576
00:26:39,350 --> 00:26:37,470
now it may be necessary if we find

577
00:26:42,130 --> 00:26:39,360
something that's concerning about the

578
00:26:44,990 --> 00:26:42,140
the survivability of the spacecraft to

579
00:26:48,260 --> 00:26:45,000
lower our grades a little bit to make

580
00:26:49,970 --> 00:26:48,270
sure that we don't we don't fail at the

581
00:26:51,830 --> 00:26:49,980
Pluto system due to those hazards and

582
00:26:54,020 --> 00:26:51,840
we're perfectly prepared to do that

583
00:26:56,150 --> 00:26:54,030
and we've practiced that in simulations

584
00:26:59,210 --> 00:26:56,160
and we have the burn targets already

585
00:27:00,680 --> 00:26:59,220
computed so that we're ready to go if we

586
00:27:02,750 --> 00:27:00,690
need to select one of those alternate

587
00:27:04,850 --> 00:27:02,760
encounters the other thing that we've

588
00:27:08,240 --> 00:27:04,860

done is that we put in place some

589
00:27:11,120 --> 00:27:08,250
science down links just 2 days and 1 day

590
00:27:14,090 --> 00:27:11,130
before approach to get some of the very

591
00:27:17,540 --> 00:27:14,100
best data off the solid state recorders

592
00:27:19,670 --> 00:27:17,550
and down to the earth as a just in case

593
00:27:21,890 --> 00:27:19,680
like Neil Armstrong's contingency sample

594
00:27:23,690 --> 00:27:21,900
that he picked up before he did much of

595
00:27:25,790 --> 00:27:23,700
anything else to make sure that he had

596
00:27:28,370 --> 00:27:25,800
something in his pocket in case he had

597
00:27:30,230 --> 00:27:28,380
to return up the ladder by analogy we

598
00:27:31,690 --> 00:27:30,240
want to make sure that we have some some

599
00:27:33,980 --> 00:27:31,700
of the very best data on the ground

600
00:27:36,350 --> 00:27:33,990
before we pass into the heart of the

601
00:27:39,440 --> 00:27:36,360
satellite system and take any possible

602
00:27:42,800 --> 00:27:39,450
risks so we've done all of that we've

603
00:27:45,020 --> 00:27:42,810
made all of those plans and and now

604
00:27:47,300 --> 00:27:45,030
we're on the heels of the beginning of

605
00:27:50,060 --> 00:27:47,310
that dumb watch campaign so if I can

606
00:27:52,460 --> 00:27:50,070
have the next time step you see listed

607
00:27:54,530 --> 00:27:52,470
on the left in that little table the

608
00:27:57,530 --> 00:27:54,540
dates of the first days of each of a

609
00:28:00,080 --> 00:27:57,540
series of campaigns - in May and then

610
00:28:02,210 --> 00:28:00,090
several more in June as we get closer

611
00:28:05,420 --> 00:28:02,220
and closer into the Pluto system and on

612
00:28:08,000 --> 00:28:05,430
the right you see those squares that are

613
00:28:10,250 --> 00:28:08,010

overlapping fields of view from the

614
00:28:12,620 --> 00:28:10,260
Lorri imager compared to the orbits of

615
00:28:16,370 --> 00:28:12,630
Pluto's known satellites and will be

616
00:28:17,870 --> 00:28:16,380
very intensively obtaining those images

617
00:28:19,520 --> 00:28:17,880
and sending them back to the ground and

618
00:28:21,890 --> 00:28:19,530
analyzing them on the ground to

619
00:28:24,470 --> 00:28:21,900
determine what we're finding if I can

620
00:28:26,060 --> 00:28:24,480
have the next time step you see what the

621
00:28:28,580 --> 00:28:26,070
system will look like as we get much

622
00:28:30,860 --> 00:28:28,590
closer late in the month of June just

623
00:28:33,680 --> 00:28:30,870
weeks before a final approach when we're

624
00:28:35,540 --> 00:28:33,690
when we're very sensitive compared to

625
00:28:37,370 --> 00:28:35,550
anything any telescope back on the earth

626
00:28:39,230 --> 00:28:37,380
and can really search for much smaller

627
00:28:41,960 --> 00:28:39,240
satellites that have been discovered

628
00:28:45,680 --> 00:28:41,970
search for debris sheets or rings that

629
00:28:46,850 --> 00:28:45,690
could give us pause so I think you can

630
00:28:49,400 --> 00:28:46,860
see that we're taking this very

631
00:28:50,810 --> 00:28:49,410
seriously but I want to emphasize and

632
00:28:53,480 --> 00:28:50,820
I'll do this with the last time step

633
00:28:56,600 --> 00:28:53,490
that our very best knowledge of the

634
00:28:59,590 --> 00:28:56,610
Pluto system is that it does not present

635
00:29:03,380 --> 00:28:59,600
any hazard to the spacecraft nonetheless

636
00:29:06,590 --> 00:29:03,390
we have planned a very extensive seven

637
00:29:09,740 --> 00:29:06,600
week campaign to study the system as we

638
00:29:12,160 --> 00:29:09,750

fly up to it and to be prepared to take

639
00:29:14,960 --> 00:29:12,170
alternative courses through the system

640
00:29:17,630 --> 00:29:14,970
if needed our backup plans are fully in

641
00:29:20,810 --> 00:29:17,640
place fully practiced and we'll be

642
00:29:23,150 --> 00:29:20,820
reporting on those results to you every

643
00:29:26,950 --> 00:29:23,160
time that we collect hazards data so

644
00:29:31,310 --> 00:29:26,960
that you like us know what we're finding

645
00:29:33,350 --> 00:29:31,320
and if we have any concerns if you

646
00:29:35,840 --> 00:29:33,360
remember from NASA's spectacular

647
00:29:38,810 --> 00:29:35,850
curiosity Lander the phrase seven

648
00:29:41,540 --> 00:29:38,820
minutes of Terror on landing I like to

649
00:29:44,380 --> 00:29:41,550
refer to the approach to Pluto is seven

650
00:29:46,490 --> 00:29:44,390
weeks of suspense so stay tuned and

651
00:29:48,380 --> 00:29:46,500
we'll let you know the news as it

652
00:29:50,840 --> 00:29:48,390
develops from the frontier on the far

653
00:29:53,330 --> 00:29:50,850
side of the solar system and now having

654
00:29:56,120 --> 00:29:53,340
told you about the challenges to the

655
00:29:58,190 --> 00:29:56,130
spacecraft as Glen did and the the

656
00:29:59,960 --> 00:29:58,200
challenges of the Pluto system is as I

657
00:30:03,800 --> 00:29:59,970
just did Hal's going to talk about the

658
00:30:05,780 --> 00:30:03,810
opportunities ok Thank You Alan hello

659
00:30:09,110 --> 00:30:05,790
everybody so if I can have the first

660
00:30:10,940 --> 00:30:09,120
graphic please so what we're gonna do

661
00:30:14,270 --> 00:30:10,950
with the numerous ins mission has turn

662
00:30:17,780 --> 00:30:14,280
this pixelated blob into a real world

663
00:30:19,340 --> 00:30:17,790

with complexity and diversity now that

664
00:30:21,290 --> 00:30:19,350
when you think about this this image

665
00:30:24,080 --> 00:30:21,300
though this is the best you can do from

666
00:30:26,930 --> 00:30:24,090
the earth it's actually pretty darn good

667
00:30:29,180 --> 00:30:26,940
Pluto is about 1,500 miles across but

668
00:30:30,259 --> 00:30:29,190
you're observing it from 30 times

669
00:30:31,749 --> 00:30:30,269
farther from the

670
00:30:34,519 --> 00:30:31,759
earth than the earth is from the Sun

671
00:30:37,039 --> 00:30:34,529
okay and what we've learned from fifty

672
00:30:39,430 --> 00:30:37,049
years of space exploration is that if

673
00:30:41,869 --> 00:30:39,440
you really want to learn details about

674
00:30:43,699 --> 00:30:41,879
planetary objects you have to go there

675
00:30:46,430 --> 00:30:43,709
and that's what the New Horizons mission

676
00:30:49,190 --> 00:30:46,440
is going to do just thirty just three

677
00:30:51,259 --> 00:30:49,200
months from today will pass within eight

678
00:30:53,329 --> 00:30:51,269
thousand miles of the surface of Pluto

679
00:30:55,099 --> 00:30:53,339
and that's going to enable us to see

680
00:30:59,599 --> 00:30:55,109
Pluto in high-definition and in color

681
00:31:01,459 --> 00:30:59,609
then go to the next graphic so just 13

682
00:31:03,499 --> 00:31:01,469
minutes before the time of closest

683
00:31:05,930 --> 00:31:03,509
approach is going to be our highest

684
00:31:07,669 --> 00:31:05,940
resolution imaging these will be black

685
00:31:11,239 --> 00:31:07,679
and white images that we take of Pluto

686
00:31:14,060 --> 00:31:11,249
as we take this is this is a still from

687
00:31:17,149 --> 00:31:14,070
a scan that will make across Pluto the

688
00:31:19,190 --> 00:31:17,159

little orange square near the center of

689
00:31:21,319 --> 00:31:19,200
that object there this is a

690
00:31:22,699 --> 00:31:21,329
representation of Pluto with our best

691
00:31:25,430 --> 00:31:22,709
current knowledge of what the brightness

692
00:31:27,399 --> 00:31:25,440
variation is over the surface that's

693
00:31:30,879 --> 00:31:27,409
football field size resolution

694
00:31:34,819 --> 00:31:30,889
seventy-five yards is the size of the

695
00:31:38,690 --> 00:31:34,829
field of view there at the same time we

696
00:31:40,969 --> 00:31:38,700
have our color imager with the all of

697
00:31:44,539 --> 00:31:40,979
those other rectangular lines to long

698
00:31:47,779 --> 00:31:44,549
narrow things that's the M Vick color

699
00:31:49,459 --> 00:31:47,789
imager as we're sweeping across Pluto

700
00:31:51,589 --> 00:31:49,469
we'll take data with both that

701
00:31:52,629 --> 00:31:51,599
instrument and with the new and with the

702
00:31:55,579 --> 00:31:52,639
Lorri

703
00:31:57,469 --> 00:31:55,589
high-resolution black-and-white imager

704
00:32:00,199 --> 00:31:57,479
if you go to the and now I actually want

705
00:32:02,569 --> 00:32:00,209
to show you an example of that that scan

706
00:32:03,769 --> 00:32:02,579
that we'll make with this movie if you

707
00:32:05,749 --> 00:32:03,779
could start that please

708
00:32:08,449 --> 00:32:05,759
near the center it gives you the global

709
00:32:10,459 --> 00:32:08,459
view with Pluto at the center and you'll

710
00:32:12,680 --> 00:32:10,469
see Sharon right next to it Sharon now

711
00:32:14,989 --> 00:32:12,690
goes behind Pluto you're looking to the

712
00:32:17,930 --> 00:32:14,999
upper right you'll see a magnified view

713
00:32:19,909 --> 00:32:17,940

of what is being centered in the field

714
00:32:23,589 --> 00:32:19,919
of view of the cameras and you'll see

715
00:32:26,659 --> 00:32:23,599
saluto passing through we get a swath

716
00:32:33,139 --> 00:32:26,669
football-field-sized resolution of Pluto

717
00:32:34,159 --> 00:32:33,149
as the spacecraft scans across it this

718
00:32:35,869 --> 00:32:34,169
is gonna be phenomenal

719
00:32:37,789 --> 00:32:35,879
of course we don't know what we're gonna

720
00:32:38,659 --> 00:32:37,799
see this is one of the main objectives

721
00:32:40,609 --> 00:32:38,669
of the mission

722
00:32:41,989 --> 00:32:40,619
what does Pluto's surface really look

723
00:32:43,579 --> 00:32:41,999
like what does Charon surface really

724
00:32:44,150 --> 00:32:43,589
look like are there mountains are there

725
00:32:46,700 --> 00:32:44,160
valleys

726
00:32:49,370 --> 00:32:46,710
they're geysers this is why we're going

727
00:32:51,320 --> 00:32:49,380
there one of the main reasons one of the

728
00:32:54,230 --> 00:32:51,330
three reasons okay if you can go to the

729
00:32:56,120 --> 00:32:54,240
next graphic one of the other most

730
00:32:58,880 --> 00:32:56,130
important objectives of the mission is

731
00:33:01,310 --> 00:32:58,890
to actually map the composition of the

732
00:33:04,340 --> 00:33:01,320
surface over the entire surfaces of both

733
00:33:06,770 --> 00:33:04,350
Pluto and Charon if you can go to the

734
00:33:09,410 --> 00:33:06,780
next graphic please and we do that with

735
00:33:12,200 --> 00:33:09,420
a near infrared spectral imager called

736
00:33:15,170 --> 00:33:12,210
Lisa the best we can do right now from

737
00:33:16,550 --> 00:33:15,180
Earth is a global view and it's already

738
00:33:19,280 --> 00:33:16,560

been very interesting we can tell

739
00:33:21,110 --> 00:33:19,290
they're very exotic ices on the surfaces

740
00:33:23,600 --> 00:33:21,120
if you look it to the left there that's

741
00:33:26,440 --> 00:33:23,610
the spectrum of Pluto all of those dips

742
00:33:29,150 --> 00:33:26,450
what those are those are fingerprints of

743
00:33:34,640 --> 00:33:29,160
exotic ices on the surface molecular

744
00:33:36,830 --> 00:33:34,650
nitrogen methane ice and also carbon

745
00:33:39,710 --> 00:33:36,840
monoxide ice on the surface of Charon

746
00:33:41,180 --> 00:33:39,720
you have plain old water ice dominating

747
00:33:43,610 --> 00:33:41,190
the surface but what we're going to do

748
00:33:44,930 --> 00:33:43,620
with the New Horizons spacecraft and the

749
00:33:49,010 --> 00:33:44,940
instruments on the new Horizons

750
00:33:51,860 --> 00:33:49,020
spacecraft is actually more than 65,000

751
00:33:54,230 --> 00:33:51,870
footprints on Pluto and Charon where you

752
00:33:56,210 --> 00:33:54,240
can now map the distribution of these

753
00:33:57,980 --> 00:33:56,220
ices and it'll be more than just what

754
00:34:00,560 --> 00:33:57,990
you see here we'll discover new

755
00:34:02,480 --> 00:34:00,570
molecules new species organics on the

756
00:34:04,420 --> 00:34:02,490
surface be able to map those over the

757
00:34:07,550 --> 00:34:04,430
entire surfaces of both of those objects

758
00:34:10,250 --> 00:34:07,560
if we go to the next graphic the other

759
00:34:11,780 --> 00:34:10,260
big objective of the milk' so I don't

760
00:34:14,150 --> 00:34:11,790
want to forget about Sharon if you can

761
00:34:16,280 --> 00:34:14,160
go ahead and start the the movie here

762
00:34:18,470 --> 00:34:16,290
we're going to do a similar scan this

763
00:34:20,419 --> 00:34:18,480

will be about 14 minutes but before the

764
00:34:23,419 --> 00:34:20,429
time of closest approach to Charon

765
00:34:24,860 --> 00:34:23,429
well we'll get resolution black and

766
00:34:28,100 --> 00:34:24,870
white in our black and white camera of

767
00:34:29,120 --> 00:34:28,110
about 175 yards across not quite as good

768
00:34:30,890 --> 00:34:29,130
as Pluto because it's a little bit

769
00:34:32,930 --> 00:34:30,900
farther away but as you go ahead and

770
00:34:35,810 --> 00:34:32,940
sweep through you saw the fields of view

771
00:34:38,720 --> 00:34:35,820
of both the Lorri high-resolution imager

772
00:34:40,790 --> 00:34:38,730
and the in Vic color camera sweeping

773
00:34:42,500 --> 00:34:40,800
across Charon and so we'll be able to

774
00:34:44,180 --> 00:34:42,510
map the surfaces of both of those

775
00:34:45,290 --> 00:34:44,190
objects and the other cool thing that

776
00:34:47,870 --> 00:34:45,300
we're going to do but with Charon

777
00:34:50,659 --> 00:34:47,880
actually is after we find fly by Pluto

778
00:34:52,820 --> 00:34:50,669
and look back it turns out because of

779
00:34:55,460 --> 00:34:52,830
the geometry Charon is closer to the

780
00:34:57,740 --> 00:34:55,470
spacecraft and then and than it is then

781
00:35:00,260 --> 00:34:57,750
then the Pluto is

782
00:35:02,390 --> 00:35:00,270
so we actually use sunlight reflected

783
00:35:04,400 --> 00:35:02,400
off of Charon to illuminate what would

784
00:35:06,770 --> 00:35:04,410
otherwise be the dark side of Pluto and

785
00:35:08,600 --> 00:35:06,780
we can measure that that side of that

786
00:35:11,780 --> 00:35:08,610
hemisphere of Pluto and much higher

787
00:35:15,110 --> 00:35:11,790
resolution than we could on the incoming

788
00:35:16,340 --> 00:35:15,120

observations okay so in the know those

789
00:35:17,330 --> 00:35:16,350
are the two objections that we just now

790
00:35:19,490 --> 00:35:17,340
talked about now we're going to go to

791
00:35:21,290 --> 00:35:19,500
the the third major objective of the

792
00:35:23,890 --> 00:35:21,300
mission which is the study of Pluto's

793
00:35:26,270 --> 00:35:23,900
atmosphere which coincidentally is

794
00:35:27,740 --> 00:35:26,280
primarily molecular nitrogen just like

795
00:35:29,270 --> 00:35:27,750
what we have on the earth but there's a

796
00:35:31,220 --> 00:35:29,280
really cool set of experiments that we

797
00:35:34,340 --> 00:35:31,230
do that are highlighted in the middle of

798
00:35:36,920 --> 00:35:34,350
the frame there after we pass by Pluto

799
00:35:39,530 --> 00:35:36,930
we then fly into Pluto's shadow at the

800
00:35:41,510 --> 00:35:39,540
same time while we're looking at radio

801
00:35:44,180 --> 00:35:41,520
beams coming up from the deep space

802
00:35:47,330 --> 00:35:44,190
network being beamed up to the Pluto to

803
00:35:49,430 --> 00:35:47,340
the to that radio dish and measuring the

804
00:35:51,590 --> 00:35:49,440
structure of Pluto's atmosphere the

805
00:35:53,960 --> 00:35:51,600
temperature and the mass of Pluto's

806
00:35:55,850 --> 00:35:53,970
atmosphere at the same time the

807
00:35:58,400 --> 00:35:55,860
ultraviolet spectrograph the Alice

808
00:36:00,020 --> 00:35:58,410
instrument will be observing the Sun and

809
00:36:03,050 --> 00:36:00,030
by looking at the the absorption of

810
00:36:03,800 --> 00:36:03,060
sunlight as as we pass behind Pluto's

811
00:36:06,320 --> 00:36:03,810
atmosphere

812
00:36:10,150 --> 00:36:06,330
we'll get the signature of all of the

813
00:36:12,890 --> 00:36:10,160

composition of Pluto's upper atmosphere

814
00:36:15,710 --> 00:36:12,900
hydrocarbons molecular nitrogen and

815
00:36:18,080 --> 00:36:15,720
other things in addition after we've

816
00:36:20,120 --> 00:36:18,090
formed by Pluto we'll also put the

817
00:36:21,860 --> 00:36:20,130
instruments on the little Crescent have

818
00:36:23,900 --> 00:36:21,870
them centered on the Crescent so we can

819
00:36:26,330 --> 00:36:23,910
map any Hayes's in the Pluto's

820
00:36:28,460 --> 00:36:26,340
atmosphere and then finally in addition

821
00:36:31,340 --> 00:36:28,470
we have these two instruments Swapp and

822
00:36:33,740 --> 00:36:31,350
Pepsi which detect charged particles and

823
00:36:35,960 --> 00:36:33,750
they're going to be sensitive to the to

824
00:36:39,770 --> 00:36:35,970
the escaping atmosphere coming off of

825
00:36:42,620 --> 00:36:39,780
Pluto and measuring how much of Pluto's

826
00:36:46,070 --> 00:36:42,630
atmosphere is being lost to space so if

827
00:36:47,930 --> 00:36:46,080
you go to the next slide we have more as

828
00:36:50,510 --> 00:36:47,940
you've heard we have this amazing system

829
00:36:53,180 --> 00:36:50,520
of satellites and the Pluto system you

830
00:36:54,470 --> 00:36:53,190
know for small satellites we know if you

831
00:36:56,570 --> 00:36:54,480
thought it was hard to observe Pluto

832
00:36:58,250 --> 00:36:56,580
from the earth you know so far away

833
00:36:59,810 --> 00:36:58,260
three billion miles away it's even

834
00:37:02,390 --> 00:36:59,820
harder to get any information on these

835
00:37:04,610 --> 00:37:02,400
small satellites but by passing close by

836
00:37:08,150 --> 00:37:04,620
as the New Horizons spacecraft will

837
00:37:09,830 --> 00:37:08,160
we'll be able to get Barry will be able

838
00:37:11,390 --> 00:37:09,840

to see finally what these out with these

839
00:37:11,690 --> 00:37:11,400
satellites small satellites look like we

840
00:37:14,060 --> 00:37:11,700
can't

841
00:37:16,400 --> 00:37:14,070
till now within 30 miles across or 100

842
00:37:19,370 --> 00:37:16,410
miles across the probably highly

843
00:37:22,339 --> 00:37:19,380
elongated objects what their rotation

844
00:37:24,050 --> 00:37:22,349
rates are and so forth you know what do

845
00:37:25,760 --> 00:37:24,060
they look like here's some examples of

846
00:37:28,280 --> 00:37:25,770
icy satellites and the Saturnian system

847
00:37:30,079 --> 00:37:28,290
along the top there and then one of the

848
00:37:32,960 --> 00:37:30,089
small satellites of Jupiter down below

849
00:37:34,940 --> 00:37:32,970
and Athiya might look something like

850
00:37:36,680 --> 00:37:34,950
this but who knows we're talking about

851
00:37:39,170 --> 00:37:36,690
the Pluto system much farther away from

852
00:37:41,390 --> 00:37:39,180
the Sun it'll be very interesting to see

853
00:37:42,650 --> 00:37:41,400
what those surfaces look like and that's

854
00:37:44,870 --> 00:37:42,660
what we'll be able to do with the new

855
00:37:49,130 --> 00:37:44,880
Horizons spacecraft okay if we go to the

856
00:37:51,589 --> 00:37:49,140
to the next slide in addition to just

857
00:37:53,720 --> 00:37:51,599
measuring the sizes the shapes what's

858
00:37:55,250 --> 00:37:53,730
what the surfaces look like the small

859
00:37:57,560 --> 00:37:55,260
satellites as Allen just said we're

860
00:37:59,870 --> 00:37:57,570
gonna be doing some very deep imaging to

861
00:38:01,370 --> 00:37:59,880
look for new satellites we might

862
00:38:03,770 --> 00:38:01,380
discover some other ones and we'll be

863
00:38:07,670 --> 00:38:03,780

looking for these dust rings so we go to

864
00:38:09,890 --> 00:38:07,680
the final slide just point out that this

865
00:38:13,490 --> 00:38:09,900
is the best ever initial reconnaissance

866
00:38:16,010 --> 00:38:13,500
of a planet in our solar system this is

867
00:38:19,040 --> 00:38:16,020
the initial exploration of this whole

868
00:38:21,430 --> 00:38:19,050
new zone the Kuiper belt that we didn't

869
00:38:24,349 --> 00:38:21,440
even know existed until the early 1990s

870
00:38:28,000 --> 00:38:24,359
this is our first step into this new

871
00:38:30,319 --> 00:38:28,010
land and and we're going to be applying

872
00:38:34,390 --> 00:38:30,329
sophisticated modern instrumentation a

873
00:38:37,069 --> 00:38:34,400
very comprehensive science program and

874
00:38:38,990 --> 00:38:37,079
squeezing out as much as we possibly can

875
00:38:41,510 --> 00:38:39,000
because this is truly a

876
00:38:42,980 --> 00:38:41,520
once-in-a-lifetime opportunity the one

877
00:38:44,480 --> 00:38:42,990
other thing I want to say is that even

878
00:38:46,970 --> 00:38:44,490
though we have a laundry list of

879
00:38:49,490 --> 00:38:46,980
specific scientific objectives that

880
00:38:51,319 --> 00:38:49,500
we're addressing the thing that we also

881
00:38:53,839 --> 00:38:51,329
have learned from the 50 years of space

882
00:38:56,150 --> 00:38:53,849
exploration is when you go somewhere new

883
00:38:58,339 --> 00:38:56,160
we haven't been there done that in this

884
00:39:00,650 --> 00:38:58,349
case you're gonna learn something you

885
00:39:02,150 --> 00:39:00,660
probably could never even imagine and

886
00:39:05,559 --> 00:39:02,160
that's gonna be part of the excitement

887
00:39:08,990 --> 00:39:05,569
of this mission so three months from now

888
00:39:11,480 --> 00:39:09,000

remember visit us at the new horizons

889
00:39:14,720 --> 00:39:11,490
you know that the Johns Hopkins Applied

890
00:39:16,490 --> 00:39:14,730
Physics Laboratory where all the data

891
00:39:18,260 --> 00:39:16,500
will be coming down and we'll have an

892
00:39:21,430 --> 00:39:18,270
opportunity to see what what this with

893
00:39:23,930 --> 00:39:21,440
the Pluto system looks like thank you

894
00:39:25,070 --> 00:39:23,940
unique spacecraft or unique mission

895
00:39:28,430 --> 00:39:25,080
thank you all

896
00:39:29,690 --> 00:39:28,440
okay so the first briefing I started

897
00:39:32,240 --> 00:39:29,700
with the phone lines I didn't get a

898
00:39:34,340 --> 00:39:32,250
chance to see if any of our folks here

899
00:39:36,380 --> 00:39:34,350
because any headquarters have any

900
00:39:38,030 --> 00:39:36,390
questions if you have any questions

901
00:39:42,710 --> 00:39:38,040
please raise your hand if not we will go

902
00:39:44,840 --> 00:39:42,720
to social media it'll take up we have it

903
00:39:47,020 --> 00:39:44,850
please wait for the mic identify your

904
00:39:50,780 --> 00:39:47,030
your name and affiliation please okay

905
00:39:52,580 --> 00:39:50,790
hear me go ahead yeah I'm Shelly from

906
00:39:54,170 --> 00:39:52,590
Discovery Channel so I know it's very

907
00:39:56,180 --> 00:39:54,180
exciting about these satellites that

908
00:39:58,270 --> 00:39:56,190
could be discovered also very concerning

909
00:40:02,480 --> 00:39:58,280
I'm just curious about the timeline

910
00:40:05,990 --> 00:40:02,490
between now and July when you think you

911
00:40:08,090 --> 00:40:06,000
might be able to see things that could

912
00:40:12,890 --> 00:40:08,100
be satellites with low mass that could

913
00:40:14,540 --> 00:40:12,900

be the source of more debris a hazards

914
00:40:15,500 --> 00:40:14,550
that kind of thing okay I'll speak to

915
00:40:17,630 --> 00:40:15,510
that and I'll tell you a little bit

916
00:40:20,090 --> 00:40:17,640
about the Associated timeline of how we

917
00:40:22,790 --> 00:40:20,100
would react to that the initial imaging

918
00:40:26,030 --> 00:40:22,800
that I showed in my package that's going

919
00:40:28,880 --> 00:40:26,040
to be made in in May is is going to be

920
00:40:31,100 --> 00:40:28,890
competitive with but not significantly

921
00:40:32,950 --> 00:40:31,110
better than the very best imaging that

922
00:40:36,050 --> 00:40:32,960
we can do from the earth and Earth orbit

923
00:40:39,680 --> 00:40:36,060
but as we get into June in particularly

924
00:40:41,330 --> 00:40:39,690
late June in the last couple of weeks of

925
00:40:43,700 --> 00:40:41,340
June we're gonna have significantly

926
00:40:46,520 --> 00:40:43,710
better capability in those last three

927
00:40:48,050 --> 00:40:46,530
sets of hazard imaging to finding the

928
00:40:50,780 --> 00:40:48,060
small satellites and rings that you're

929
00:40:54,620 --> 00:40:50,790
asking about and so we'll be downlinking

930
00:40:56,150 --> 00:40:54,630
images at the fastest pace the

931
00:40:58,400 --> 00:40:56,160
spacecraft can handle and getting them

932
00:41:00,620 --> 00:40:58,410
into the hands of the hazard team to

933
00:41:02,780 --> 00:41:00,630
look at those data to make an assessment

934
00:41:04,700 --> 00:41:02,790
of what we're finding and whether

935
00:41:07,190 --> 00:41:04,710
anything that we're finding can generate

936
00:41:10,480 --> 00:41:07,200
a significant hazard and we're prepared

937
00:41:13,850 --> 00:41:10,490
to use the engines on the spacecraft

938
00:41:16,550 --> 00:41:13,860

within a matter of days if necessary to

939
00:41:18,950 --> 00:41:16,560
to divert we also have the option to

940
00:41:21,380 --> 00:41:18,960
change the onboard sequence so that

941
00:41:24,650 --> 00:41:21,390
instead of letting the spacecraft point

942
00:41:27,110 --> 00:41:24,660
at every target in the system freely to

943
00:41:30,110 --> 00:41:27,120
use this high gain antenna as a shield

944
00:41:32,720 --> 00:41:30,120
by flying the high gain antenna forward

945
00:41:34,070 --> 00:41:32,730
what we call in the RAM direction to

946
00:41:37,160 --> 00:41:34,080
shield most of the body of the

947
00:41:38,779 --> 00:41:37,170
spacecraft from any hazards and we can

948
00:41:41,929 --> 00:41:38,789
make a decision to do that

949
00:41:44,299 --> 00:41:41,939
as late as just days before arrival we

950
00:41:46,099 --> 00:41:44,309
can make a decision to a divert to one

951
00:41:51,819 --> 00:41:46,109
of the alternate Shabbat trajectories as

952
00:41:58,219 --> 00:41:55,179
any other questions here before we yes

953
00:42:00,259 --> 00:41:58,229
you wait for the mic and identify name

954
00:42:02,329 --> 00:42:00,269
and affiliation please NOLA red

955
00:42:04,249 --> 00:42:02,339
freelancer just as a follow-up how would

956
00:42:05,449 --> 00:42:04,259
that affect communications or how could

957
00:42:07,909 --> 00:42:05,459
that potentially affect if you're using

958
00:42:08,419 --> 00:42:07,919
it as a shield that's a very good

959
00:42:11,359 --> 00:42:08,429
question

960
00:42:13,370 --> 00:42:11,369
so in fact on encounter day the day that

961
00:42:16,599 --> 00:42:13,380
we're going to fly through the satellite

962
00:42:19,099 --> 00:42:16,609
system we actually won't be using the

963
00:42:21,199 --> 00:42:19,109

communication system the spacecraft to

964
00:42:23,839 --> 00:42:21,209
talk to the earth at all the spacecraft

965
00:42:27,049 --> 00:42:23,849
is going to be busy taking data so even

966
00:42:29,719 --> 00:42:27,059
if whether or not we pin the antenna

967
00:42:30,799 --> 00:42:29,729
into the RAM direction as a shield will

968
00:42:32,299 --> 00:42:30,809
make no difference in what

969
00:42:34,699 --> 00:42:32,309
communications we get back from the

970
00:42:37,009 --> 00:42:34,709
spacecraft on the on the day of July the

971
00:42:39,079 --> 00:42:37,019
14th the spacecraft will be busy at

972
00:42:41,630 --> 00:42:39,089
Pluto and not talking to the earth until

973
00:42:44,029 --> 00:42:41,640
late in the evening East Coast time when

974
00:42:44,599 --> 00:42:44,039
it will check back in and tell us how

975
00:42:47,179 --> 00:42:44,609
it's doing

976
00:42:49,909 --> 00:42:47,189
give us a Health Report and then go back

977
00:42:50,539 --> 00:42:49,919
to data taking again within less than

978
00:42:52,819 --> 00:42:50,549
half an hour

979
00:42:54,409 --> 00:42:52,829
the first downloads won't come until the

980
00:42:56,630 --> 00:42:54,419
morning of the 15th when you'll start to

981
00:42:59,899 --> 00:42:56,640
see imagery from closest approach and

982
00:43:03,309 --> 00:42:59,909
that will happen whether or not we've

983
00:43:06,289 --> 00:43:03,319
made an antenna to ram a decision or not

984
00:43:08,179 --> 00:43:06,299
but let me ask answer another part of

985
00:43:11,959 --> 00:43:08,189
what your question sounded like it was

986
00:43:14,120 --> 00:43:11,969
getting at the putting the antenna

987
00:43:17,989 --> 00:43:14,130
forward and having if we should have a

988
00:43:20,209 --> 00:43:17,999

particle hit it hole in the antenna but

989
00:43:25,640 --> 00:43:20,219
it'll be so small that will not affect

990
00:43:27,370 --> 00:43:25,650
the communication good point okay what

991
00:43:30,739 --> 00:43:27,380
we're gonna do here is we're gonna

992
00:43:34,069 --> 00:43:30,749
social media is of a buzz as usual and

993
00:43:36,499 --> 00:43:34,079
go to my colleague from the Applied

994
00:43:38,419 --> 00:43:36,509
Physics lab Michael Buckley on social

995
00:43:40,039 --> 00:43:38,429
media and then we'll go to the phone

996
00:43:41,479 --> 00:43:40,049
lines and come back and wrap up Mike

997
00:43:42,799 --> 00:43:41,489
what's going on in the social media

998
00:43:44,059 --> 00:43:42,809
world this is one of those questions it

999
00:43:46,219 --> 00:43:44,069
kind of seems easy when you start but

1000
00:43:48,019 --> 00:43:46,229
then a little hard to answer is what are

1001
00:43:50,599 --> 00:43:48,029
you most excited to learn about Pluto

1002
00:43:52,340 --> 00:43:50,609
from this mission then how will this

1003
00:43:54,130 --> 00:43:52,350
mission impact future ones

1004
00:43:58,130 --> 00:43:54,140
don't we each take a turn at that if

1005
00:44:00,680 --> 00:43:58,140
okay for from my perspective this

1006
00:44:03,470 --> 00:44:00,690
particular body is a very special one

1007
00:44:06,350 --> 00:44:03,480
you know it's it's learning something

1008
00:44:08,770 --> 00:44:06,360
about a whole new population now we have

1009
00:44:12,500 --> 00:44:08,780
opportunities also to make comparisons

1010
00:44:14,780 --> 00:44:12,510
but we have dawn now it's Ceres Ceres

1011
00:44:17,330 --> 00:44:14,790
might be related to the Kuiper belt in

1012
00:44:18,440 --> 00:44:17,340
some way we really don't know we have

1013
00:44:20,690 --> 00:44:18,450

another body

1014
00:44:23,240 --> 00:44:20,700
that's a moon in the Neptune system

1015
00:44:25,610 --> 00:44:23,250
called Triton there's speculation that

1016
00:44:28,210 --> 00:44:25,620
perhaps Triton is a captured Kuiper belt

1017
00:44:30,830 --> 00:44:28,220
object so those are very tantalizing

1018
00:44:32,690 --> 00:44:30,840
pieces of information that once I think

1019
00:44:34,610 --> 00:44:32,700
we see Pluto we're going to be able to

1020
00:44:36,860 --> 00:44:34,620
make great progress in understanding how

1021
00:44:39,170 --> 00:44:36,870
these objects are related and therefore

1022
00:44:41,060 --> 00:44:39,180
begin to understand how they got to

1023
00:44:42,950 --> 00:44:41,070
where they are you know what was the

1024
00:44:45,110 --> 00:44:42,960
dynamics within our solar system that

1025
00:44:47,510 --> 00:44:45,120
moved these bodies around got captured

1026
00:44:49,490 --> 00:44:47,520
perhaps or put in the asteroid belt and

1027
00:44:54,140 --> 00:44:49,500
how that how did that happen and those

1028
00:44:56,660 --> 00:44:54,150
are huge steps for us and for me there's

1029
00:44:57,710 --> 00:44:56,670
the comparisons that we've already had

1030
00:45:01,340 --> 00:44:57,720
in the solar system

1031
00:45:04,280 --> 00:45:01,350
how is Pluto alike are different and I'm

1032
00:45:07,400 --> 00:45:04,290
always in love with geography so I'm

1033
00:45:09,620 --> 00:45:07,410
interested in the geography of Pluto and

1034
00:45:11,930 --> 00:45:09,630
that will be exciting we get these

1035
00:45:14,690 --> 00:45:11,940
images back we look at the apocrypha we

1036
00:45:18,050 --> 00:45:14,700
look at the geology that's gonna be an

1037
00:45:19,850 --> 00:45:18,060
exciting piece of data for me well I

1038
00:45:21,950 --> 00:45:19,860

want to answer this in three parts I

1039
00:45:24,500 --> 00:45:21,960
want to first say that I've been working

1040
00:45:27,260 --> 00:45:24,510
on as a member of the scientific

1041
00:45:29,960 --> 00:45:27,270
community I've been working for over 25

1042
00:45:32,780 --> 00:45:29,970
years now since 1989 to see a mission

1043
00:45:35,330 --> 00:45:32,790
fly to what we used to call the last

1044
00:45:37,070 --> 00:45:35,340
planet what we now know is the archetype

1045
00:45:40,580 --> 00:45:37,080
of the third class of planets in our

1046
00:45:41,570 --> 00:45:40,590
solar system and so at at one level more

1047
00:45:43,880 --> 00:45:41,580
than anything else

1048
00:45:46,550 --> 00:45:43,890
I just want to unwrap that Christmas

1049
00:45:48,500 --> 00:45:46,560
present that's been under my tree for 25

1050
00:45:51,230 --> 00:45:48,510
plus years and see what's inside

1051
00:45:54,110 --> 00:45:51,240
my technical specialty is the second

1052
00:45:55,610 --> 00:45:54,120
part of the answer because I'm very

1053
00:45:58,550 --> 00:45:55,620
interested in Pluto's atmosphere its

1054
00:46:00,230 --> 00:45:58,560
composition and its structure and what

1055
00:46:02,330 --> 00:46:00,240
the Alice and Rex instruments

1056
00:46:05,180 --> 00:46:02,340
particularly have to tell us about this

1057
00:46:05,750 --> 00:46:05,190
exotic kind of planetary atmosphere that

1058
00:46:07,610 --> 00:46:05,760
actually

1059
00:46:10,160 --> 00:46:07,620
just about some of the conditions on the

1060
00:46:13,010 --> 00:46:10,170
early Earth but I want to leave you with

1061
00:46:15,020 --> 00:46:13,020
one thought it may be a long shot or it

1062
00:46:19,340 --> 00:46:15,030
might not be I want to leave you with

1063
00:46:20,750 --> 00:46:19,350

one word liquids I think one of the most

1064
00:46:22,970 --> 00:46:20,760
interesting things that we can do with

1065
00:46:24,410 --> 00:46:22,980
new horizons is look for cryogenic

1066
00:46:27,110 --> 00:46:24,420
liquids on the surface or in the

1067
00:46:28,640 --> 00:46:27,120
interior in the interior like an ocean

1068
00:46:30,950 --> 00:46:28,650
as bill MacKinnon spoke about in the

1069
00:46:34,240 --> 00:46:30,960
earlier panel on the surface there are

1070
00:46:38,210 --> 00:46:34,250
many fewer possibilities but there are

1071
00:46:40,460 --> 00:46:38,220
there are materials like neon for

1072
00:46:42,650 --> 00:46:40,470
example there could be rivers of neon

1073
00:46:45,770 --> 00:46:42,660
that have been speculated about or

1074
00:46:48,410 --> 00:46:45,780
evidence of past liquids flowing on

1075
00:46:50,750 --> 00:46:48,420
Pluto's surface and that I think is

1076
00:46:54,710 --> 00:46:50,760
something really exciting that we're

1077
00:46:56,720 --> 00:46:54,720
going to be able to test I can't really

1078
00:46:58,430 --> 00:46:56,730
say any better you know but the

1079
00:46:59,960 --> 00:46:58,440
scientific objectives or the mission but

1080
00:47:02,090 --> 00:46:59,970
what I'm really looking forward to is

1081
00:47:04,070 --> 00:47:02,100
what does Pluto really look like is this

1082
00:47:07,610 --> 00:47:04,080
it behind us you know they look anything

1083
00:47:08,450 --> 00:47:07,620
like this at all I mean it's it's you

1084
00:47:10,820 --> 00:47:08,460
know this is our best

1085
00:47:13,010 --> 00:47:10,830
you know just knowledge of what we

1086
00:47:16,510 --> 00:47:13,020
already know about Pluto and and and

1087
00:47:18,800 --> 00:47:16,520
Charon and we have these these

1088
00:47:20,720 --> 00:47:18,810

astronomers have spent a lot of time

1089
00:47:22,490 --> 00:47:20,730
trying to you know use the Hubble data

1090
00:47:25,090 --> 00:47:22,500
the brightness variations over the

1091
00:47:29,060 --> 00:47:25,100
surface and the color measurements to

1092
00:47:30,560 --> 00:47:29,070
you know sort of figure out you know you

1093
00:47:32,090 --> 00:47:30,570
know how much variegation how much

1094
00:47:34,910 --> 00:47:32,100
coloration there is on Pluto and so

1095
00:47:36,710 --> 00:47:34,920
forth but really you know I can't wait

1096
00:47:38,420 --> 00:47:36,720
to see those those high-resolution

1097
00:47:39,830 --> 00:47:38,430
images that we take near the time of

1098
00:47:46,160 --> 00:47:39,840
closest approach and see what it really

1099
00:47:48,080 --> 00:47:46,170
looks like okay before Mike before I

1100
00:47:50,030 --> 00:47:48,090
asked for another question that you know

1101
00:47:51,950 --> 00:47:50,040
this is being seen all over the world so

1102
00:47:53,960 --> 00:47:51,960
I want to make sure because I I kind of

1103
00:47:55,820 --> 00:47:53,970
didn't do you justice on exactly your

1104
00:47:58,640 --> 00:47:55,830
organization I want to say the Johns

1105
00:48:04,100 --> 00:47:58,650
Hopkins University Applied Physics

1106
00:48:05,570 --> 00:48:04,110
Laboratory okay where'd you get it more

1107
00:48:07,520 --> 00:48:05,580
of a technical question but timing is

1108
00:48:09,650 --> 00:48:07,530
crucial during the new Horizons flyby to

1109
00:48:13,340 --> 00:48:09,660
collect data so how challenging is it to

1110
00:48:14,750 --> 00:48:13,350
choreograph that dance on July 14th I'll

1111
00:48:17,420 --> 00:48:14,760
talk a little about it nothing one would

1112
00:48:19,220 --> 00:48:17,430
like to as well as we've told you the

1113
00:48:22,550 --> 00:48:19,230

entire flyby is scripted

1114
00:48:24,740 --> 00:48:22,560
and the specialists in in the planning

1115
00:48:26,900 --> 00:48:24,750
of the sequence start with what our

1116
00:48:28,960 --> 00:48:26,910
scientific objectives are which are

1117
00:48:31,280 --> 00:48:28,970
translated by the scientist team into

1118
00:48:33,589 --> 00:48:31,290
requests for particular observations

1119
00:48:35,720 --> 00:48:33,599
these kind of spectra some other kind of

1120
00:48:38,450 --> 00:48:35,730
images observations of the atmosphere or

1121
00:48:40,900 --> 00:48:38,460
the surface as it may be and then the

1122
00:48:43,520 --> 00:48:40,910
sequencing specialists use

1123
00:48:45,890 --> 00:48:43,530
computer-generated animations from the

1124
00:48:48,290 --> 00:48:45,900
actual trajectory that we will fly and

1125
00:48:50,620 --> 00:48:48,300
the known orbits of Pluto and its

1126
00:48:53,089 --> 00:48:50,630
satellites to predict win the best time

1127
00:48:54,890 --> 00:48:53,099
along the trajectory is to make each

1128
00:48:56,900 --> 00:48:54,900
type of observation and then they

1129
00:48:58,430 --> 00:48:56,910
sequence those in one at a time starting

1130
00:49:00,170 --> 00:48:58,440
with the highest priority and then

1131
00:49:01,880 --> 00:49:00,180
filling in with successive levels of

1132
00:49:05,210 --> 00:49:01,890
priority but it's a little bit more

1133
00:49:07,460 --> 00:49:05,220
complicated game than that because like

1134
00:49:10,099 --> 00:49:07,470
any real-world problem there are

1135
00:49:11,750 --> 00:49:10,109
uncertainties small uncertainties in

1136
00:49:13,640 --> 00:49:11,760
terms of the position of Pluto and its

1137
00:49:16,010 --> 00:49:13,650
satellites because we don't have perfect

1138
00:49:17,870 --> 00:49:16,020

knowledge and uncertainties in the

1139
00:49:19,819 --> 00:49:17,880
knowledge of exactly when the spacecraft

1140
00:49:22,579 --> 00:49:19,829
will arrive as Glenn said plus and minus

1141
00:49:24,859 --> 00:49:22,589
100 seconds which is amazing after a

1142
00:49:26,980 --> 00:49:24,869
ten-year journey but nonetheless in a

1143
00:49:29,990 --> 00:49:26,990
hundred seconds New Horizons moves

1144
00:49:32,000 --> 00:49:30,000
almost a thousand miles and so there can

1145
00:49:34,030 --> 00:49:32,010
be some significant parallax and looking

1146
00:49:37,460 --> 00:49:34,040
at the satellites and the planet itself

1147
00:49:40,460 --> 00:49:37,470
and so we take that into account too by

1148
00:49:43,130 --> 00:49:40,470
taking extra data if the scan is

1149
00:49:46,250 --> 00:49:43,140
predicted to need X number of degrees to

1150
00:49:48,829 --> 00:49:46,260
cover the surface of a given body we add

1151
00:49:52,339 --> 00:49:48,839
margin on the ends of it to take into

1152
00:49:55,370 --> 00:49:52,349
account the potential for those unknowns

1153
00:49:57,890 --> 00:49:55,380
and we add those pads specifically so

1154
00:50:00,680 --> 00:49:57,900
that we can be sure at very high

1155
00:50:02,599 --> 00:50:00,690
probability that each observation is is

1156
00:50:07,640 --> 00:50:02,609
captured and then that's what gets

1157
00:50:10,450 --> 00:50:07,650
sequenced in yeah let me borrow this

1158
00:50:14,569 --> 00:50:10,460
again and and talk a little bit about

1159
00:50:16,819 --> 00:50:14,579
the one area that we can't do justice

1160
00:50:19,370 --> 00:50:16,829
and testing on the ground we have a

1161
00:50:21,230 --> 00:50:19,380
simulator so we can simulate all the

1162
00:50:23,359 --> 00:50:21,240
commands being generated be sure all

1163
00:50:25,099 --> 00:50:23,369

that command sequence is properly

1164
00:50:27,650 --> 00:50:25,109
defined it's it turns the right

1165
00:50:29,390 --> 00:50:27,660
instrument on at the right time the one

1166
00:50:32,900 --> 00:50:29,400
that's very hard to do on the ground is

1167
00:50:35,930 --> 00:50:32,910
to simulate the motion of the spacecraft

1168
00:50:38,360 --> 00:50:35,940
and so one of the big concerns in our

1169
00:50:40,610 --> 00:50:38,370
guidance of control experts take a lot

1170
00:50:43,250 --> 00:50:40,620
of time at this this first simulated on

1171
00:50:47,540 --> 00:50:43,260
software on the ground and then as Alan

1172
00:50:50,390 --> 00:50:47,550
said we did a test we did two tests so

1173
00:50:51,920 --> 00:50:50,400
during the closest approach when we're

1174
00:50:53,840 --> 00:50:51,930
the busiest and we're moving the

1175
00:50:55,850 --> 00:50:53,850
spacecraft around pointing the

1176
00:50:58,010 --> 00:50:55,860
instruments then turning back eventually

1177
00:51:00,980 --> 00:50:58,020
to point the antenna back to the earth

1178
00:51:03,950 --> 00:51:00,990
playing back so we when we pass in the

1179
00:51:05,600 --> 00:51:03,960
shadow of Pluto we are sure be to be

1180
00:51:08,600 --> 00:51:05,610
looking back toward the earth and the

1181
00:51:10,910 --> 00:51:08,610
Sun all of that has to be timed

1182
00:51:14,840 --> 00:51:10,920
precisely we have to have the motions

1183
00:51:15,950 --> 00:51:14,850
done precisely so that when we get to

1184
00:51:19,870 --> 00:51:15,960
the point we're gonna make the

1185
00:51:24,710 --> 00:51:19,880
observation the spacecraft is still and

1186
00:51:27,170 --> 00:51:24,720
we did that in by doing two tests on the

1187
00:51:29,090 --> 00:51:27,180
spacecraft one in twenty twelve when we

1188
00:51:32,120 --> 00:51:29,100

did that very busy time right around

1189
00:51:35,330 --> 00:51:32,130
closest approach and then in 2013 we did

1190
00:51:37,250 --> 00:51:35,340
the entire nine days and that for me the

1191
00:51:39,740 --> 00:51:37,260
most important thing about that test was

1192
00:51:42,050 --> 00:51:39,750
to see that the spacecraft motion did

1193
00:51:46,430 --> 00:51:42,060
exactly what we expected it to do what

1194
00:51:48,020 --> 00:51:46,440
you did okay let's go to the phone lines

1195
00:51:51,920 --> 00:51:48,030
and then we'll come back here and wrap

1196
00:51:56,060 --> 00:51:51,930
up and I believe first up is Alan Boyle

1197
00:52:00,340 --> 00:51:56,070
from NBC Alan thank you I wanted to ask

1198
00:52:02,270 --> 00:52:00,350
about the global coverage of the imagery

1199
00:52:05,480 --> 00:52:02,280
since you're going through the shadow

1200
00:52:07,910 --> 00:52:05,490
how how wide will the coverage beam only

1201
00:52:11,000 --> 00:52:07,920
be able to create a high-resolution

1202
00:52:12,890 --> 00:52:11,010
global map of Pluto as well as Charon or

1203
00:52:15,440 --> 00:52:12,900
will there be some things missing just

1204
00:52:17,360 --> 00:52:15,450
because of the trajectory I'll take a

1205
00:52:20,290 --> 00:52:17,370
crack at that Alan it's a great question

1206
00:52:22,700 --> 00:52:20,300
and people ask that question

1207
00:52:25,310 --> 00:52:22,710
to those of us on the science team when

1208
00:52:28,150 --> 00:52:25,320
we give public talks so this is a this

1209
00:52:32,270 --> 00:52:28,160
is a good one to answer in this forum

1210
00:52:34,340 --> 00:52:32,280
let me start by saying that much of the

1211
00:52:36,460 --> 00:52:34,350
imaging that will be doing the global

1212
00:52:38,630 --> 00:52:36,470
imaging will be with the Lorri

1213
00:52:41,000 --> 00:52:38,640

instrument that we spoken so much about

1214
00:52:43,790 --> 00:52:41,010
it's a telescope that feeds a CCD camera

1215
00:52:46,160 --> 00:52:43,800
and it's telescopic capabilities are

1216
00:52:46,910 --> 00:52:46,170
very important because Pluto itself

1217
00:52:49,339 --> 00:52:46,920
wrote

1218
00:52:53,150 --> 00:52:49,349
dates on its axis very slowly it takes

1219
00:52:55,160 --> 00:52:53,160
in fact 6.4 days almost a week to turn

1220
00:52:57,890 --> 00:52:55,170
on its axis and one consequence of that

1221
00:52:59,630 --> 00:52:57,900
is that we will fly by one hemisphere of

1222
00:53:02,599 --> 00:52:59,640
Pluto and by the way Charon has the same

1223
00:53:04,700 --> 00:53:02,609
rotation period one hemisphere of Charon

1224
00:53:06,799 --> 00:53:04,710
and be able to image it with Laurie and

1225
00:53:10,430 --> 00:53:06,809
with our Ralph's color and black and

1226
00:53:12,349 --> 00:53:10,440
white cameras as well with the kind of

1227
00:53:14,930 --> 00:53:12,359
resolution that Hao was talking to you

1228
00:53:17,809 --> 00:53:14,940
about but the other hemisphere we will

1229
00:53:20,030 --> 00:53:17,819
last see half a rotation or three days

1230
00:53:22,970 --> 00:53:20,040
before when the spacecraft is still

1231
00:53:24,890 --> 00:53:22,980
millions of miles from Pluto Laurie

1232
00:53:27,559 --> 00:53:24,900
because of its long focal length its

1233
00:53:29,900 --> 00:53:27,569
magnification capabilities allows us to

1234
00:53:32,599 --> 00:53:29,910
do imaging of the far side hemispheres

1235
00:53:34,700 --> 00:53:32,609
three days out it's actually very good

1236
00:53:36,859 --> 00:53:34,710
it's the reason we put Laurie on the

1237
00:53:39,410 --> 00:53:36,869
spacecraft because it gave us a

1238
00:53:42,349 --> 00:53:39,420

competitive edge in doing more science

1239
00:53:44,000 --> 00:53:42,359
even from afar and the kind of imagery

1240
00:53:47,240 --> 00:53:44,010
that you'll see are the far sides of

1241
00:53:48,620 --> 00:53:47,250
Pluto and Charon are comparable to what

1242
00:53:51,770 --> 00:53:48,630
you might see if you took a pair of

1243
00:53:54,109 --> 00:53:51,780
garden-variety binoculars out and looked

1244
00:53:55,910 --> 00:53:54,119
at the Earth's moon so pretty good now

1245
00:53:57,380 --> 00:53:55,920
there are still some other terrains and

1246
00:53:58,849 --> 00:53:57,390
I'm giving a very detailed answer but

1247
00:54:02,299 --> 00:53:58,859
there's still some other terrains that

1248
00:54:04,539 --> 00:54:02,309
are difficult because Pluto beings

1249
00:54:07,309 --> 00:54:04,549
tipped on its side as Glynn showed you

1250
00:54:10,880 --> 00:54:07,319
has the equivalent of the Antarctic

1251
00:54:14,420 --> 00:54:10,890
polar night where one hemisphere it

1252
00:54:16,940 --> 00:54:14,430
there's never any sunlight in 2015 and

1253
00:54:19,579 --> 00:54:16,950
so what we've done for that is we've

1254
00:54:22,910 --> 00:54:19,589
arranged the timing of the flyby the day

1255
00:54:25,760 --> 00:54:22,920
of the flyby to be such that Pluto's

1256
00:54:28,730 --> 00:54:25,770
giant moon Charon is behind Pluto and

1257
00:54:30,859 --> 00:54:28,740
casting its own moon light back into

1258
00:54:33,680 --> 00:54:30,869
those permanently shadowed regions and

1259
00:54:36,230 --> 00:54:33,690
after we passed the planet we will look

1260
00:54:37,490 --> 00:54:36,240
back again with the Lorri camera it's a

1261
00:54:39,890 --> 00:54:37,500
tough experiment because we have to look

1262
00:54:41,930 --> 00:54:39,900
back into the glare of the Sun and we

1263
00:54:45,319 --> 00:54:41,940

will use Charon moonlight and attempt to

1264
00:54:47,390 --> 00:54:45,329
map those final terrains the the polar

1265
00:54:49,730 --> 00:54:47,400
terrains in this very difficult

1266
00:54:51,559 --> 00:54:49,740
experiment looking back into the glint

1267
00:54:53,329 --> 00:54:51,569
of the Sun and we'll have to see how

1268
00:54:54,559 --> 00:54:53,339
that that actually turns out because

1269
00:54:57,920 --> 00:54:54,569
it's very challenging for the Lorri

1270
00:54:59,990 --> 00:54:57,930
instrument but whether or not that last

1271
00:55:00,480 --> 00:55:00,000
piece falls into place we expect to have

1272
00:55:02,359 --> 00:55:00,490
nearly

1273
00:55:05,490 --> 00:55:02,369
global maps of pluto and charon and

1274
00:55:09,510 --> 00:55:05,500
pretty good imagery of the other four

1275
00:55:13,290 --> 00:55:09,520
small satellites as well any last

1276
00:55:13,650 --> 00:55:13,300
question here before we wrap up all

1277
00:55:16,650 --> 00:55:13,660
right

1278
00:55:18,060 --> 00:55:16,660
I want to thank panel here in our

1279
00:55:20,790 --> 00:55:18,070
previous panel ladies and gentlemen

1280
00:55:24,390 --> 00:55:20,800
today you've heard about the Pluto New

1281
00:55:28,380 --> 00:55:24,400
Horizons mission historic you heard the

1282
00:55:30,570 --> 00:55:28,390
science the expected images and data the

1283
00:55:33,300 --> 00:55:30,580
spacecraft and the challenges I believe

1284
00:55:34,890 --> 00:55:33,310
dr. Stern's seven weeks of suspense did

1285
00:55:37,290 --> 00:55:34,900
I get that right

1286
00:55:40,140 --> 00:55:37,300
social media is abuzz with that as I'm

1287
00:55:43,890 --> 00:55:40,150
being told so for the media watching

1288
00:55:46,710 --> 00:55:43,900

this and listening and on social media

1289
00:55:51,600 --> 00:55:46,720
there will be a number of worldwide

1290
00:55:54,210 --> 00:55:51,610
events public outreach education and of

1291
00:55:55,920 --> 00:55:54,220
course media activities stay tuned for

1292
00:55:59,340 --> 00:55:55,930
updates on that working with my

1293
00:56:02,160 --> 00:55:59,350
colleagues we will get you a timeline of

1294
00:56:04,590 --> 00:56:02,170
those events logistics etc sometime in

1295
00:56:06,330 --> 00:56:04,600
the May or June timeline there will be a

1296
00:56:08,460 --> 00:56:06,340
host of events and I know the media

1297
00:56:11,580 --> 00:56:08,470
particularly will want to know other

1298
00:56:13,920 --> 00:56:11,590
logistics on getting on the site July

1299
00:56:16,820 --> 00:56:13,930
4th has its own fireworks ladies and

1300
00:56:19,410 --> 00:56:16,830
gentlemen NASA will have equally

1301
00:56:22,380 --> 00:56:19,420
exciting if not more fireworks for July

1302
00:56:26,490 --> 00:56:22,390
for the historic encounter of Pluto you

1303
00:56:30,390 --> 00:56:26,500
can go to WWE gov slash New Horizons for