
NASA

1
00:01:00,069 --> 00:00:58,150
what a sight nasa's mega moon rocket is

2
00:01:02,549 --> 00:01:00,079
on the launch pad after recently

3
00:01:04,950 --> 00:01:02,559
completing a wet dress rehearsal here in

4
00:01:06,950 --> 00:01:04,960
florida it is not launching today but

5
00:01:08,630 --> 00:01:06,960
before a rocket like this one starts

6
00:01:10,950 --> 00:01:08,640
launching missions to help assemble a

7
00:01:14,070 --> 00:01:10,960
space station in orbit around the moon

8
00:01:17,030 --> 00:01:14,080
nasa is first enabling a small cubesat

9
00:01:19,510 --> 00:01:17,040
called capstone to test out that same

10
00:01:22,390 --> 00:01:19,520
lunar orbit and we're taking you live to

11
00:01:35,560 --> 00:01:22,400
new zealand for that rocket lab launch

12
00:01:49,030 --> 00:01:42,660
[Music]

13
00:01:49,040 --> 00:01:59,910

so

14
00:02:04,149 --> 00:02:01,749
in less than an hour rocket labs

15
00:02:06,709 --> 00:02:04,159
electron rocket will lift off from

16
00:02:09,589 --> 00:02:06,719
launch complex one on the mahi uh

17
00:02:12,150 --> 00:02:09,599
peninsula in new zealand it's dark out

18
00:02:15,270 --> 00:02:12,160
there just a few hours after sunset for

19
00:02:18,150 --> 00:02:15,280
our friends uh in new zealand which time

20
00:02:22,390 --> 00:02:18,160
wise right after 9 pm local time liftoff

21
00:02:25,190 --> 00:02:22,400
is 9 55 p.m local time that's 5 55 p.m

22
00:02:26,949 --> 00:02:25,200
p.m eastern time and if all goes well

23
00:02:29,510 --> 00:02:26,959
that electron rocket that you see on the

24
00:02:31,910 --> 00:02:29,520
pad there will light up the night sky

25
00:02:33,350 --> 00:02:31,920
carrying nasa's capstone spacecraft

26
00:02:34,869 --> 00:02:33,360
towards the moon

27
00:02:36,710 --> 00:02:34,879
back here in florida thank you for

28
00:02:39,030 --> 00:02:36,720
joining us for live coverage of the

29
00:02:40,949 --> 00:02:39,040
capstone launch i'm daryl nail and as i

30
00:02:42,630 --> 00:02:40,959
mentioned earlier that's nasa's moon

31
00:02:45,350 --> 00:02:42,640
rocket on the pad behind me with the

32
00:02:48,390 --> 00:02:45,360
orion spacecraft it's on launch complex

33
00:02:51,110 --> 00:02:48,400
39b and preparations are being made to

34
00:02:53,830 --> 00:02:51,120
roll that sls rocket back to the vehicle

35
00:02:56,150 --> 00:02:53,840
assembly building on a gigantic mobile

36
00:02:58,070 --> 00:02:56,160
crawler currently scheduled for friday

37
00:03:00,550 --> 00:02:58,080
but when the launcher and moon rocket

38
00:03:03,270 --> 00:03:00,560

return to this pad they will be ready

39
00:03:06,149 --> 00:03:03,280
for artemis one and uncrewed test flight

40
00:03:08,390 --> 00:03:06,159
on an orbit around the moon that has yet

41
00:03:10,470 --> 00:03:08,400
to be scheduled but now back to today's

42
00:03:12,949 --> 00:03:10,480
mission before ryan goes to the moon

43
00:03:15,910 --> 00:03:12,959
we're sending capstone first a satellite

44
00:03:17,990 --> 00:03:15,920
the size of about a microwave oven which

45
00:03:19,750 --> 00:03:18,000
will demonstrate a new way to guide a

46
00:03:22,390 --> 00:03:19,760
spacecraft around the moon without

47
00:03:24,949 --> 00:03:22,400
relying on earth-based communication

48
00:03:27,509 --> 00:03:24,959
capstone stands for cislunar autonomous

49
00:03:29,750 --> 00:03:27,519
positioning system technology operations

50
00:03:31,750 --> 00:03:29,760
and navigation experiment it's a

51
00:03:33,509 --> 00:03:31,760
mouthful and here are some fast facts

52
00:03:35,589 --> 00:03:33,519
about it

53
00:03:37,430 --> 00:03:35,599
it's a 12 unit cubesat and as you can

54
00:03:39,830 --> 00:03:37,440
see from this animation it has solar

55
00:03:42,229 --> 00:03:39,840
rays and thrusters small ones at the

56
00:03:46,070 --> 00:03:42,239
bottom the dimensions without the arrays

57
00:03:48,550 --> 00:03:46,080
are just one by one by two feet or 34 by

58
00:03:52,390 --> 00:03:48,560
34 by 61 centimeters and it weighs just

59
00:03:54,470 --> 00:03:52,400
55 pounds or 25 kilograms and it doesn't

60
00:03:57,190 --> 00:03:54,480
need much of a push from its mono

61
00:03:59,910 --> 00:03:57,200
propellant hydrazine system because this

62
00:04:01,750 --> 00:03:59,920
orbit it's going into is very efficient

63
00:04:03,830 --> 00:04:01,760

the mission is funded by the space

64
00:04:05,670 --> 00:04:03,840
technology mission directorate which

65
00:04:08,869 --> 00:04:05,680
develops transformative space

66
00:04:10,470 --> 00:04:08,879
technologies to enable future missions

67
00:04:12,710 --> 00:04:10,480
but first let's get an update on

68
00:04:15,270 --> 00:04:12,720
preparations to launch capstone on

69
00:04:18,150 --> 00:04:15,280
electron rocket by taking you literally

70
00:04:20,390 --> 00:04:18,160
halfway around the world to rocket labs

71
00:04:22,469 --> 00:04:20,400
mission control center in auckland new

72
00:04:24,790 --> 00:04:22,479
zealand that's where launch commentator

73
00:04:27,270 --> 00:04:24,800
muriel baker is standing by

74
00:04:28,870 --> 00:04:27,280
muriel we're separated by 8 000 miles so

75
00:04:31,189 --> 00:04:28,880
there's a little bit of a delay between

76
00:04:33,430 --> 00:04:31,199
us it's not nearly as long as the time

77
00:04:35,909 --> 00:04:33,440
difference though 16 hours you're ahead

78
00:04:38,390 --> 00:04:35,919
of us here on the eastern coast of the

79
00:04:45,270 --> 00:04:38,400
united states but i say to you good

80
00:04:49,990 --> 00:04:47,270
thanks daryl that's right welcome to

81
00:04:54,310 --> 00:04:50,000
quite literally the future of space

82
00:04:56,230 --> 00:04:54,320
exploration it is uh just at t minus 51

83
00:04:58,390 --> 00:04:56,240
minutes to the countdown and here in new

84
00:05:00,469 --> 00:04:58,400
zealand i am joining you live from the

85
00:05:02,390 --> 00:05:00,479
rocket lab mission control center in

86
00:05:04,550 --> 00:05:02,400
auckland to take you through today's

87
00:05:06,870 --> 00:05:04,560
launch of the capstone mission from our

88
00:05:09,270 --> 00:05:06,880

country's eastern shore of the north

89
00:05:10,950 --> 00:05:09,280
island our rocket lab launch operators

90
00:05:12,950 --> 00:05:10,960
are making their way through the count

91
00:05:15,110 --> 00:05:12,960
with checks on the systems and the

92
00:05:18,230 --> 00:05:15,120
health of the rocket lab electron launch

93
00:05:19,990 --> 00:05:18,240
vehicle and photon luna upper stage as

94
00:05:22,150 --> 00:05:20,000
well as the capstone spacecraft

95
00:05:23,909 --> 00:05:22,160
integrated to photon

96
00:05:25,749 --> 00:05:23,919
all three are sitting on the pad at

97
00:05:28,150 --> 00:05:25,759
rocket lab launch complex one as you can

98
00:05:30,469 --> 00:05:28,160
see there on the mahia peninsula from

99
00:05:32,710 --> 00:05:30,479
where we will launch the electron rocket

100
00:05:34,150 --> 00:05:32,720
on an eastern trajectory over the south

101
00:05:36,870 --> 00:05:34,160
pacific ocean

102
00:05:41,350 --> 00:05:36,880
now liftoff is currently scheduled for

103
00:05:42,629 --> 00:05:41,360
2154 local new zealand time or 0 9 55

104
00:05:44,950 --> 00:05:42,639
utc

105
00:05:47,749 --> 00:05:44,960
in eastern daylight time that translates

106
00:05:49,590 --> 00:05:47,759
to 5 55 in the morning for you daryl

107
00:05:52,070 --> 00:05:49,600
sorry about that and for pacific

108
00:05:53,749 --> 00:05:52,080
daylight time liftoff is scheduled to a

109
00:05:56,070 --> 00:05:53,759
even unfriendlier

110
00:05:58,150 --> 00:05:56,080
2 55am

111
00:05:59,909 --> 00:05:58,160
our latest status update from our

112
00:06:01,990 --> 00:05:59,919
weather official in mission control

113
00:06:04,710 --> 00:06:02,000

reported clear skies over the launch

114
00:06:06,469 --> 00:06:04,720
site the weather is nice and still this

115
00:06:09,189 --> 00:06:06,479
evening with the probability of

116
00:06:11,670 --> 00:06:09,199
violation very low meaning we are very

117
00:06:13,590 --> 00:06:11,680
close to that launch liftoff now over

118
00:06:16,070 --> 00:06:13,600
the past few hours rocket labs launch

119
00:06:18,150 --> 00:06:16,080
crew on the ground and in mission and

120
00:06:20,550 --> 00:06:18,160
range controls have been readying the

121
00:06:22,950 --> 00:06:20,560
launch pad with vertical and avionics

122
00:06:24,550 --> 00:06:22,960
checks with the rocket and have loaded

123
00:06:28,070 --> 00:06:24,560
electron with its propellant types

124
00:06:30,710 --> 00:06:28,080
kerosene and liquid oxygen so right now

125
00:06:33,189 --> 00:06:30,720
with just about 50 minutes left to lift

126
00:06:35,110 --> 00:06:33,199
off all systems uh go for launch and i'm

127
00:06:37,110 --> 00:06:35,120
going to hand it back over to you at

128
00:06:39,830 --> 00:06:37,120
kennedy darryl all right great report

129
00:06:48,629 --> 00:06:39,840
muriel and quick question for you why

130
00:06:52,469 --> 00:06:50,390
daryl if you're looking for a launch

131
00:06:54,629 --> 00:06:52,479
site anywhere in the world the ideal

132
00:06:56,870 --> 00:06:54,639
location is an island in the middle of

133
00:06:59,270 --> 00:06:56,880
the ocean which new zealand as a country

134
00:07:01,110 --> 00:06:59,280
makes a great option for and if you're

135
00:07:02,790 --> 00:07:01,120
going to launch east which you would

136
00:07:05,110 --> 00:07:02,800
like to do because you get that free

137
00:07:07,110 --> 00:07:05,120
push in the same rotation of the earth

138
00:07:09,270 --> 00:07:07,120

then the east coast of new zealand is a

139
00:07:10,950 --> 00:07:09,280
great place to be and mahia on its

140
00:07:13,029 --> 00:07:10,960
peninsula jutting out over into the

141
00:07:15,029 --> 00:07:13,039
coast is a wonderful spot because we

142
00:07:17,270 --> 00:07:15,039
have very little air in marine traffic

143
00:07:19,270 --> 00:07:17,280
so it's really a one in a million

144
00:07:21,189 --> 00:07:19,280
location it certainly is and it's

145
00:07:23,749 --> 00:07:21,199
incredibly gorgeous especially during

146
00:07:26,710 --> 00:07:23,759
the daytime and hopefully in the future

147
00:07:28,150 --> 00:07:26,720
we can show you a daytime launch as well

148
00:07:29,670 --> 00:07:28,160
well we've got a lot of cool stuff to

149
00:07:31,270 --> 00:07:29,680
show you coming up in our pre-launch

150
00:07:33,749 --> 00:07:31,280
show as well as some great interviews

151
00:07:36,390 --> 00:07:33,759
first we'll take a closer look at the

152
00:07:39,110 --> 00:07:36,400
capstone mission itself the very first

153
00:07:41,189 --> 00:07:39,120
spacecraft to fly as part of the artemis

154
00:07:43,909 --> 00:07:41,199
program plus we'll speak to an expert

155
00:07:45,909 --> 00:07:43,919
about this the rectilinear halo orbit

156
00:07:48,469 --> 00:07:45,919
what do we expect to learn and how will

157
00:07:50,790 --> 00:07:48,479
we use the data and from capstone to

158
00:07:52,790 --> 00:07:50,800
gateway we'll talk to a nasa expert

159
00:07:55,110 --> 00:07:52,800
about the latest on plans for a lunar

160
00:07:57,270 --> 00:07:55,120
outpost where nasa astronauts will dock

161
00:07:58,390 --> 00:07:57,280
before going down to the surface of the

162
00:08:00,309 --> 00:07:58,400
moon

163
00:08:02,150 --> 00:08:00,319

after liftoff it will take about four

164
00:08:04,550 --> 00:08:02,160
months for capstone to get into the near

165
00:08:06,869 --> 00:08:04,560
rectilinear halo orbit here's more on

166
00:08:11,189 --> 00:08:06,879
the orbit and the cubesat six-month

167
00:08:14,950 --> 00:08:13,749
before nasa's artemis astronauts go to

168
00:08:17,670 --> 00:08:14,960
the moon

169
00:08:19,909 --> 00:08:17,680
a small spacecraft called capstone will

170
00:08:22,150 --> 00:08:19,919
help lead the way

171
00:08:24,390 --> 00:08:22,160
the sysloner autonomous positioning

172
00:08:27,749 --> 00:08:24,400
system technology operations and

173
00:08:30,070 --> 00:08:27,759
navigation experiment will test a unique

174
00:08:31,589 --> 00:08:30,080
lunar orbit that has never been flown

175
00:08:33,589 --> 00:08:31,599
before

176
00:08:34,949 --> 00:08:33,599
this orbit will be home for nasa's

177
00:08:37,190 --> 00:08:34,959
gateway

178
00:08:39,430 --> 00:08:37,200
the future space outpost that will

179
00:08:41,829 --> 00:08:39,440
support visiting astronauts on their way

180
00:08:44,149 --> 00:08:41,839
to the moon and beyond

181
00:08:47,190 --> 00:08:44,159
to help prepare for gateway operations

182
00:08:48,949 --> 00:08:47,200
in this orbit capstone will fly the path

183
00:08:51,030 --> 00:08:48,959
first

184
00:08:54,630 --> 00:08:51,040
the mission will be led by small

185
00:08:57,750 --> 00:08:54,640
business partner advanced space rocket

186
00:09:00,630 --> 00:08:57,760
lab will launch the spacecraft

187
00:09:04,150 --> 00:09:00,640
the gravities of earth the sun and the

188
00:09:06,790 --> 00:09:04,160

moon will help propel it into deep space

189
00:09:09,110 --> 00:09:06,800
as it nears its destination capstone

190
00:09:12,230 --> 00:09:09,120
will use its propulsion system to enter

191
00:09:14,150 --> 00:09:12,240
an elongated path around the moon

192
00:09:16,550 --> 00:09:14,160
the spacecraft will orbit between the

193
00:09:19,110 --> 00:09:16,560
gravities of earth and the moon in a

194
00:09:21,670 --> 00:09:19,120
precisely balanced dance

195
00:09:24,150 --> 00:09:21,680
for six months it will gather data about

196
00:09:27,350 --> 00:09:24,160
this crown shaped trajectory known as a

197
00:09:29,670 --> 00:09:27,360
near rectilinear halo orbit

198
00:09:32,630 --> 00:09:29,680
the path provides an unobstructed view

199
00:09:34,949 --> 00:09:32,640
of earth as it orbits the moon's poles

200
00:09:37,670 --> 00:09:34,959
and allows for continuous communications

201
00:09:40,230 --> 00:09:37,680
with ground-based control centers

202
00:09:42,949 --> 00:09:40,240
capstone will also demonstrate a new

203
00:09:44,949 --> 00:09:42,959
on-board navigation system

204
00:09:47,269 --> 00:09:44,959
it will communicate with nasa's moon

205
00:09:49,990 --> 00:09:47,279
observing lunar reconnaissance orbiter

206
00:09:52,230 --> 00:09:50,000
satellite to calculate its position the

207
00:09:54,070 --> 00:09:52,240
technology could allow future spacecraft

208
00:09:56,710 --> 00:09:54,080
to pinpoint their location without

209
00:09:58,550 --> 00:09:56,720
having to entirely rely on tracking from

210
00:10:00,870 --> 00:09:58,560
earth

211
00:10:03,829 --> 00:10:00,880
capstone's flight will demonstrate how

212
00:10:06,630 --> 00:10:03,839
this unique lunar orbit can support

213
00:10:10,230 --> 00:10:06,640

future spacecraft around the moon

214
00:10:19,910 --> 00:10:10,240
helping to launch a new era of human

215
00:10:23,910 --> 00:10:21,990
joining us now is dr jeff parker the

216
00:10:26,230 --> 00:10:23,920
chief technology officer with advanced

217
00:10:29,509 --> 00:10:26,240
space the company operating this mission

218
00:10:32,949 --> 00:10:29,519
for nasa and he brings capstone a

219
00:10:34,470 --> 00:10:32,959
literal life-size model of the exact

220
00:10:36,470 --> 00:10:34,480
spacecraft what's great about this is

221
00:10:39,110 --> 00:10:36,480
you get perspective of how big the

222
00:10:41,430 --> 00:10:39,120
spacecraft is it's this big

223
00:10:44,470 --> 00:10:41,440
that's right this is a 12 view form

224
00:10:46,630 --> 00:10:44,480
factor satellite it's a full spacecraft

225
00:10:48,949 --> 00:10:46,640
in a small body it's got propulsion

226
00:10:51,269 --> 00:10:48,959
system down here it's got an antenna

227
00:10:53,030 --> 00:10:51,279
that talks to the ground here this is

228
00:10:54,949 --> 00:10:53,040
the antenna that talks to the lunar

229
00:10:57,430 --> 00:10:54,959
reconnaissance orbiter another satellite

230
00:10:59,990 --> 00:10:57,440
in orbit about the moon solar panels

231
00:11:03,030 --> 00:11:00,000
these extend so this isn't a fully

232
00:11:04,710 --> 00:11:03,040
inferraled uh solar panel but yeah

233
00:11:07,190 --> 00:11:04,720
that's right it's about right the

234
00:11:09,110 --> 00:11:07,200
microwave oven was the analogy given and

235
00:11:11,430 --> 00:11:09,120
it certainly it looks like like it's

236
00:11:14,630 --> 00:11:11,440
exactly that tell me this is going into

237
00:11:16,550 --> 00:11:14,640
this near rectilinear halo orbit

238
00:11:19,030 --> 00:11:16,560

how will it do that and what's it going

239
00:11:21,190 --> 00:11:19,040
to do when it's there you bet so the

240
00:11:23,030 --> 00:11:21,200
near rectilinear halo orbit is a

241
00:11:24,790 --> 00:11:23,040
challenging orbit to say but it's a

242
00:11:26,310 --> 00:11:24,800
really impressive orbit for its

243
00:11:29,910 --> 00:11:26,320
operations

244
00:11:30,790 --> 00:11:29,920
we use a low energy transfer to get this

245
00:11:33,030 --> 00:11:30,800
guy

246
00:11:35,829 --> 00:11:33,040
into that orbit and it uses very little

247
00:11:38,389 --> 00:11:35,839
fuel to get there when we get there this

248
00:11:41,430 --> 00:11:38,399
is a model of what the uh orbit looks

249
00:11:42,949 --> 00:11:41,440
like uh hopefully we can see that yeah

250
00:11:45,910 --> 00:11:42,959
so earth is in the middle moon goes

251
00:11:48,069 --> 00:11:45,920
around and we form this crown shape uh

252
00:11:50,550 --> 00:11:48,079
about about the earth there

253
00:11:52,949 --> 00:11:50,560
and then this orbit is just fantastic

254
00:11:56,310 --> 00:11:52,959
for what it needs to demonstrate um

255
00:11:58,389 --> 00:11:56,320
there we go and uh uh it's it takes very

256
00:12:00,310 --> 00:11:58,399
little fuel to get into this orbit using

257
00:12:02,230 --> 00:12:00,320
this certain type of transfer to get

258
00:12:04,150 --> 00:12:02,240
there and then it takes very little fuel

259
00:12:05,590 --> 00:12:04,160
to get down to the surface of the moon

260
00:12:07,590 --> 00:12:05,600
we might even be able to use it to go

261
00:12:09,590 --> 00:12:07,600
out to asteroids it's a gateway and

262
00:12:11,269 --> 00:12:09,600
we're demonstrating this as the gateway

263
00:12:12,710 --> 00:12:11,279

for the artemis program

264
00:12:14,389 --> 00:12:12,720
we're seeing a beautiful shot of

265
00:12:16,629 --> 00:12:14,399
capstone right there on the top of the

266
00:12:18,870 --> 00:12:16,639
electron rocket you're with advanced

267
00:12:21,030 --> 00:12:18,880
space we've got that team as well that's

268
00:12:23,509 --> 00:12:21,040
online tonight they'll really start

269
00:12:25,829 --> 00:12:23,519
working when the mission fires up what

270
00:12:29,110 --> 00:12:25,839
challenges do you expect to find once

271
00:12:31,110 --> 00:12:29,120
this gets into its orbit

272
00:12:33,509 --> 00:12:31,120
so nobody has ever flown one of these

273
00:12:36,069 --> 00:12:33,519
orbits before now we have demonstrated

274
00:12:39,030 --> 00:12:36,079
this in simulation many times we're

275
00:12:41,190 --> 00:12:39,040
ready for anything even contingencies

276
00:12:42,710 --> 00:12:41,200
but space flight is challenging so we're

277
00:12:45,190 --> 00:12:42,720
ready for anything we're going to go

278
00:12:47,350 --> 00:12:45,200
head on and teach nasa every lesson we

279
00:12:50,389 --> 00:12:47,360
learn and there's your team waving at us

280
00:12:52,150 --> 00:12:50,399
live from colorado that's the advanced

281
00:12:54,389 --> 00:12:52,160
space headquarters in colorado where

282
00:12:56,949 --> 00:12:54,399
capstone mission operations center is

283
00:12:58,710 --> 00:12:56,959
located a lively bunch tonight again

284
00:13:00,629 --> 00:12:58,720
they're going to get working in six days

285
00:13:02,710 --> 00:13:00,639
that's right that's right i love this

286
00:13:04,389 --> 00:13:02,720
launch it gives us six days to prepare

287
00:13:06,470 --> 00:13:04,399
between launch and the time that our

288
00:13:07,590 --> 00:13:06,480

team picks up the satellite on the way

289
00:13:09,670 --> 00:13:07,600
to the moon

290
00:13:10,949 --> 00:13:09,680
so tell me what other lunar orbits were

291
00:13:12,629 --> 00:13:10,959
considered when you were first

292
00:13:13,670 --> 00:13:12,639
developing this because you know nasa

293
00:13:15,269 --> 00:13:13,680
gave you

294
00:13:16,389 --> 00:13:15,279
the funding for this mission and then

295
00:13:18,710 --> 00:13:16,399
said hey

296
00:13:20,230 --> 00:13:18,720
check it out for us oh sure yeah we

297
00:13:21,509 --> 00:13:20,240
looked at a lot of different orbits like

298
00:13:23,030 --> 00:13:21,519
this and they all had to have the same

299
00:13:26,470 --> 00:13:23,040
kind of requirements so they all had to

300
00:13:28,710 --> 00:13:26,480
have a low fuel requirement to get this

301
00:13:31,030 --> 00:13:28,720
satellite which only has so much fuel

302
00:13:32,870 --> 00:13:31,040
into that orbit has to be a gateway just

303
00:13:34,870 --> 00:13:32,880
like nasa is doing

304
00:13:36,629 --> 00:13:34,880
and then nasa in general has tested out

305
00:13:39,670 --> 00:13:36,639
a lot of different orbits we've landed

306
00:13:41,189 --> 00:13:39,680
on this nrho because of its terrific

307
00:13:42,870 --> 00:13:41,199
viability

308
00:13:44,550 --> 00:13:42,880
and with this spacecraft here when it

309
00:13:46,230 --> 00:13:44,560
maneuvers it's it's these small little

310
00:13:48,790 --> 00:13:46,240
jets here at the bottom is that right

311
00:13:50,790 --> 00:13:48,800
yep that's right yeah it has a enough

312
00:13:52,629 --> 00:13:50,800
fuel to do everything we need we have

313
00:13:53,509 --> 00:13:52,639

enough fuel for an extended mission as

314
00:13:56,150 --> 00:13:53,519
well

315
00:13:58,470 --> 00:13:56,160
it's a mono-propellant hydrazine system

316
00:14:00,710 --> 00:13:58,480
yeah full spacecraft

317
00:14:02,550 --> 00:14:00,720
and so in order for it to know where it

318
00:14:06,150 --> 00:14:02,560
is are you telling me this antenna up

319
00:14:07,990 --> 00:14:06,160
here is what communicates with the lro

320
00:14:10,470 --> 00:14:08,000
yeah another spacecraft that's right

321
00:14:12,310 --> 00:14:10,480
this so the space our spacecraft has two

322
00:14:13,990 --> 00:14:12,320
radios one to talk to the earth which is

323
00:14:17,030 --> 00:14:14,000
a conventional approach and one to talk

324
00:14:19,590 --> 00:14:17,040
to another spacecraft the lro and this

325
00:14:21,750 --> 00:14:19,600
is a reverse radio for lro so it's

326
00:14:23,509 --> 00:14:21,760
perfect to talk to lro

327
00:14:25,990 --> 00:14:23,519
we're going to demonstrate navigation in

328
00:14:27,990 --> 00:14:26,000
a couple of ways one with

329
00:14:30,389 --> 00:14:28,000
communications with lro which should be

330
00:14:33,030 --> 00:14:30,399
enough to navigate the spacecraft

331
00:14:35,829 --> 00:14:33,040
another one to do one-way communications

332
00:14:38,470 --> 00:14:35,839
with the dsn which is a future advanced

333
00:14:40,389 --> 00:14:38,480
navigation technology everything we can

334
00:14:43,189 --> 00:14:40,399
do to try to help

335
00:14:44,949 --> 00:14:43,199
enable future lunar exploration we

336
00:14:46,949 --> 00:14:44,959
envision a future that has a lot of

337
00:14:48,790 --> 00:14:46,959
missions at the in orbit about the moon

338
00:14:50,069 --> 00:14:48,800

we're trying to help that out absolutely

339
00:14:52,150 --> 00:14:50,079
thank you for bringing this this is

340
00:14:54,629 --> 00:14:52,160
great and for describing it jeff but now

341
00:14:56,069 --> 00:14:54,639
we're going to go to the real capstone

342
00:14:57,509 --> 00:14:56,079
you see on your screen there and check

343
00:14:59,430 --> 00:14:57,519
back in with the launch team and our

344
00:15:05,750 --> 00:14:59,440
commentator muriel baker how are we

345
00:15:10,310 --> 00:15:07,670
thanks derek on your screen right now is

346
00:15:11,750 --> 00:15:10,320
the range control center located just a

347
00:15:15,189 --> 00:15:11,760
couple of kilometers back from the

348
00:15:17,670 --> 00:15:15,199
launch pad itself on the mahia peninsula

349
00:15:19,910 --> 00:15:17,680
this peninsula is culturally significant

350
00:15:22,069 --> 00:15:19,920
to local maori people with ancestral

351
00:15:24,069 --> 00:15:22,079
ties to the land so i want to

352
00:15:27,430 --> 00:15:24,079
acknowledge first the manifenoa or the

353
00:15:30,150 --> 00:15:27,440
local people for today's historic launch

354
00:15:32,389 --> 00:15:30,160
now within range control along the back

355
00:15:35,269 --> 00:15:32,399
row of the control center starting from

356
00:15:37,509 --> 00:15:35,279
the right of your screen and moving left

357
00:15:39,829 --> 00:15:37,519
so it's two of our photon engineers

358
00:15:41,350 --> 00:15:39,839
making the spacecraft tank sorry

359
00:15:43,749 --> 00:15:41,360
managing the spacecraft's tank and

360
00:15:44,870 --> 00:15:43,759
communications and our it support

361
00:15:46,790 --> 00:15:44,880
engineer

362
00:15:48,949 --> 00:15:46,800
across the aisle is our senior launch

363
00:15:51,829 --> 00:15:48,959

conductor supporting the flight director

364
00:15:53,430 --> 00:15:51,839
based out of mission control in auckland

365
00:15:55,030 --> 00:15:53,440
next to them are two engineers

366
00:15:57,030 --> 00:15:55,040
responsible for the health of the

367
00:15:59,670 --> 00:15:57,040
electron rockets engines and its

368
00:16:02,629 --> 00:15:59,680
reaction control systems their cool set

369
00:16:05,110 --> 00:16:02,639
call names are prop and stage

370
00:16:07,030 --> 00:16:05,120
so in front of them said the engineers

371
00:16:09,590 --> 00:16:07,040
looking after electrons guidance

372
00:16:11,430 --> 00:16:09,600
navigation and control and monitoring

373
00:16:13,509 --> 00:16:11,440
the state of the rockets flight

374
00:16:16,310 --> 00:16:13,519
computers and software

375
00:16:18,629 --> 00:16:16,320
along the front row sets our gcs or

376
00:16:21,269 --> 00:16:18,639
ground control operators who monitor the

377
00:16:23,829 --> 00:16:21,279
launch pads ground systems and to their

378
00:16:26,310 --> 00:16:23,839
left on the right of your screen closest

379
00:16:28,629 --> 00:16:26,320
to the camera are the avionics operators

380
00:16:31,030 --> 00:16:28,639
with eyes on the operational status of

381
00:16:33,110 --> 00:16:31,040
the rockets electrical systems

382
00:16:35,749 --> 00:16:33,120
by hand behind them in the middle are

383
00:16:38,470 --> 00:16:35,759
the range and life launch safety offices

384
00:16:40,310 --> 00:16:38,480
keeping a close watch on the launch pad

385
00:16:42,710 --> 00:16:40,320
surroundings

386
00:16:45,430 --> 00:16:42,720
now cutting to mission control here on

387
00:16:47,030 --> 00:16:45,440
your screen this hub is in auckland and

388
00:16:49,509 --> 00:16:47,040

it's home to our engineers and

389
00:16:51,910 --> 00:16:49,519
technicians whose focus is on our photon

390
00:16:54,310 --> 00:16:51,920
and lunar upper stage and the capstone

391
00:16:55,990 --> 00:16:54,320
mission beyond earth orbit

392
00:16:57,990 --> 00:16:56,000
in the front row furthest from the

393
00:16:59,749 --> 00:16:58,000
camera starting from the right we have

394
00:17:02,389 --> 00:16:59,759
engineering support for the flight

395
00:17:03,990 --> 00:17:02,399
software on the photon lunar upper stage

396
00:17:06,069 --> 00:17:04,000
in the middle of the road to the end are

397
00:17:08,470 --> 00:17:06,079
the engineers managing ground tracking

398
00:17:10,789 --> 00:17:08,480
for today's launch and then on the end

399
00:17:12,630 --> 00:17:10,799
is our operator with eyes on photons

400
00:17:14,470 --> 00:17:12,640
hyper curie engine

401
00:17:16,230 --> 00:17:14,480
behind them starting closest to the

402
00:17:18,230 --> 00:17:16,240
camera and moving right we have the

403
00:17:20,309 --> 00:17:18,240
guidance navigation and control

404
00:17:22,390 --> 00:17:20,319
engineers who are across photon and

405
00:17:24,069 --> 00:17:22,400
capstone's path to the moon their core

406
00:17:25,829 --> 00:17:24,079
name is fido

407
00:17:27,429 --> 00:17:25,839
in the middle sits the spacecraft

408
00:17:29,750 --> 00:17:27,439
engineer supporting photons

409
00:17:32,150 --> 00:17:29,760
communication software and on the end

410
00:17:34,070 --> 00:17:32,160
set space ops software ensuring our

411
00:17:36,310 --> 00:17:34,080
telemetry makes it from the photon

412
00:17:38,549 --> 00:17:36,320
spacecraft to the operator

413
00:17:40,789 --> 00:17:38,559

now moving to the back row starting from

414
00:17:43,029 --> 00:17:40,799
the right sits our weather officer for

415
00:17:45,669 --> 00:17:43,039
today's mission followed by the engineer

416
00:17:48,070 --> 00:17:45,679
managing the it systems linking range

417
00:17:50,150 --> 00:17:48,080
and mission controls and then our team

418
00:17:52,549 --> 00:17:50,160
lead responsible for our hardware

419
00:17:54,549 --> 00:17:52,559
simulation platform called hittle which

420
00:17:57,270 --> 00:17:54,559
we use to simulate multiple flights to

421
00:17:59,430 --> 00:17:57,280
orbit before each mission we launch

422
00:18:01,830 --> 00:17:59,440
and next to them sets tank which

423
00:18:03,990 --> 00:18:01,840
monitors photons fluid systems to ensure

424
00:18:06,070 --> 00:18:04,000
its hypercure engine is provided with

425
00:18:08,230 --> 00:18:06,080
its propellants and finally at the end

426
00:18:09,590 --> 00:18:08,240
of the row is our director of gnc dr

427
00:18:12,789 --> 00:18:09,600
jonathan curry

428
00:18:14,950 --> 00:18:12,799
so with that we are now at t minus 38

429
00:18:16,950 --> 00:18:14,960
minutes and counting and proceeding

430
00:18:18,789 --> 00:18:16,960
comfortably with the countdowns left off

431
00:18:22,710 --> 00:18:18,799
a quick reminder that launch today is

432
00:18:25,669 --> 00:18:22,720
set for 9 55 pm new zealand time or 9 55

433
00:18:28,310 --> 00:18:25,679
a.m utc over to you daryl all right

434
00:18:31,190 --> 00:18:28,320
thank you muriel it'll be 5 55 a.m

435
00:18:33,350 --> 00:18:31,200
eastern time as well joining me now is

436
00:18:35,590 --> 00:18:33,360
ollie gueneris luna project manager for

437
00:18:37,430 --> 00:18:35,600
nasa's small satellite program she's

438
00:18:39,990 --> 00:18:37,440

here to talk about why cubesats like

439
00:18:42,070 --> 00:18:40,000
capstone are proof that small satellites

440
00:18:42,870 --> 00:18:42,080
can have a big impact thanks for being

441
00:18:45,029 --> 00:18:42,880
here

442
00:18:46,870 --> 00:18:45,039
no thank you for having me today so why

443
00:18:49,029 --> 00:18:46,880
would nasa choose a small satellite

444
00:18:51,029 --> 00:18:49,039
instead of a large one well i mean the

445
00:18:53,990 --> 00:18:51,039
reason why we choose small satellites is

446
00:18:55,190 --> 00:18:54,000
to be able to understand the risk

447
00:18:57,830 --> 00:18:55,200
of the missions that we're trying to

448
00:18:59,669 --> 00:18:57,840
develop and small satellites actually

449
00:19:02,390 --> 00:18:59,679
gives us the benefit of doing you know

450
00:19:04,150 --> 00:19:02,400
taking bigger risk and so having a small

451
00:19:06,390 --> 00:19:04,160
satellites being able to

452
00:19:08,310 --> 00:19:06,400
you know utilize uh and develop the

453
00:19:11,430 --> 00:19:08,320
technology for the bigger missions like

454
00:19:14,150 --> 00:19:11,440
the gateway you know is one of the the

455
00:19:15,830 --> 00:19:14,160
reasons why we choose the cap soon

456
00:19:17,909 --> 00:19:15,840
and so what are the most important

457
00:19:19,029 --> 00:19:17,919
factors when you go to design a small

458
00:19:21,190 --> 00:19:19,039
satellite

459
00:19:22,789 --> 00:19:21,200
well definitely i think it's going to be

460
00:19:24,630 --> 00:19:22,799
understanding the mission architecture

461
00:19:27,590 --> 00:19:24,640
where you're going understand the

462
00:19:30,230 --> 00:19:27,600
requirements the environment and you

463
00:19:31,990 --> 00:19:30,240

know trying to develop that technology

464
00:19:35,029 --> 00:19:32,000
so you can infuse it later into the

465
00:19:36,710 --> 00:19:35,039
bigger missions it's fascinating to to

466
00:19:38,549 --> 00:19:36,720
hear about how nasa is working with

467
00:19:40,870 --> 00:19:38,559
small businesses and these small

468
00:19:42,789 --> 00:19:40,880
satellites to get big jobs done what are

469
00:19:45,830 --> 00:19:42,799
the biggest technological advancements

470
00:19:47,590 --> 00:19:45,840
you've seen in small satellites

471
00:19:49,990 --> 00:19:47,600
i think the beauty for small satellites

472
00:19:52,150 --> 00:19:50,000
has been that not only are we able to

473
00:19:55,110 --> 00:19:52,160
develop the technology really fast and

474
00:19:57,750 --> 00:19:55,120
quickly you know and mature it but also

475
00:19:59,350 --> 00:19:57,760
being able to now do a pathfinder's

476
00:20:00,950 --> 00:19:59,360
missions like the capstone is going to

477
00:20:03,350 --> 00:20:00,960
be for the gateway

478
00:20:05,669 --> 00:20:03,360
and and so that actually gives us a lot

479
00:20:08,230 --> 00:20:05,679
of benefits because we can turn around

480
00:20:10,470 --> 00:20:08,240
and really develop and mature that

481
00:20:13,110 --> 00:20:10,480
technology which will help the mission

482
00:20:15,029 --> 00:20:13,120
behind us right here which is the sls

483
00:20:16,549 --> 00:20:15,039
not launching today but a beautiful shot

484
00:20:18,950 --> 00:20:16,559
on the pad we've got two different

485
00:20:20,470 --> 00:20:18,960
rockets on two different pads in vastly

486
00:20:22,630 --> 00:20:20,480
different locations

487
00:20:24,950 --> 00:20:22,640
on a more personal note ali i was

488
00:20:27,750 --> 00:20:24,960

reading uh an article about your

489
00:20:30,390 --> 00:20:27,760
personal journey here and it begins with

490
00:20:34,149 --> 00:20:30,400
an 8.0 magnitude earthquake in mexico

491
00:20:36,789 --> 00:20:34,159
city back in 1985 5 000 people killed

492
00:20:38,950 --> 00:20:36,799
devastated mexico city where you were uh

493
00:20:40,789 --> 00:20:38,960
born and raised before you came here

494
00:20:43,909 --> 00:20:40,799
tell me a little about your personal

495
00:20:45,510 --> 00:20:43,919
journey and and how that sparked your

496
00:20:47,830 --> 00:20:45,520
you and your mother's journey here to

497
00:20:49,990 --> 00:20:47,840
the united states well definitely i mean

498
00:20:51,510 --> 00:20:50,000
it's a long story but just to make it

499
00:20:53,430 --> 00:20:51,520
short uh

500
00:20:55,830 --> 00:20:53,440
you know when the earthquake happened my

501
00:20:57,750 --> 00:20:55,840
mother you know had four children i was

502
00:20:59,590 --> 00:20:57,760
the oldest one four you know and she did

503
00:21:02,390 --> 00:20:59,600
not really had a wealth

504
00:21:04,789 --> 00:21:02,400
education so for her to be able to

505
00:21:06,390 --> 00:21:04,799
survive you know in mexico at that time

506
00:21:09,190 --> 00:21:06,400
you know it was

507
00:21:10,950 --> 00:21:09,200
not viable so she decided to move to the

508
00:21:14,070 --> 00:21:10,960
united states and

509
00:21:16,310 --> 00:21:14,080
you know move with her four children and

510
00:21:18,470 --> 00:21:16,320
i was you know the oldest one so i moved

511
00:21:19,590 --> 00:21:18,480
with my mother here and

512
00:21:20,789 --> 00:21:19,600
you know i

513
00:21:23,830 --> 00:21:20,799

had to

514
00:21:26,149 --> 00:21:23,840
learn the culture you know understand um

515
00:21:28,070 --> 00:21:26,159
well learn the language too right and

516
00:21:30,470 --> 00:21:28,080
then be able to

517
00:21:33,029 --> 00:21:30,480
to you know get adjusted to this new

518
00:21:36,230 --> 00:21:33,039
world and you know it took me some time

519
00:21:38,230 --> 00:21:36,240
you know obviously like anybody you know

520
00:21:40,470 --> 00:21:38,240
you went to school yes dropped out

521
00:21:44,230 --> 00:21:40,480
because of it and then went back that's

522
00:21:46,549 --> 00:21:44,240
right i decided to go back to school

523
00:21:48,549 --> 00:21:46,559
after many years because you know i have

524
00:21:50,870 --> 00:21:48,559
two small children with that with mental

525
00:21:53,029 --> 00:21:50,880
illness and for me that was the drive to

526
00:21:55,669 --> 00:21:53,039
actually you know get into school and

527
00:21:57,990 --> 00:21:55,679
get a degree you know to be able to

528
00:22:00,070 --> 00:21:58,000
have them you know have them to have a

529
00:22:02,390 --> 00:22:00,080
better life and for me going back to

530
00:22:04,870 --> 00:22:02,400
school was you know was the drive and so

531
00:22:07,669 --> 00:22:04,880
i did it and i graduated and then

532
00:22:09,110 --> 00:22:07,679
when i um was graduated my professor

533
00:22:11,270 --> 00:22:09,120
actually told me there's an internship

534
00:22:13,350 --> 00:22:11,280
advanced i ended up you know working at

535
00:22:14,870 --> 00:22:13,360
nasa not thinking that that was the path

536
00:22:16,549 --> 00:22:14,880
that i was going to take but

537
00:22:18,470 --> 00:22:16,559
you know i'm here and i'm

538
00:22:20,630 --> 00:22:18,480

really happy to be here how about that

539
00:22:22,310 --> 00:22:20,640
what an inspiring story ali thank you

540
00:22:24,789 --> 00:22:22,320
for sharing it with us overcoming all

541
00:22:26,310 --> 00:22:24,799
those hardships to be here at nasa thank

542
00:22:27,990 --> 00:22:26,320
you good luck on the launch and thank

543
00:22:29,909 --> 00:22:28,000
you again for being here well we've

544
00:22:32,470 --> 00:22:29,919
showed you how capstone is a pathfinder

545
00:22:34,230 --> 00:22:32,480
mission for nasa's lunar gateway as nasa

546
00:22:36,470 --> 00:22:34,240
astronaut randy bresnik will show you

547
00:22:38,870 --> 00:22:36,480
the planned orbiting lunar outpost is

548
00:22:42,630 --> 00:22:38,880
the first step to fulfilling plans for a

549
00:22:45,029 --> 00:22:42,640
more permanent presence on the moon

550
00:22:49,270 --> 00:22:48,149
for me home is where my family is

551
00:22:50,789 --> 00:22:49,280
but there have been times in my life

552
00:22:52,830 --> 00:22:50,799
where i was called away from my family

553
00:22:55,029 --> 00:22:52,840
for extended periods of

554
00:22:56,789 --> 00:22:55,039
time while i was serving in the marine

555
00:22:57,830 --> 00:22:56,799
corps it was hard to be away from my

556
00:23:00,070 --> 00:22:57,840
loved ones

557
00:23:01,669 --> 00:23:00,080
but thankfully i had my squadron family

558
00:23:04,549 --> 00:23:01,679
but other places where we were stationed

559
00:23:06,310 --> 00:23:04,559
around the globe became a temporary home

560
00:23:08,310 --> 00:23:06,320
then in 2009 i launched the

561
00:23:10,149 --> 00:23:08,320
international space station traveling

562
00:23:12,870 --> 00:23:10,159
even farther away from my family

563
00:23:13,830 --> 00:23:12,880

conducting science 250 miles above the

564
00:23:15,430 --> 00:23:13,840
earth

565
00:23:17,909 --> 00:23:15,440
the space station was an orbiting home

566
00:23:19,990 --> 00:23:17,919
for my crewmates and myself

567
00:23:22,470 --> 00:23:20,000
talk about a room with a breathtaking

568
00:23:24,470 --> 00:23:22,480
view

569
00:23:26,230 --> 00:23:24,480
with artemis nast will send the first

570
00:23:27,830 --> 00:23:26,240
woman and the first person of color to

571
00:23:29,830 --> 00:23:27,840
the moon

572
00:23:31,990 --> 00:23:29,840
we are going there for the benefit of

573
00:23:33,350 --> 00:23:32,000
all here

574
00:23:35,830 --> 00:23:33,360
we'll need a place to orbit around the

575
00:23:37,110 --> 00:23:35,840
moon where we can live and work a place

576
00:23:38,789 --> 00:23:37,120
where to get ready for our learned

577
00:23:40,789 --> 00:23:38,799
surface expeditions

578
00:23:42,950 --> 00:23:40,799
and a place to return to when our work

579
00:23:45,990 --> 00:23:42,960
on the lunar surface is complete

580
00:23:49,029 --> 00:23:46,000
we need a lunar home away from home

581
00:23:50,630 --> 00:23:49,039
this will be the gateway

582
00:23:53,190 --> 00:23:50,640
starting with the power and habitation

583
00:23:55,350 --> 00:23:53,200
modules the gateway will be the first

584
00:23:56,950 --> 00:23:55,360
long-term outpost in lunar orbit humans

585
00:23:58,710 --> 00:23:56,960
have ever had

586
00:24:00,470 --> 00:23:58,720
prime for new discoveries this orbiting

587
00:24:02,070 --> 00:24:00,480
laboratory will provide us with a unique

588
00:24:03,590 --> 00:24:02,080

view of our solar system

589
00:24:05,029 --> 00:24:03,600
and it's already becoming a beacon for

590
00:24:08,230 --> 00:24:05,039
the future of international and

591
00:24:10,390 --> 00:24:08,240
commercial cooperation in space

592
00:24:12,630 --> 00:24:10,400
with increasing capability and longer

593
00:24:14,789 --> 00:24:12,640
missions over time the gala will be a

594
00:24:16,549 --> 00:24:14,799
powerhouse of technology and science

595
00:24:18,549 --> 00:24:16,559
paving the way for future human missions

596
00:24:20,070 --> 00:24:18,559
to mars

597
00:24:21,990 --> 00:24:20,080
design and fabrication of gateway

598
00:24:23,590 --> 00:24:22,000
elements by nasa and our international

599
00:24:26,230 --> 00:24:23,600
partners is well underway around the

600
00:24:28,710 --> 00:24:26,240
world right now

601
00:24:30,870 --> 00:24:28,720
wherever you are on planet earth

602
00:24:32,470 --> 00:24:30,880
today you are part of the artemis

603
00:24:34,789 --> 00:24:32,480
generation

604
00:24:37,029 --> 00:24:34,799
i'm nasa astronaut randy bresnik i

605
00:24:39,430 --> 00:24:37,039
invite you to join us by following nasa

606
00:24:44,390 --> 00:24:39,440
gateway on social media and telling us

607
00:24:49,590 --> 00:24:46,710
t-minus 31 minutes and counting until

608
00:24:52,149 --> 00:24:49,600
launch in new zealand with our nasa mega

609
00:24:54,549 --> 00:24:52,159
moon rocket here on the ground as a

610
00:24:56,630 --> 00:24:54,559
backdrop it's time now to dive into the

611
00:24:59,350 --> 00:24:56,640
details of capstone's orbit the near

612
00:25:01,590 --> 00:24:59,360
rectilinear halo orbit i spoke to jude

613
00:25:07,029 --> 00:25:01,600

marantzy chief of the nasa exploration

614
00:25:11,269 --> 00:25:08,950
morenci thank you for being here we're

615
00:25:14,310 --> 00:25:11,279
launching of course capstone today

616
00:25:15,510 --> 00:25:14,320
a microwave size cubesat that's going

617
00:25:18,149 --> 00:25:15,520
into this

618
00:25:19,909 --> 00:25:18,159
near rectilinear halo orbit

619
00:25:22,470 --> 00:25:19,919
eventually it will lead the way for

620
00:25:24,310 --> 00:25:22,480
gateway a much larger lunar outpost

621
00:25:25,669 --> 00:25:24,320
where astronauts will go what's the

622
00:25:26,549 --> 00:25:25,679
difference between

623
00:25:29,350 --> 00:25:26,559
getting

624
00:25:31,029 --> 00:25:29,360
capstone into that orbit versus the

625
00:25:32,310 --> 00:25:31,039
lunar gateway one of the really

626
00:25:34,149 --> 00:25:32,320
interesting things with the orbit

627
00:25:35,830 --> 00:25:34,159
mechanics is we can sort of play with

628
00:25:37,750 --> 00:25:35,840
you know how much propellant it takes to

629
00:25:40,070 --> 00:25:37,760
get somewhere and the time it takes so

630
00:25:41,909 --> 00:25:40,080
capstone is using a ballistic lunar

631
00:25:43,750 --> 00:25:41,919
transfer so it'll take three months to

632
00:25:46,230 --> 00:25:43,760
get to nrho

633
00:25:48,549 --> 00:25:46,240
and but it'll use a quarter of the delta

634
00:25:50,230 --> 00:25:48,559
velocity that we'll need when we fly

635
00:25:52,070 --> 00:25:50,240
this with artemis and the crew so the

636
00:25:54,710 --> 00:25:52,080
crew will only spend you know five to

637
00:25:57,110 --> 00:25:54,720
ten days in transit will fly very close

638
00:25:59,190 --> 00:25:57,120

to the moon and use the moon to to

639
00:26:00,950 --> 00:25:59,200
slingshot us out there but it takes more

640
00:26:02,870 --> 00:26:00,960
delta velocity or you know relative

641
00:26:04,630 --> 00:26:02,880
propellant amount so you know we can

642
00:26:06,390 --> 00:26:04,640
play with both the time and the duration

643
00:26:08,230 --> 00:26:06,400
to get into nrho

644
00:26:10,149 --> 00:26:08,240
based on whether we're flying crew or

645
00:26:11,750 --> 00:26:10,159
you're doing something so uncrewed like

646
00:26:13,510 --> 00:26:11,760
the capstone mission

647
00:26:16,070 --> 00:26:13,520
and looking at this near rectilinear

648
00:26:18,390 --> 00:26:16,080
halo orbit you can see it really goes

649
00:26:21,350 --> 00:26:18,400
quickly around the moon but spends more

650
00:26:23,269 --> 00:26:21,360
time away from it why is that and are

651
00:26:25,590 --> 00:26:23,279
there advantages or disadvantages to

652
00:26:27,269 --> 00:26:25,600
that yeah so the nrho or near

653
00:26:29,669 --> 00:26:27,279
rectilinear halo orbit it's an

654
00:26:32,710 --> 00:26:29,679
elliptical orbit so when you're close to

655
00:26:34,870 --> 00:26:32,720
the moon uh the spacecraft either any

656
00:26:37,269 --> 00:26:34,880
spacecraft will fly very fast you'll go

657
00:26:39,990 --> 00:26:37,279
over the north pole of the moon in about

658
00:26:42,070 --> 00:26:40,000
a day but then we spend about six days

659
00:26:44,070 --> 00:26:42,080
over the big part below the south pole

660
00:26:45,590 --> 00:26:44,080
of the orbit so you go very fast close

661
00:26:46,710 --> 00:26:45,600
to the moon slow when you're away from

662
00:26:48,710 --> 00:26:46,720
the moon

663
00:26:50,549 --> 00:26:48,720

but the reason we're in this orbit is

664
00:26:52,950 --> 00:26:50,559
it's incredibly stable

665
00:26:55,269 --> 00:26:52,960
but also relatively close to the moon so

666
00:26:57,350 --> 00:26:55,279
with that stability we only need the

667
00:26:59,190 --> 00:26:57,360
equivalent of 10 meters per second of

668
00:27:00,950 --> 00:26:59,200
delta velocity for a whole year to

669
00:27:03,350 --> 00:27:00,960
maintain the orbit which is very small

670
00:27:05,909 --> 00:27:03,360
in spacecraft terms so that means we can

671
00:27:07,909 --> 00:27:05,919
put the gateway there for you know 10 15

672
00:27:10,149 --> 00:27:07,919
years and not need a lot of propellant

673
00:27:11,990 --> 00:27:10,159
to keep it there but it's also close

674
00:27:14,230 --> 00:27:12,000
enough to the moon that the human

675
00:27:16,310 --> 00:27:14,240
landing system can access the south pole

676
00:27:17,430 --> 00:27:16,320
we can do the human exploration in the

677
00:27:19,269 --> 00:27:17,440
future

678
00:27:21,830 --> 00:27:19,279
as well as have that stability for a

679
00:27:24,310 --> 00:27:21,840
good outpost capability so

680
00:27:26,389 --> 00:27:24,320
really it was that balanced orbit

681
00:27:28,549 --> 00:27:26,399
for the long-term planning of artemis

682
00:27:31,029 --> 00:27:28,559
and the objectives we need for human

683
00:27:34,389 --> 00:27:31,039
exploration oh that's very interesting

684
00:27:37,029 --> 00:27:34,399
and so what is required in order to

685
00:27:38,710 --> 00:27:37,039
maintain that very unique orbit is it

686
00:27:40,710 --> 00:27:38,720
difficult so the orbit should be

687
00:27:42,789 --> 00:27:40,720
relatively easy to maintain but that's

688
00:27:44,710 --> 00:27:42,799

why we want capstone to go first so we

689
00:27:46,789 --> 00:27:44,720
can collect all the data and validate

690
00:27:48,630 --> 00:27:46,799
the models so it doesn't really matter

691
00:27:50,389 --> 00:27:48,640
what size the vehicles are the orbit

692
00:27:53,110 --> 00:27:50,399
mechanics will work the same so with

693
00:27:55,430 --> 00:27:53,120
capstone as the sort of pathfinder

694
00:27:57,669 --> 00:27:55,440
it can demonstrate the navigation the

695
00:27:59,750 --> 00:27:57,679
guidance the the propulsive capability

696
00:28:01,669 --> 00:27:59,760
to maintain the orbit and we can really

697
00:28:03,990 --> 00:28:01,679
just extract from that the math to

698
00:28:06,149 --> 00:28:04,000
validate the orbits for gateway orion

699
00:28:08,230 --> 00:28:06,159
and artemis missions so

700
00:28:09,110 --> 00:28:08,240
the maintenance of the orbit is is

701
00:28:11,350 --> 00:28:09,120
really

702
00:28:13,029 --> 00:28:11,360
fascinating easy thing to do so we can

703
00:28:14,149 --> 00:28:13,039
use these two missions to compare how

704
00:28:15,909 --> 00:28:14,159
they work

705
00:28:17,590 --> 00:28:15,919
but the other advantages of this orbit

706
00:28:19,590 --> 00:28:17,600
is it's very stable for power and

707
00:28:22,149 --> 00:28:19,600
thermal and has continuous communication

708
00:28:23,990 --> 00:28:22,159
with earth so you know the operations in

709
00:28:26,630 --> 00:28:24,000
this orbit are really good for that

710
00:28:28,950 --> 00:28:26,640
long-term deep space exploration uh

711
00:28:30,230 --> 00:28:28,960
capabilities that we want to demonstrate

712
00:28:34,710 --> 00:28:30,240
more antsy thank you so much for your

713
00:28:38,870 --> 00:28:36,789

capstone packs a lot of technology into

714
00:28:45,430 --> 00:28:38,880
a very small package and that's thanks

715
00:28:48,310 --> 00:28:46,789
we're incredibly excited to be leading

716
00:28:50,149 --> 00:28:48,320
the capstone mission for nasa and

717
00:28:51,430 --> 00:28:50,159
demonstrating critical technologies that

718
00:28:53,510 --> 00:28:51,440
will not just help people return to the

719
00:28:55,669 --> 00:28:53,520
moon will help people stay at the moon

720
00:28:57,830 --> 00:28:55,679
before nasa sends their human rated

721
00:29:00,470 --> 00:28:57,840
spacecraft we want to send our cubesat

722
00:29:01,990 --> 00:29:00,480
capstone to kind of work out the issues

723
00:29:03,750 --> 00:29:02,000
of how do you operate in this type of

724
00:29:06,070 --> 00:29:03,760
orbit how do you do station keeping how

725
00:29:08,230 --> 00:29:06,080
do you do navigation capstone is a

726
00:29:10,950 --> 00:29:08,240
pathfinder mission uh capstone is going

727
00:29:13,029 --> 00:29:10,960
to be demonstrating how to put a space

728
00:29:15,909 --> 00:29:13,039
station at the moon so it's important

729
00:29:18,310 --> 00:29:15,919
for us to characterize that orbit and to

730
00:29:20,630 --> 00:29:18,320
understand what it is like to have

731
00:29:22,149 --> 00:29:20,640
spacecraft in that orbit the capstone

732
00:29:24,389 --> 00:29:22,159
mission is important because we'll be

733
00:29:26,389 --> 00:29:24,399
one of the first to explore the nrho the

734
00:29:28,470 --> 00:29:26,399
near rectilinear halo orbit in and

735
00:29:31,190 --> 00:29:28,480
around cislunar space which will provide

736
00:29:33,110 --> 00:29:31,200
valuable experience and knowledge for an

737
00:29:35,110 --> 00:29:33,120
asset when they operate their artemis

738
00:29:36,389 --> 00:29:35,120

missions what i think makes it a really

739
00:29:38,630 --> 00:29:36,399
interesting orbit is that it's kind of

740
00:29:39,430 --> 00:29:38,640
like balancing a pencil or a pin on the

741
00:29:41,350 --> 00:29:39,440
tip

742
00:29:42,630 --> 00:29:41,360
like theoretically you can but you never

743
00:29:45,669 --> 00:29:42,640
actually can

744
00:29:47,750 --> 00:29:45,679
at its core caps is a peer-to-peer

745
00:29:49,830 --> 00:29:47,760
navigation system so caps is the

746
00:29:51,750 --> 00:29:49,840
cislunar autonomous positioning system

747
00:29:53,510 --> 00:29:51,760
and we'll be using that

748
00:29:54,549 --> 00:29:53,520
to sort of do autonomous lunar

749
00:29:56,149 --> 00:29:54,559
navigation

750
00:29:59,190 --> 00:29:56,159
in addition to demonstrating the

751
00:30:01,510 --> 00:29:59,200
neorectilinear halo orbit for nasa caps

752
00:30:04,149 --> 00:30:01,520
enables a future where

753
00:30:06,389 --> 00:30:04,159
many spacecraft can talk to each other

754
00:30:08,230 --> 00:30:06,399
and they can help each other navigate

755
00:30:09,990 --> 00:30:08,240
figure out where they are avoid

756
00:30:11,190 --> 00:30:10,000
collisions carry out their objectives

757
00:30:13,110 --> 00:30:11,200
and so on

758
00:30:15,510 --> 00:30:13,120
instead of talking to the ground

759
00:30:17,430 --> 00:30:15,520
we can talk just directly with lro and

760
00:30:19,350 --> 00:30:17,440
determine where we are in space

761
00:30:21,350 --> 00:30:19,360
determine our position and our velocity

762
00:30:24,549 --> 00:30:21,360
in space you don't just know that you

763
00:30:26,549 --> 00:30:24,559

are you know x kilometers separated you

764
00:30:28,630 --> 00:30:26,559
can actually estimate the full

765
00:30:30,710 --> 00:30:28,640
six-dimensional state of both of those

766
00:30:32,389 --> 00:30:30,720
spacecraft people have shown that

767
00:30:34,549 --> 00:30:32,399
mathematically for

768
00:30:35,590 --> 00:30:34,559
probably 15 years at this point and this

769
00:30:37,830 --> 00:30:35,600
will be the first time that we actually

770
00:30:39,350 --> 00:30:37,840
get to demonstrate it in space going to

771
00:30:41,269 --> 00:30:39,360
the moon is about learning it's about

772
00:30:43,350 --> 00:30:41,279
learning how to operate in deep space

773
00:30:44,549 --> 00:30:43,360
without a lot of support from the ground

774
00:30:45,830 --> 00:30:44,559
i think it's very cool that we're

775
00:30:47,110 --> 00:30:45,840
working to put people back on the moon

776
00:30:49,110 --> 00:30:47,120
especially because

777
00:30:50,710 --> 00:30:49,120
when i was growing up that wasn't

778
00:30:52,230 --> 00:30:50,720
a big thing it was a big thing we had

779
00:30:54,149 --> 00:30:52,240
done but not a big thing that we were

780
00:30:55,830 --> 00:30:54,159
doing and so i think it's really cool to

781
00:30:58,149 --> 00:30:55,840
be part of the generation is kind of

782
00:30:59,909 --> 00:30:58,159
bringing that back space travel

783
00:31:01,590 --> 00:30:59,919
is kind of like

784
00:31:03,669 --> 00:31:01,600
sea travel was

785
00:31:06,149 --> 00:31:03,679
many hundreds of years ago

786
00:31:08,870 --> 00:31:06,159
it's hard it's dangerous

787
00:31:10,630 --> 00:31:08,880
but the resources out there the

788
00:31:12,789 --> 00:31:10,640

knowledge out there

789
00:31:15,110 --> 00:31:12,799
will have tremendous impact on human

790
00:31:16,630 --> 00:31:15,120
life in the future it has been an

791
00:31:17,990 --> 00:31:16,640
exhilarating two and a half years

792
00:31:19,590 --> 00:31:18,000
leading the development of the capstone

793
00:31:21,190 --> 00:31:19,600
mission for nasa but what i'm most

794
00:31:23,669 --> 00:31:21,200
excited about is this is just the

795
00:31:25,509 --> 00:31:23,679
beginning of developing a foundation for

796
00:31:27,350 --> 00:31:25,519
the permanent return of humanity to the

797
00:31:32,149 --> 00:31:27,360
moon and a starting point for us to

798
00:31:36,710 --> 00:31:34,549
well you heard from the advanced space

799
00:31:38,870 --> 00:31:36,720
engineers now you're seeing them live

800
00:31:40,870 --> 00:31:38,880
this is an advanced space headquarters

801
00:31:43,909 --> 00:31:40,880
in colorado where the capstone mission

802
00:31:46,630 --> 00:31:43,919
operations control center is they will

803
00:31:48,710 --> 00:31:46,640
jump into action six days from today

804
00:31:50,230 --> 00:31:48,720
that's when the spacecraft separates the

805
00:31:52,950 --> 00:31:50,240
advanced space team will then assess

806
00:31:54,950 --> 00:31:52,960
capstone's orbit operate the payloads

807
00:31:57,669 --> 00:31:54,960
and communicate with capstone through

808
00:32:00,549 --> 00:31:57,679
nasa's deep space network and terran

809
00:32:02,389 --> 00:32:00,559
orbital back out to the pad t minus 24

810
00:32:04,789 --> 00:32:02,399
minutes and counting here's a quick

811
00:32:06,549 --> 00:32:04,799
overview now of the launch preparations

812
00:32:09,350 --> 00:32:06,559
and what we can expect in the final

813
00:32:11,269 --> 00:32:09,360

minutes of countdown

814
00:32:13,830 --> 00:32:11,279
the countdown to launch is the most

815
00:32:15,350 --> 00:32:13,840
closely watched clock in mission control

816
00:32:17,190 --> 00:32:15,360
here are some of the things that take

817
00:32:18,440 --> 00:32:17,200
place at each milestone after the

818
00:32:20,230 --> 00:32:18,450
countdown begins

819
00:32:22,549 --> 00:32:20,240
[Music]

820
00:32:25,029 --> 00:32:22,559
at t minus nine hours before launch our

821
00:32:26,789 --> 00:32:25,039
crew are on site at launch complex one

822
00:32:28,630 --> 00:32:26,799
to configure the pad for launch and

823
00:32:31,110 --> 00:32:28,640
prepare to power on electron for the

824
00:32:32,789 --> 00:32:31,120
day's operations meanwhile our operators

825
00:32:34,070 --> 00:32:32,799
in mission control start checking in to

826
00:32:36,149 --> 00:32:34,080
their stations

827
00:32:37,669 --> 00:32:36,159
at t-minus seven hours our operators

828
00:32:39,909 --> 00:32:37,679
will brief the launch director with a

829
00:32:41,830 --> 00:32:39,919
status update mission control also

830
00:32:43,750 --> 00:32:41,840
receives its first weather check on what

831
00:32:45,590 --> 00:32:43,760
to expect at liftoff including cloud

832
00:32:49,590 --> 00:32:45,600
cover and predicted wind speed at launch

833
00:32:53,509 --> 00:32:51,830
now at t minus 6 hours our ground

834
00:32:55,269 --> 00:32:53,519
tracking stations begin to power up

835
00:32:56,710 --> 00:32:55,279
before electron is prepared to go

836
00:32:58,630 --> 00:32:56,720
vertical on the pad

837
00:33:00,710 --> 00:32:58,640
soon afterward electrons rutherford

838
00:33:02,870 --> 00:33:00,720

engines are tested with a short burst of

839
00:33:04,710 --> 00:33:02,880
engine fire to confirm all systems are

840
00:33:07,190 --> 00:33:04,720
operating as they should

841
00:33:09,990 --> 00:33:07,200
at t minus 5 hours through t minus 3

842
00:33:11,990 --> 00:33:10,000
hours our range safety team runs through

843
00:33:13,669 --> 00:33:12,000
safety status checks for those on and

844
00:33:14,710 --> 00:33:13,679
around our launch complex on the

845
00:33:16,630 --> 00:33:14,720
peninsula

846
00:33:18,070 --> 00:33:16,640
making sure the team and the public are

847
00:33:20,230 --> 00:33:18,080
kept safe during the day's launch

848
00:33:22,389 --> 00:33:20,240
attempt fuel loading of kerosene will

849
00:33:24,230 --> 00:33:22,399
soon begin on electron while additional

850
00:33:29,509 --> 00:33:24,240
vertical systems checks take place and

851
00:33:33,669 --> 00:33:31,669
it's t-minus three hours now and soon

852
00:33:36,230 --> 00:33:33,679
liquid oxygen will begin to flow into

853
00:33:38,789 --> 00:33:36,240
electron as the rocket slowly fills with

854
00:33:40,950 --> 00:33:38,799
this oxidizer electron's black body

855
00:33:43,029 --> 00:33:40,960
turns white as humidity in the air

856
00:33:44,630 --> 00:33:43,039
around the rocket freezes into a thin

857
00:33:47,590 --> 00:33:44,640
sheet of ice due to the freezing

858
00:33:49,750 --> 00:33:47,600
temperatures of the liquid oxygen inside

859
00:33:52,070 --> 00:33:49,760
with one hour left to launch it's crunch

860
00:33:53,590 --> 00:33:52,080
time for our operators vehicle cameras

861
00:33:55,590 --> 00:33:53,600
are switched to their launch settings

862
00:33:57,669 --> 00:33:55,600
our avionics team enables electron for

863
00:33:59,990 --> 00:33:57,679

flight our final weather brief comes

864
00:34:01,750 --> 00:34:00,000
through and the range safety status will

865
00:34:02,710 --> 00:34:01,760
confirm that the area is clear for

866
00:34:04,789 --> 00:34:02,720
launch

867
00:34:07,190 --> 00:34:04,799
with 12 minutes left in the count our

868
00:34:08,790 --> 00:34:07,200
launch director runs the go no-go poll

869
00:34:11,030 --> 00:34:08,800
with our operators to make the final

870
00:34:13,109 --> 00:34:11,040
decision to proceed with the launch

871
00:34:15,589 --> 00:34:13,119
all final checks are completed before we

872
00:34:17,270 --> 00:34:15,599
reach t minus 2 minutes in the countdown

873
00:34:19,030 --> 00:34:17,280
at this critical point the countdown

874
00:34:21,109 --> 00:34:19,040
auto sequence begins and electrons

875
00:34:23,190 --> 00:34:21,119
flight computers take over the launch

876
00:34:25,270 --> 00:34:23,200
director begins counting down to liftoff

877
00:34:27,030 --> 00:34:25,280
from t minus 10 seconds before the

878
00:34:29,349 --> 00:34:27,040
engines ignite three seconds before

879
00:34:31,750 --> 00:34:29,359
launch and electron lifts off the pad at

880
00:34:42,790 --> 00:34:31,760
t0 on its way to complete its next

881
00:34:46,629 --> 00:34:44,869
and i was made aware of one more small

882
00:34:48,790 --> 00:34:46,639
launch preparation and that is eating

883
00:34:51,030 --> 00:34:48,800
the good luck peanuts dr jeffrey parker

884
00:34:53,349 --> 00:34:51,040
is here he's had his and it's a

885
00:34:56,149 --> 00:34:53,359
tradition of navigators to do so before

886
00:34:58,310 --> 00:34:56,159
a big mission well capstone is flying on

887
00:35:00,470 --> 00:34:58,320
a small rocket but it has a long journey

888
00:35:02,710 --> 00:35:00,480

to get to the moon a key technology that

889
00:35:04,710 --> 00:35:02,720
will get capstone there is the third

890
00:35:06,870 --> 00:35:04,720
stage of the electron rocket called

891
00:35:09,349 --> 00:35:06,880
photon let's head back down to new

892
00:35:14,950 --> 00:35:09,359
zealand and join muriel for more on that

893
00:35:19,750 --> 00:35:17,829
thank you daryl so to get the spacecraft

894
00:35:22,069 --> 00:35:19,760
out of low earth orbit and on a

895
00:35:24,069 --> 00:35:22,079
ballistic lunar transfer to the moon for

896
00:35:26,150 --> 00:35:24,079
the first time rocket lab is using its

897
00:35:28,790 --> 00:35:26,160
lunar configuration of our photon

898
00:35:31,349 --> 00:35:28,800
spacecraft bus now unlike the apollo

899
00:35:33,430 --> 00:35:31,359
lunar missions of the 1960s and 70s

900
00:35:35,829 --> 00:35:33,440
which took a free return trajectory to

901
00:35:37,990 --> 00:35:35,839
the moon a fuel-efficient ballistic

902
00:35:41,030 --> 00:35:38,000
lunar transfer makes it possible to

903
00:35:42,790 --> 00:35:41,040
deploy capstone on a distant orbit using

904
00:35:44,310 --> 00:35:42,800
a small launch vehicle

905
00:35:46,310 --> 00:35:44,320
the first nine minutes or so of the

906
00:35:48,550 --> 00:35:46,320
mission will follow the typical mission

907
00:35:50,870 --> 00:35:48,560
profile of an electron launch the rocket

908
00:35:53,109 --> 00:35:50,880
will complete liftoff first and second

909
00:35:55,750 --> 00:35:53,119
stage separation and finally end with

910
00:35:58,470 --> 00:35:55,760
photon separating from electrons second

911
00:36:00,230 --> 00:35:58,480
stage in an elliptical orbit now that is

912
00:36:02,630 --> 00:36:00,240
where things start to get interesting

913
00:36:04,870 --> 00:36:02,640

because once separated from electron

914
00:36:07,270 --> 00:36:04,880
photon will carry out a series of orbit

915
00:36:09,589 --> 00:36:07,280
raising maneuvers using its hyper curie

916
00:36:12,390 --> 00:36:09,599
engine stretching its orbit into a

917
00:36:14,870 --> 00:36:12,400
prominent ellipse around earth about six

918
00:36:17,670 --> 00:36:14,880
days after launch a final burn from the

919
00:36:22,470 --> 00:36:17,680
hypocuria engine will accelerate photon

920
00:36:25,430 --> 00:36:22,480
to 24 500 miles per hour enabling it to

921
00:36:27,349 --> 00:36:25,440
escape low earth orbit and set capstone

922
00:36:29,430 --> 00:36:27,359
on a course for the moon

923
00:36:31,910 --> 00:36:29,440
within 20 minutes of the final burn

924
00:36:34,230 --> 00:36:31,920
photon will release capstone into space

925
00:36:36,470 --> 00:36:34,240
for the first leg of the cubesat solo

926
00:36:39,270 --> 00:36:36,480
flight and then capstone's journey to

927
00:36:41,030 --> 00:36:39,280
niho is expected to take around four

928
00:36:43,670 --> 00:36:41,040
months from that point

929
00:36:45,990 --> 00:36:43,680
now once successfully inserted into the

930
00:36:48,069 --> 00:36:46,000
orbit capstone is expected to remain

931
00:36:50,790 --> 00:36:48,079
there for at least six months allowing

932
00:36:52,870 --> 00:36:50,800
nasa to study the orbits dynamics now

933
00:36:55,030 --> 00:36:52,880
here are two pivotal members of our

934
00:36:57,990 --> 00:36:55,040
photon team to explain more about our

935
00:36:59,589 --> 00:36:58,000
photon luna upper stage

936
00:37:01,430 --> 00:36:59,599
my name is essan mosley i'm the chief

937
00:37:03,589 --> 00:37:01,440
engineer for space systems at rocket lab

938
00:37:06,069 --> 00:37:03,599

i'm rich hunter and i'm a mission design

939
00:37:08,230 --> 00:37:06,079
engineer on the gnc team my job is to

940
00:37:11,109 --> 00:37:08,240
oversee the entire technical progress of

941
00:37:13,589 --> 00:37:11,119
the mission between uh conception to

942
00:37:15,270 --> 00:37:13,599
delivery of the 12 you cubesat to its

943
00:37:16,230 --> 00:37:15,280
end destination

944
00:37:18,870 --> 00:37:16,240
i do

945
00:37:19,990 --> 00:37:18,880
mission design and flight dynamics for

946
00:37:21,589 --> 00:37:20,000
capstone

947
00:37:24,550 --> 00:37:21,599
and i

948
00:37:26,870 --> 00:37:24,560
combine all that into a picture of what

949
00:37:29,030 --> 00:37:26,880
photon and electron are

950
00:37:33,270 --> 00:37:29,040
and use that to design and optimize

951
00:37:35,430 --> 00:37:33,280
trajectories to get us from lc1 to

952
00:37:37,030 --> 00:37:35,440
putting capstone on a ballistic lunar

953
00:37:38,630 --> 00:37:37,040
transfer to the moon

954
00:37:41,589 --> 00:37:38,640
it's the most unique mission i've worked

955
00:37:43,589 --> 00:37:41,599
on at rocket labs so far we've taken our

956
00:37:45,270 --> 00:37:43,599
electron kick stage

957
00:37:47,589 --> 00:37:45,280
and turned that into a full functioning

958
00:37:48,950 --> 00:37:47,599
spacecraft added a lot of delta v to its

959
00:37:50,550 --> 00:37:48,960
capability in order to be able to

960
00:37:52,150 --> 00:37:50,560
deliver the capstone vehicle into this

961
00:37:53,990 --> 00:37:52,160
higher energy orbit

962
00:37:57,270 --> 00:37:54,000
traditionally what they did is they'd

963
00:37:58,230 --> 00:37:57,280

line it up right and they'd burn in one

964
00:38:00,390 --> 00:37:58,240
direction

965
00:38:03,349 --> 00:38:00,400
for a very long time to get the energy

966
00:38:05,670 --> 00:38:03,359
they needed to basically put them on a

967
00:38:09,270 --> 00:38:05,680
translunar injection or a translunar

968
00:38:11,430 --> 00:38:09,280
orbit that is less efficient if you have

969
00:38:13,270 --> 00:38:11,440
a lower thrust engine

970
00:38:16,550 --> 00:38:13,280
the way to get around that is to simply

971
00:38:19,190 --> 00:38:16,560
split that burn into multiple burns over

972
00:38:22,550 --> 00:38:19,200
the course of several orbits so rather

973
00:38:25,109 --> 00:38:22,560
than build your orbit from circular to a

974
00:38:27,510 --> 00:38:25,119
trans-lunar injection in one go

975
00:38:29,910 --> 00:38:27,520
you build it from circular through a

976
00:38:31,030 --> 00:38:29,920
series of successively more eccentric

977
00:38:33,030 --> 00:38:31,040
orbits

978
00:38:35,829 --> 00:38:33,040
through a number of burns so rather than

979
00:38:38,069 --> 00:38:35,839
one like apollo we are doing eight burns

980
00:38:40,550 --> 00:38:38,079
to build up our transur injection and

981
00:38:42,230 --> 00:38:40,560
the cool part about the initial phase of

982
00:38:43,270 --> 00:38:42,240
the mission even though it's on day one

983
00:38:46,470 --> 00:38:43,280
of six

984
00:38:49,270 --> 00:38:46,480
is the t0 that we launch into we'll set

985
00:38:50,790 --> 00:38:49,280
our right ascension one of the orbital

986
00:38:53,190 --> 00:38:50,800
elements that defines our orbital

987
00:38:56,230 --> 00:38:53,200
alignment and as soon as we launch into

988
00:38:57,750 --> 00:38:56,240

that orbital plane our right ascension

989
00:38:59,829 --> 00:38:57,760
as our

990
00:39:01,589 --> 00:38:59,839
payload deployment six days into the

991
00:39:03,910 --> 00:39:01,599
mission is set

992
00:39:06,310 --> 00:39:03,920
and then ten minutes later we'll do our

993
00:39:07,829 --> 00:39:06,320
first hyphen curing maneuver which will

994
00:39:10,150 --> 00:39:07,839
set the line of absolutes which is

995
00:39:12,550 --> 00:39:10,160
another measure of orbital alignment so

996
00:39:13,430 --> 00:39:12,560
then two of the alignment parameters are

997
00:39:15,109 --> 00:39:13,440
set

998
00:39:17,349 --> 00:39:15,119
within the first 20 minutes of the

999
00:39:19,589 --> 00:39:17,359
mission so we need to set them really

1000
00:39:21,910 --> 00:39:19,599
accurately so they'll drift onto a

1001
00:39:23,750 --> 00:39:21,920
moving target to then hit a moving

1002
00:39:25,829 --> 00:39:23,760
target which is the moon

1003
00:39:28,630 --> 00:39:25,839
kind of three months later when the

1004
00:39:33,109 --> 00:39:28,640
mission ends for everybody else i expect

1005
00:39:36,550 --> 00:39:33,119
we'll be trying uh some zero pressure

1006
00:39:38,790 --> 00:39:36,560
deep space maneuvering to test our our

1007
00:39:40,870 --> 00:39:38,800
com systems and our propulsion system

1008
00:39:42,470 --> 00:39:40,880
and our assist learning navigation for

1009
00:39:44,069 --> 00:39:42,480
other missions like venus i'm really

1010
00:39:45,910 --> 00:39:44,079
proud of the technology we developed for

1011
00:39:48,230 --> 00:39:45,920
this mission but i'm most proud of the

1012
00:39:50,470 --> 00:39:48,240
fact that this technology extends

1013
00:40:02,790 --> 00:39:50,480

to future missions for rocket lab and

1014
00:40:07,670 --> 00:40:05,270
we are coming up soon on the go no go

1015
00:40:10,150 --> 00:40:07,680
pole one of the final gates we need to

1016
00:40:12,630 --> 00:40:10,160
pass through for electron and capstone

1017
00:40:13,670 --> 00:40:12,640
to leave the pad for today's mission to

1018
00:40:15,750 --> 00:40:13,680
the moon

1019
00:40:17,670 --> 00:40:15,760
our talented and dedicated team have

1020
00:40:20,150 --> 00:40:17,680
been making their way methodically

1021
00:40:23,109 --> 00:40:20,160
through launch pad range and vehicle

1022
00:40:25,430 --> 00:40:23,119
preparations in the hours before liftoff

1023
00:40:28,069 --> 00:40:25,440
so to confirm we are proceeding all the

1024
00:40:31,109 --> 00:40:28,079
way through to launch let's listen into

1025
00:40:33,270 --> 00:40:31,119
mission control for that final go no go

1026
00:40:34,950 --> 00:40:33,280
pull that will be coming up in just a

1027
00:41:42,870 --> 00:40:34,960
few moments and we'll keep our fingers

1028
00:41:47,510 --> 00:41:45,349
all right all stations ld on mission

1029
00:41:49,910 --> 00:41:47,520
proceeding with the go no-go pole this

1030
00:41:52,710 --> 00:41:49,920
time stay there you go

1031
00:41:55,910 --> 00:41:52,720
stretch your skull avionics

1032
00:42:05,829 --> 00:42:01,510
vms ems is go t1 t1 is go gc

1033
00:42:07,349 --> 00:42:05,839
gc is go pls pls let's go iriso

1034
00:42:08,309 --> 00:42:07,359
iris always go

1035
00:42:11,750 --> 00:42:08,319
mit

1036
00:42:12,790 --> 00:42:11,760
that is go amen

1037
00:42:19,829 --> 00:42:12,800
tank

1038
00:42:20,950 --> 00:42:19,839

go av charlie av trailers go econ

1039
00:42:22,069 --> 00:42:20,960
ecommerce

1040
00:42:27,030 --> 00:42:22,079
c2

1041
00:42:31,910 --> 00:42:27,040
fighter oscar audi sup

1042
00:42:36,150 --> 00:42:34,390
in all stations uh that is the go no go

1043
00:42:38,550 --> 00:42:36,160
sequence complete we're currently t

1044
00:42:40,710 --> 00:42:38,560
minus 14 minutes eight seconds and

1045
00:42:42,390 --> 00:42:40,720
counting we go for terminal count start

1046
00:42:43,990 --> 00:42:42,400
at t minus 10 minutes

1047
00:42:50,550 --> 00:42:44,000
be advised from this time the three word

1048
00:42:55,349 --> 00:42:53,190
and there we go that is a clear run

1049
00:42:57,510 --> 00:42:55,359
through status checks and as you heard

1050
00:43:01,030 --> 00:42:57,520
we are moving forward to the launch of

1051
00:43:04,230 --> 00:43:01,040
the capstone mission to the moon our t0

1052
00:43:10,309 --> 00:43:04,240
launch time remains 9 55 pm new zealand

1053
00:43:14,069 --> 00:43:10,319
local time and 9 55 a.m utc or 5 55 a.m

1054
00:43:15,829 --> 00:43:14,079
and 2 55 a.m eastern and pacific so

1055
00:43:18,150 --> 00:43:15,839
let's go back to the kennedy space

1056
00:43:20,630 --> 00:43:18,160
center in florida where daryl is with

1057
00:43:22,309 --> 00:43:20,640
another special guest thank you muriel

1058
00:43:25,190 --> 00:43:22,319
got all the times covered appreciate

1059
00:43:27,030 --> 00:43:25,200
that joining us now is justin trepto

1060
00:43:29,430 --> 00:43:27,040
deputy of the flight opportunities in

1061
00:43:31,589 --> 00:43:29,440
small spacecraft technology programs to

1062
00:43:34,870 --> 00:43:31,599
talk about how small businesses played a

1063
00:43:36,790 --> 00:43:34,880

large role in this mission justin great

1064
00:43:39,109 --> 00:43:36,800
to have you back you used to work here

1065
00:43:40,950 --> 00:43:39,119
spent 10 years here yep you're now up at

1066
00:43:42,870 --> 00:43:40,960
headquarters but back in florida for

1067
00:43:44,630 --> 00:43:42,880
this launch absolutely i'm i'm

1068
00:43:46,710 --> 00:43:44,640
extraordinarily excited to be here for

1069
00:43:48,550 --> 00:43:46,720
our our lunar mission

1070
00:43:50,309 --> 00:43:48,560
first question why does nasa partner

1071
00:43:52,309 --> 00:43:50,319
with small businesses like the ones that

1072
00:43:54,309 --> 00:43:52,319
were involved in the capstone mission

1073
00:43:56,390 --> 00:43:54,319
well it's an interesting interplay

1074
00:43:58,630 --> 00:43:56,400
between government and commercial

1075
00:44:00,550 --> 00:43:58,640
commercial companies um

1076
00:44:02,790 --> 00:44:00,560
with uh spacecraft getting smaller and

1077
00:44:05,190 --> 00:44:02,800
more capable we're seeing more entrants

1078
00:44:06,950 --> 00:44:05,200
getting into the space industry and as

1079
00:44:09,109 --> 00:44:06,960
they get more and more experience on

1080
00:44:11,109 --> 00:44:09,119
orbit they're demonstrating real

1081
00:44:13,589 --> 00:44:11,119
capabilities that nasa can partner with

1082
00:44:16,630 --> 00:44:13,599
to lead missions like capstone and and

1083
00:44:18,790 --> 00:44:16,640
really take a leading role in uh

1084
00:44:20,069 --> 00:44:18,800
gathering data that we can use for other

1085
00:44:21,510 --> 00:44:20,079
projects

1086
00:44:24,550 --> 00:44:21,520
this

1087
00:44:26,230 --> 00:44:24,560
spools into the ability to have

1088
00:44:28,309 --> 00:44:26,240

those companies

1089
00:44:30,550 --> 00:44:28,319
turn those capabilities into services

1090
00:44:33,109 --> 00:44:30,560
that you can buy as another government

1091
00:44:34,950 --> 00:44:33,119
organization or other parts of nasa um

1092
00:44:36,390 --> 00:44:34,960
we heard uh interview with rocket lab

1093
00:44:39,510 --> 00:44:36,400
earlier talking about their escapade

1094
00:44:41,270 --> 00:44:39,520
mission they developed the lunar photon

1095
00:44:42,710 --> 00:44:41,280
which is being used for another nasa

1096
00:44:44,630 --> 00:44:42,720
mission which would not have come to

1097
00:44:47,030 --> 00:44:44,640
pass it wasn't for the capstone mission

1098
00:44:49,030 --> 00:44:47,040
you we wouldn't have the data for

1099
00:44:52,790 --> 00:44:49,040
gateway to take advantage of if advanced

1100
00:44:55,270 --> 00:44:52,800
space wasn't here as a commercial

1101
00:44:58,630 --> 00:44:55,280
partner on this project to to bring the

1102
00:45:00,150 --> 00:44:58,640
data from one project to another project

1103
00:45:02,309 --> 00:45:00,160
that's fascinating so you mentioned some

1104
00:45:04,150 --> 00:45:02,319
of the benefits already

1105
00:45:05,829 --> 00:45:04,160
that have been gained and we've seen

1106
00:45:08,309 --> 00:45:05,839
that through the development of capstone

1107
00:45:10,230 --> 00:45:08,319
right because nasa says hey go develop

1108
00:45:12,710 --> 00:45:10,240
this and then if there's spin-offs that

1109
00:45:13,910 --> 00:45:12,720
are beneficial in other areas you're

1110
00:45:16,630 --> 00:45:13,920
starting to already see that with

1111
00:45:17,910 --> 00:45:16,640
capstone yeah absolutely um

1112
00:45:19,349 --> 00:45:17,920
some of the examples like one of the

1113
00:45:22,550 --> 00:45:19,359

most obvious ones is with the capstone

1114
00:45:25,589 --> 00:45:22,560
propulsion system itself um having a

1115
00:45:28,470 --> 00:45:25,599
high delta v propulsion system on a

1116
00:45:30,069 --> 00:45:28,480
cubesat form factor is something that is

1117
00:45:31,829 --> 00:45:30,079
in the small set world kind of the holy

1118
00:45:33,750 --> 00:45:31,839
grail being able to go somewhere and

1119
00:45:36,069 --> 00:45:33,760
actually do something of value

1120
00:45:38,710 --> 00:45:36,079
is is really useful and having stellar

1121
00:45:40,710 --> 00:45:38,720
exploration develop a propulsion system

1122
00:45:43,109 --> 00:45:40,720
that capstone is using to to get into

1123
00:45:44,550 --> 00:45:43,119
orbit around the noon in the nrh show

1124
00:45:46,470 --> 00:45:44,560
and to stay there for an extended period

1125
00:45:48,309 --> 00:45:46,480
of time is a propulsion system that's

1126
00:45:50,150 --> 00:45:48,319
showing up in other commercial products

1127
00:45:52,550 --> 00:45:50,160
that that's infusing within the industry

1128
00:45:55,109 --> 00:45:52,560
so we're seeing the technology that nasa

1129
00:45:56,550 --> 00:45:55,119
is funding for our missions

1130
00:45:59,270 --> 00:45:56,560
going to other places within the space

1131
00:46:01,829 --> 00:45:59,280
industry already so quickly early on in

1132
00:46:03,270 --> 00:46:01,839
this that's impressive we're now t minus

1133
00:46:05,589 --> 00:46:03,280
10 minutes and counting until the

1134
00:46:07,430 --> 00:46:05,599
liftoff of uh

1135
00:46:09,829 --> 00:46:07,440
rocket labs electron rocket i want to

1136
00:46:11,589 --> 00:46:09,839
ask you about a previous rocket lab

1137
00:46:14,150 --> 00:46:11,599
mission that nasa did you're familiar

1138
00:46:17,030 --> 00:46:14,160

with it alana 19 as part of the venture

1139
00:46:19,270 --> 00:46:17,040
class launch services initiative um what

1140
00:46:21,270 --> 00:46:19,280
was the benefit of that and what did we

1141
00:46:23,349 --> 00:46:21,280
learn from that that we're

1142
00:46:24,870 --> 00:46:23,359
moving into this mission

1143
00:46:26,710 --> 00:46:24,880
so the

1144
00:46:28,550 --> 00:46:26,720
initial elana 19

1145
00:46:29,349 --> 00:46:28,560
flight was a venture clash launch

1146
00:46:32,069 --> 00:46:29,359
service

1147
00:46:33,910 --> 00:46:32,079
rocket lab was a very new entry to the

1148
00:46:35,430 --> 00:46:33,920
launch market at that point and nasa

1149
00:46:38,710 --> 00:46:35,440
wanted to get an opportunity to work

1150
00:46:41,030 --> 00:46:38,720
with them on a project um and what we

1151
00:46:43,750 --> 00:46:41,040
learned from that is that companies like

1152
00:46:46,550 --> 00:46:43,760
rocket lab like uh tyvac the bus

1153
00:46:48,630 --> 00:46:46,560
supplier uh for this mission they're

1154
00:46:50,710 --> 00:46:48,640
they're very capable uh bringing their

1155
00:46:52,150 --> 00:46:50,720
commercial best practices to the table

1156
00:46:55,510 --> 00:46:52,160
and are able to like

1157
00:46:58,550 --> 00:46:55,520
really lead missions and projects um so

1158
00:47:00,470 --> 00:46:58,560
it it has alana 19 and the venture class

1159
00:47:01,910 --> 00:47:00,480
launch service was like the first

1160
00:47:03,510 --> 00:47:01,920
stepping stone to getting into these

1161
00:47:05,109 --> 00:47:03,520
more advanced missions where our

1162
00:47:07,670 --> 00:47:05,119
industry partners again are really

1163
00:47:10,710 --> 00:47:07,680

taking a strong lead in the overall uh

1164
00:47:12,950 --> 00:47:10,720
mission and briefly justin any give me a

1165
00:47:15,349 --> 00:47:12,960
sneak peek at what's coming down the

1166
00:47:17,030 --> 00:47:15,359
line any exciting uh partnerships with

1167
00:47:18,470 --> 00:47:17,040
small businesses similar to this

1168
00:47:20,150 --> 00:47:18,480
capstone mission

1169
00:47:21,750 --> 00:47:20,160
uh yep so like in the near future we

1170
00:47:23,030 --> 00:47:21,760
have a number of other cubesats that are

1171
00:47:25,510 --> 00:47:23,040
in the work they're also going to be

1172
00:47:27,990 --> 00:47:25,520
doing uh big technology demonstrations

1173
00:47:30,790 --> 00:47:28,000
in small packages we have lunar photon

1174
00:47:32,950 --> 00:47:30,800
also going to the moon to shine a laser

1175
00:47:34,549 --> 00:47:32,960
into the permanently shadowed craters of

1176
00:47:36,870 --> 00:47:34,559
the moon to look for water

1177
00:47:38,470 --> 00:47:36,880
we have a starling

1178
00:47:41,510 --> 00:47:38,480
constellation of small spacecraft

1179
00:47:43,270 --> 00:47:41,520
there's going to be doing on-orbit uh

1180
00:47:44,470 --> 00:47:43,280
networking demonstrations and

1181
00:47:47,430 --> 00:47:44,480
interfacing with other commercial

1182
00:47:50,549 --> 00:47:47,440
partners on orbit uh helping to to

1183
00:47:52,309 --> 00:47:50,559
alleviate conjunctions and to make space

1184
00:47:53,990 --> 00:47:52,319
easier to access for for all

1185
00:47:56,230 --> 00:47:54,000
participants justin trepto thank you

1186
00:47:57,990 --> 00:47:56,240
very much and welcome back

1187
00:47:59,349 --> 00:47:58,000
thank you very much a quick programming

1188
00:48:00,790 --> 00:47:59,359

note before we go back down to new

1189
00:48:02,549 --> 00:48:00,800
zealand i want to let you know that uh

1190
00:48:05,270 --> 00:48:02,559
later this morning northrop grumman

1191
00:48:08,790 --> 00:48:05,280
cygnus spacecraft will be departing the

1192
00:48:11,190 --> 00:48:08,800
international space station at 7 05 a.m

1193
00:48:15,030 --> 00:48:11,200
eastern time we will have live coverage

1194
00:48:17,109 --> 00:48:15,040
here on nasa tv starting at 6 45 a.m

1195
00:48:18,950 --> 00:48:17,119
eastern time again northrop grumman

1196
00:48:20,390 --> 00:48:18,960
cygnus spacecraft will be departing the

1197
00:48:23,430 --> 00:48:20,400
international space station

1198
00:48:25,270 --> 00:48:23,440
at 7 05 a.m eastern time all right let's

1199
00:48:27,430 --> 00:48:25,280
head back down to new zealand we are t

1200
00:48:34,150 --> 00:48:27,440
minus eight minutes and counting and

1201
00:48:39,030 --> 00:48:36,390
thank you daryl it is t minus eight

1202
00:48:41,270 --> 00:48:39,040
minutes and ten seconds until liftoff if

1203
00:48:43,589 --> 00:48:41,280
you're just joining us welcome to rocket

1204
00:48:45,990 --> 00:48:43,599
labs mission control center in auckland

1205
00:48:47,829 --> 00:48:46,000
new zealand things are looking great so

1206
00:48:49,990 --> 00:48:47,839
far for an on-time launch today from our

1207
00:48:53,190 --> 00:48:50,000
private orbital range rocket lab launch

1208
00:48:55,510 --> 00:48:53,200
complex 1 on new zealand's eastern shore

1209
00:48:57,990 --> 00:48:55,520
now you have seen the launch range and

1210
00:48:59,990 --> 00:48:58,000
inside our mission and control centers

1211
00:49:02,309 --> 00:49:00,000
now it is time to get you acquainted

1212
00:49:04,390 --> 00:49:02,319
with the electron rocket lifting off the

1213
00:49:06,710 --> 00:49:04,400

pad today and as you will have seen

1214
00:49:08,790 --> 00:49:06,720
earlier in the show we are taking an

1215
00:49:11,030 --> 00:49:08,800
unconventional path to the moon and that

1216
00:49:13,430 --> 00:49:11,040
is because electron is an unconventional

1217
00:49:15,750 --> 00:49:13,440
rocket the first of its kind in many

1218
00:49:17,910 --> 00:49:15,760
ways and one of the smallest orbital

1219
00:49:20,790 --> 00:49:17,920
rockets in history to attempt to launch

1220
00:49:24,870 --> 00:49:20,800
a spacecraft to lunar orbit so here's a

1221
00:49:29,270 --> 00:49:27,030
a small launcher dedicated for small

1222
00:49:31,270 --> 00:49:29,280
satellites electron was the first of its

1223
00:49:34,549 --> 00:49:31,280
kind to reach orbit when it first took

1224
00:49:37,670 --> 00:49:34,559
to the skies in 2017 opening up access

1225
00:49:39,750 --> 00:49:37,680
to space for small satellite operators

1226
00:49:42,390 --> 00:49:39,760
today it is the second most frequently

1227
00:49:44,790 --> 00:49:42,400
launched u.s rocket annually more than

1228
00:49:46,710 --> 00:49:44,800
140 satellites have found their home in

1229
00:49:48,950 --> 00:49:46,720
space across more than two dozen

1230
00:49:51,750 --> 00:49:48,960
electron missions launched from rocket

1231
00:49:54,470 --> 00:49:51,760
lab launch complex one the world's first

1232
00:49:56,630 --> 00:49:54,480
and only private orbital spaceport

1233
00:49:59,109 --> 00:49:56,640
designed manufactured and launched by

1234
00:50:01,510 --> 00:49:59,119
rocket lab electron is a two-stage

1235
00:50:03,750 --> 00:50:01,520
launch vehicle powered by liquid oxygen

1236
00:50:05,190 --> 00:50:03,760
and rocket-grade kerosene

1237
00:50:07,430 --> 00:50:05,200
much of its structures are made of

1238
00:50:09,349 --> 00:50:07,440

advanced carbon composite material

1239
00:50:12,470 --> 00:50:09,359
including its propellant tanks which is

1240
00:50:14,710 --> 00:50:12,480
what gives electron its sleek black look

1241
00:50:16,630 --> 00:50:14,720
the rocket is powered by 10 rutherford

1242
00:50:19,589 --> 00:50:16,640
engines 9 at the bottom of the first

1243
00:50:23,030 --> 00:50:19,599
stage and a 10th space optimized engine

1244
00:50:24,870 --> 00:50:23,040
to power the second stage to orbit

1245
00:50:27,589 --> 00:50:24,880
the rutherford engine is the world's

1246
00:50:29,829 --> 00:50:27,599
first to use an electric pump feed cycle

1247
00:50:31,670 --> 00:50:29,839
for orbital space travel making use of

1248
00:50:33,190 --> 00:50:31,680
electric motors and batteries to drive

1249
00:50:35,589 --> 00:50:33,200
its propellant pumps

1250
00:50:38,390 --> 00:50:35,599
it's also 3d printed using additive

1251
00:50:40,870 --> 00:50:38,400
manufacturing processes

1252
00:50:43,349 --> 00:50:40,880
electron is also equipped with a third

1253
00:50:46,710 --> 00:50:43,359
upper stage that serves as in-space

1254
00:50:48,870 --> 00:50:46,720
propulsion to deploy payloads to orbit

1255
00:50:51,349 --> 00:50:48,880
in its most advanced form this stage is

1256
00:50:53,349 --> 00:50:51,359
called photon a spacecraft bus to

1257
00:50:56,549 --> 00:50:53,359
support small satellite missions even

1258
00:51:00,710 --> 00:50:58,630
it's to this structure that the capstone

1259
00:51:02,630 --> 00:51:00,720
satellite is attached

1260
00:51:05,430 --> 00:51:02,640
ready to be carried on its way to its

1261
00:51:15,349 --> 00:51:05,440
lunar destination and near rectilinear

1262
00:51:20,309 --> 00:51:17,990
t minus 5 minutes and 30 seconds on the

1263
00:51:22,470 --> 00:51:20,319

clock and from here the launch team will

1264
00:51:25,190 --> 00:51:22,480
move on to some of the final milestones

1265
00:51:27,430 --> 00:51:25,200
and checks of electron photon and

1266
00:51:29,670 --> 00:51:27,440
capstone before liftoff

1267
00:51:31,990 --> 00:51:29,680
the mission will launch from pad b today

1268
00:51:33,670 --> 00:51:32,000
at launch complex one where we have two

1269
00:51:35,589 --> 00:51:33,680
orbital launch pads within our private

1270
00:51:36,630 --> 00:51:35,599
spaceport dedicated for electron

1271
00:51:41,630 --> 00:51:36,640
launches

1272
00:51:44,630 --> 00:51:41,640
spacecrafts to orbits between 500 and

1273
00:51:47,190 --> 00:51:44,640
1200 kilometers altitude above earth's

1274
00:51:49,589 --> 00:51:47,200
surface but this time as you'll know

1275
00:51:52,069 --> 00:51:49,599
electron and our upper stage photon will

1276
00:51:55,829 --> 00:51:52,079
send the capstone spacecraft a little

1277
00:51:58,150 --> 00:51:55,839
bit further than usual some 1.3 million

1278
00:52:00,470 --> 00:51:58,160
kilometers further around nine minutes

1279
00:52:02,710 --> 00:52:00,480
after liftoff electrons second stage

1280
00:52:05,190 --> 00:52:02,720
will separate from photon placing the

1281
00:52:07,950 --> 00:52:05,200
spacecraft bus and its capstone payload

1282
00:52:11,030 --> 00:52:07,960
into an initial low earth orbit of just

1283
00:52:13,589 --> 00:52:11,040
165 kilometers now from this initial

1284
00:52:16,069 --> 00:52:13,599
parking orbit photons hyper curie engine

1285
00:52:19,109 --> 00:52:16,079
will perform a series of orbit raising

1286
00:52:21,270 --> 00:52:19,119
maneuvers over five days to stretch its

1287
00:52:23,670 --> 00:52:21,280
orbit into a prominent ellipse around

1288
00:52:26,549 --> 00:52:23,680

earth now six days after launch

1289
00:52:28,549 --> 00:52:26,559
hypercure will ignite one final time

1290
00:52:31,349 --> 00:52:28,559
accelerating photon to allow it to

1291
00:52:33,270 --> 00:52:31,359
escape low earth orbit and set capstone

1292
00:52:35,829 --> 00:52:33,280
on a course for the moon

1293
00:52:38,150 --> 00:52:35,839
from there capstone's journey to nrho is

1294
00:52:40,390 --> 00:52:38,160
expected to take around four months with

1295
00:52:42,630 --> 00:52:40,400
the cubesats team at advanced spaces

1296
00:52:44,950 --> 00:52:42,640
mission operation center commanding the

1297
00:52:47,670 --> 00:52:44,960
spacecraft to fire its thrusters to

1298
00:52:49,829 --> 00:52:47,680
adjust its course accordingly

1299
00:52:51,430 --> 00:52:49,839
now if we are looking back at the pad

1300
00:52:53,990 --> 00:52:51,440
camera now we can see that the rocket

1301
00:52:55,750 --> 00:52:54,000
strongback has retracted and has moved

1302
00:52:57,990 --> 00:52:55,760
into the launch position

1303
00:52:59,829 --> 00:52:58,000
this launch platform structure is what

1304
00:53:02,150 --> 00:52:59,839
holds the umbilical lines providing

1305
00:53:04,470 --> 00:53:02,160
power to the rocket which will fall away

1306
00:53:07,109 --> 00:53:04,480
as electron lifts off the pad

1307
00:53:09,430 --> 00:53:07,119
you can see electrons icy white stripes

1308
00:53:11,670 --> 00:53:09,440
on the outside of the rocket there too

1309
00:53:14,230 --> 00:53:11,680
those are because of the super cold

1310
00:53:16,470 --> 00:53:14,240
liquid oxygen propellant on the inside

1311
00:53:18,470 --> 00:53:16,480
of the rocket which freezes water on the

1312
00:53:20,950 --> 00:53:18,480
outside causing it to form those

1313
00:53:23,190 --> 00:53:20,960

distinctive icy areas along the rocket's

1314
00:53:24,710 --> 00:53:23,200
black carbon composite body

1315
00:53:27,030 --> 00:53:24,720
now our last weather update also

1316
00:53:29,190 --> 00:53:27,040
confirmed that the wind speed at t0 is

1317
00:53:31,430 --> 00:53:29,200
expected to be good for launch further

1318
00:53:32,790 --> 00:53:31,440
minimising the weather risk to today's

1319
00:53:34,630 --> 00:53:32,800
mission

1320
00:53:36,870 --> 00:53:34,640
now as we get closer to the countdown it

1321
00:53:38,790 --> 00:53:36,880
is worth pointing out what kind of views

1322
00:53:40,390 --> 00:53:38,800
to expect from launch today

1323
00:53:41,990 --> 00:53:40,400
as always we'll be bringing you the live

1324
00:53:44,470 --> 00:53:42,000
views you see on your screen from

1325
00:53:47,190 --> 00:53:44,480
various cameras at the pad and at range

1326
00:53:49,750 --> 00:53:47,200
control however for this mission we

1327
00:53:51,829 --> 00:53:49,760
won't have the typical on-board vehicle

1328
00:53:53,829 --> 00:53:51,839
cameras you might be familiar with for

1329
00:53:55,829 --> 00:53:53,839
electron launches and that is because

1330
00:53:58,230 --> 00:53:55,839
this mission has extensive telemetry

1331
00:54:00,390 --> 00:53:58,240
requirements so to reduce the load on

1332
00:54:02,710 --> 00:54:00,400
systems and operators with streamlines

1333
00:54:03,589 --> 00:54:02,720
the mission down to essential systems

1334
00:54:04,950 --> 00:54:03,599
only

1335
00:54:06,790 --> 00:54:04,960
now while we won't have those live

1336
00:54:09,829 --> 00:54:06,800
vehicle feeds to show you we will be

1337
00:54:11,270 --> 00:54:09,839
broadcasting mission data and animations

1338
00:54:14,069 --> 00:54:11,280

so you can keep up with the launch

1339
00:54:16,069 --> 00:54:14,079
progress throughout the ascent

1340
00:54:17,510 --> 00:54:16,079
and now we are coming up to a critical

1341
00:54:19,910 --> 00:54:17,520
juncture in the lead up to launch the

1342
00:54:21,589 --> 00:54:19,920
switch to the countdown auto sequence

1343
00:54:23,510 --> 00:54:21,599
the team are tracking no issues with the

1344
00:54:25,430 --> 00:54:23,520
launch vehicle capstone and photon

1345
00:54:28,150 --> 00:54:25,440
remain healthy and the weather is

1346
00:54:29,670 --> 00:54:28,160
looking good so at t minus two minutes

1347
00:54:31,589 --> 00:54:29,680
very shortly that autonomous flight

1348
00:54:33,910 --> 00:54:31,599
computer on electron will take over the

1349
00:54:35,910 --> 00:54:33,920
launch countdown followed by the call

1350
00:54:38,230 --> 00:54:35,920
that locks loading is complete on

1351
00:54:39,750 --> 00:54:38,240
electron then at t minus one minute we

1352
00:54:41,990 --> 00:54:39,760
can expect confirmation that the

1353
00:54:43,589 --> 00:54:42,000
vehicle's first and second stages are

1354
00:54:44,309 --> 00:54:43,599
pressurized for launch

1355
00:54:46,069 --> 00:54:44,319
so

1356
00:54:48,710 --> 00:54:46,079
followed by that will be the iconic

1357
00:54:51,270 --> 00:54:48,720
final countdown to liftoff at t minus 10

1358
00:54:52,470 --> 00:54:51,280
seconds and engine ignition at t minus

1359
00:54:54,950 --> 00:54:52,480
three seconds

1360
00:54:58,549 --> 00:54:54,960
we'll hand over now to mission control

1361
00:55:01,270 --> 00:54:58,559
and listen into those calls to launch

1362
00:55:01,280 --> 00:55:16,309
lunar photon is on internal power

1363
00:55:41,030 --> 00:55:17,910

locks load complete lock system and

1364
00:55:41,040 --> 00:55:55,349
oh hello man together disabled

1365
00:55:55,359 --> 00:56:07,750
stitch one stitch to adjust

1366
00:56:07,760 --> 00:56:18,549
high flow engine purge enabled

1367
00:56:18,559 --> 00:56:26,390
what a doubt you've activated

1368
00:56:26,400 --> 00:56:35,510
t minus 20 seconds

1369
00:56:37,589 --> 00:56:36,549
10

1370
00:56:38,470 --> 00:56:37,599
9

1371
00:56:39,349 --> 00:56:38,480
8

1372
00:56:40,390 --> 00:56:39,359
7

1373
00:56:41,430 --> 00:56:40,400
6

1374
00:56:42,390 --> 00:56:41,440
5

1375
00:56:43,430 --> 00:56:42,400
4

1376
00:56:44,470 --> 00:56:43,440
3

1377
00:56:45,830 --> 00:56:44,480
two

1378
00:56:53,430 --> 00:56:45,840
one

1379
00:56:53,440 --> 00:57:01,190
[Music]

1380
00:57:01,200 --> 00:57:08,000
be disgusting

1381
00:57:08,010 --> 00:57:17,349
[Music]

1382
00:57:17,359 --> 00:57:27,349
special proportions

1383
00:57:27,359 --> 00:57:41,570
entering burn architect mode

1384
00:57:52,150 --> 00:57:42,789
[Applause]

1385
00:57:57,030 --> 00:57:55,030
at t plus one minute and and electron is

1386
00:57:59,589 --> 00:57:57,040
in the air and onward to the moon for

1387
00:58:02,150 --> 00:57:59,599
the capstone mission that rocket is

1388
00:58:04,390 --> 00:58:02,160

soaring through this nighttime sky now

1389
00:58:07,270 --> 00:58:04,400
past uh now past 14 kilometers in

1390
00:58:09,190 --> 00:58:07,280
altitude in these past few moments now

1391
00:58:11,349 --> 00:58:09,200
things look to be continuing nominally

1392
00:58:14,309 --> 00:58:11,359
which means that shortly electron will

1393
00:58:15,990 --> 00:58:14,319
come up against max q or maximum dynamic

1394
00:58:17,910 --> 00:58:16,000
pressure now this is the moment when

1395
00:58:19,670 --> 00:58:17,920
electron will experience its most amount

1396
00:58:21,109 --> 00:58:19,680
of mechanical stress as it travels

1397
00:58:23,270 --> 00:58:21,119
through the atmosphere

1398
00:58:26,230 --> 00:58:23,280
and i can confirm from mission control

1399
00:58:27,990 --> 00:58:26,240
that we have had max q confirmed so that

1400
00:58:30,470 --> 00:58:28,000
was a successful pass through that

1401
00:58:31,670 --> 00:58:30,480
milestone and electron is onward to low

1402
00:58:33,430 --> 00:58:31,680
earth orbit

1403
00:58:35,589 --> 00:58:33,440
so propulsion appears nominal on that

1404
00:58:37,829 --> 00:58:35,599
first stage and the photon luna upper

1405
00:58:40,789 --> 00:58:37,839
stage and capstone spacecraft remain

1406
00:58:43,829 --> 00:58:40,799
healthy inside the rockets bearing

1407
00:58:45,910 --> 00:58:43,839
we are coming up soon on three events in

1408
00:58:49,109 --> 00:58:45,920
the launch timeline that will occur in

1409
00:58:51,430 --> 00:58:49,119
very short succession so soon the nine

1410
00:58:53,750 --> 00:58:51,440
rutherford engines powering electron

1411
00:58:55,829 --> 00:58:53,760
right now will diminish their power and

1412
00:58:57,430 --> 00:58:55,839
then shut off completely that command is

1413
00:58:59,190 --> 00:58:57,440

signaled by the rocket's flight computer

1414
00:59:02,309 --> 00:58:59,200
and then called across mission control

1415
00:59:04,150 --> 00:59:02,319
comms as miko or main engine cutoff now

1416
00:59:06,150 --> 00:59:04,160
once that action is complete electron

1417
00:59:08,470 --> 00:59:06,160
will separate its first and second

1418
00:59:10,630 --> 00:59:08,480
stages the main booster will continue to

1419
00:59:12,309 --> 00:59:10,640
slow and remain behind while the second

1420
00:59:17,190 --> 00:59:12,319
stage carries on with the mission with

1421
00:59:22,950 --> 00:59:20,549
and we have had miko confirmed

1422
00:59:25,430 --> 00:59:22,960
and will be coming up soon on the

1423
00:59:27,030 --> 00:59:25,440
fairing separation for the mission so

1424
00:59:29,910 --> 00:59:27,040
just to confirm from mission control

1425
00:59:31,750 --> 00:59:29,920
comms we have had miko uh and second

1426
00:59:34,390 --> 00:59:31,760
stage separation and it's carrying on

1427
00:59:36,950 --> 00:59:34,400
now as you can see in that animation

1428
00:59:39,750 --> 00:59:36,960
so soon we will be coming up to the

1429
00:59:41,109 --> 00:59:39,760
fairing separation of this mission uh

1430
00:59:42,710 --> 00:59:41,119
that is the jettison of the fairing

1431
00:59:45,190 --> 00:59:42,720
halves or the rocket's nose cone that

1432
00:59:46,710 --> 00:59:45,200
sits on top of the second stage so now

1433
00:59:48,309 --> 00:59:46,720
the electron is well past the common

1434
00:59:49,910 --> 00:59:48,319
line we don't need that fearing it

1435
00:59:52,150 --> 00:59:49,920
served its purpose to protect the

1436
00:59:53,190 --> 00:59:52,160
payload and the photon upper stage

1437
00:59:55,190 --> 00:59:53,200
during the launch through earth's

1438
00:59:57,030 --> 00:59:55,200

atmosphere so again that fairing will

1439
00:59:59,349 --> 00:59:57,040
separate shortly in preparation for the

1440
01:00:03,430 --> 00:59:59,359
final stage separation between the

1441
01:00:06,950 --> 01:00:05,109
so there we go we heard it on comms we

1442
01:00:09,109 --> 01:00:06,960
have had fairing separation on that

1443
01:00:11,510 --> 01:00:09,119
second stage and so there's confirmation

1444
01:00:13,589 --> 01:00:11,520
that mission is continuing as it should

1445
01:00:16,630 --> 01:00:13,599
with capstone and the photon lunar upper

1446
01:00:18,549 --> 01:00:16,640
stage now exposed to space and no longer

1447
01:00:20,309 --> 01:00:18,559
needing that protection through

1448
01:00:21,670 --> 01:00:20,319
earth's atmosphere

1449
01:00:23,670 --> 01:00:21,680
now it's very exciting to see this

1450
01:00:25,670 --> 01:00:23,680
mission up and in the end if you've just

1451
01:00:27,510 --> 01:00:25,680
joined us we have had a great start to

1452
01:00:29,430 --> 01:00:27,520
today's journey to the moon we have

1453
01:00:31,270 --> 01:00:29,440
successfully successfully cleared the

1454
01:00:32,789 --> 01:00:31,280
pad at launch complex one just a few

1455
01:00:35,190 --> 01:00:32,799
moments ago and we are now well on our

1456
01:00:37,430 --> 01:00:35,200
way to space having completed that first

1457
01:00:39,750 --> 01:00:37,440
successful pass through max q main

1458
01:00:41,670 --> 01:00:39,760
engine cutoff stage separation and

1459
01:00:42,950 --> 01:00:41,680
fairing jettison to reach this point now

1460
01:00:44,789 --> 01:00:42,960
in the mission

1461
01:00:46,549 --> 01:00:44,799
now electron second stage remains

1462
01:00:48,870 --> 01:00:46,559
attached to the photon luna upper stage

1463
01:00:50,910 --> 01:00:48,880

carrying capstone providing it with that

1464
01:00:53,750 --> 01:00:50,920
assist to the emissions parking orbit at

1465
01:00:55,349 --> 01:00:53,760
165 kilometers above earth

1466
01:00:58,309 --> 01:00:55,359
the rocket's second stage is moving

1467
01:01:01,030 --> 01:00:58,319
along nicely on its continued ascent now

1468
01:01:04,150 --> 01:01:01,040
traveling at a very fast speed of more

1469
01:01:07,030 --> 01:01:04,160
than 9 000 kilometers an hour

1470
01:01:08,870 --> 01:01:07,040
soon the second stage on the

1471
01:01:10,789 --> 01:01:08,880
electron rocket

1472
01:01:13,430 --> 01:01:10,799
which is powered by our vacuum optimized

1473
01:01:15,510 --> 01:01:13,440
rutherford engine soon the batteries on

1474
01:01:17,670 --> 01:01:15,520
that engine will need to be swapped out

1475
01:01:19,910 --> 01:01:17,680
now this is a unique aspect of our 3d

1476
01:01:21,430 --> 01:01:19,920
printed engines because it's not many

1477
01:01:23,430 --> 01:01:21,440
engines that are powered by batteries in

1478
01:01:25,190 --> 01:01:23,440
the first place in fact the rutherford

1479
01:01:27,430 --> 01:01:25,200
became the first rocket engine in the

1480
01:01:29,349 --> 01:01:27,440
world to reach space using an electric

1481
01:01:31,349 --> 01:01:29,359
pump bead cycle when it was first

1482
01:01:32,870 --> 01:01:31,359
launched all those years ago

1483
01:01:34,549 --> 01:01:32,880
now how it works is that we keep the

1484
01:01:36,549 --> 01:01:34,559
engine firing all the way to orbit with

1485
01:01:38,710 --> 01:01:36,559
the batteries that are powering the

1486
01:01:40,549 --> 01:01:38,720
engine but like all batteries do these

1487
01:01:42,390 --> 01:01:40,559
ones get depleted of power and we'll

1488
01:01:44,950 --> 01:01:42,400

need to swap them out with a new set to

1489
01:01:47,109 --> 01:01:44,960
keep the system running we call that a

1490
01:01:49,109 --> 01:01:47,119
battery hot swap and that moment is

1491
01:01:50,150 --> 01:01:49,119
coming up shortly we will hopefully hear

1492
01:02:12,789 --> 01:01:50,160
that

1493
01:02:12,799 --> 01:02:24,630
stage 2 is starting to throttle down

1494
01:02:31,510 --> 01:02:26,630
stage two guidance remains nominal 200

1495
01:02:35,829 --> 01:02:33,990
if we take a look at the graphics on the

1496
01:02:37,750 --> 01:02:35,839
right hand side of our screen we can see

1497
01:02:40,150 --> 01:02:37,760
the measurements for the propellants on

1498
01:02:42,950 --> 01:02:40,160
electron so on your left you have the

1499
01:02:46,150 --> 01:02:42,960
kerosene propellant and the level of the

1500
01:02:48,710 --> 01:02:46,160
tanks that it is now at so we're at 45

1501
01:02:51,910 --> 01:02:48,720
and counting uh sitting at a nice and

1502
01:02:53,670 --> 01:02:51,920
warm eight degrees uh um in temperature

1503
01:02:55,750 --> 01:02:53,680
and that is very warm compared to the

1504
01:02:57,829 --> 01:02:55,760
liquid oxygen temperature our other

1505
01:03:02,470 --> 01:02:57,839
propellant so that is sitting at a nice

1506
01:03:08,549 --> 01:03:02,480
and chilly minus 178 degrees with 40

1507
01:03:08,559 --> 01:03:15,109
hotspot

1508
01:03:19,990 --> 01:03:17,430
and there we have the core that battery

1509
01:03:21,349 --> 01:03:20,000
hot swap on the second stage was

1510
01:03:23,670 --> 01:03:21,359
successful

1511
01:03:25,510 --> 01:03:23,680
now next we should expect to hear one of

1512
01:03:28,150 --> 01:03:25,520
our operators in mission control call

1513
01:03:29,829 --> 01:03:28,160

out that electron is orbital indicating

1514
01:03:32,309 --> 01:03:29,839
that the rocket is in the right place

1515
01:03:35,270 --> 01:03:32,319
ahead of stage separation

1516
01:03:37,109 --> 01:03:35,280
so seco the acronym for second engine

1517
01:03:39,910 --> 01:03:37,119
cutoff and the subsequent stage

1518
01:03:42,549 --> 01:03:39,920
separation follow relatively the same

1519
01:03:44,150 --> 01:03:42,559
procedure as main engine cut off where

1520
01:03:46,069 --> 01:03:44,160
the rutherford engine on the second

1521
01:03:48,549 --> 01:03:46,079
stage will shut off ahead of the final

1522
01:03:50,950 --> 01:03:48,559
separation of the vehicle between the

1523
01:03:53,190 --> 01:03:50,960
second stage and the photon luna upper

1524
01:03:55,349 --> 01:03:53,200
stage there will be a bit of a gap

1525
01:03:57,829 --> 01:03:55,359
between that final separation and the

1526
01:03:59,990 --> 01:03:57,839
first hypercarry burn as this stage

1527
01:04:02,150 --> 01:04:00,000
separation places the photon lunar upper

1528
01:04:05,910 --> 01:04:02,160
stage in an elliptical orbit of earth

1529
01:04:08,470 --> 01:04:05,920
first now a reminder that 165 low earth

1530
01:04:10,950 --> 01:04:08,480
orbit is just the first orbital phase

1531
01:04:13,270 --> 01:04:10,960
for this capstone mission with photon

1532
01:04:15,670 --> 01:04:13,280
and cat stones orbit continuously raised

1533
01:04:17,430 --> 01:04:15,680
higher and higher over the next few days

1534
01:04:19,430 --> 01:04:17,440
with a series of engine burns on the

1535
01:04:21,109 --> 01:04:19,440
upper stage i'll go into more detail

1536
01:04:23,430 --> 01:04:21,119
about photons phasing orbits and

1537
01:04:26,069 --> 01:04:23,440
capstones passed to the moon shortly

1538
01:04:28,150 --> 01:04:26,079

once electron has completed seco and

1539
01:05:09,510 --> 01:04:28,160
stage separation let's listen into

1540
01:05:09,520 --> 01:05:18,549
entering burnout detect mode

1541
01:05:21,910 --> 01:05:20,230
so a quick check on the speed and

1542
01:05:24,789 --> 01:05:21,920
altitude of this mission we are

1543
01:05:27,029 --> 01:05:24,799
traveling at more than 23 000 kilometers

1544
01:05:30,230 --> 01:05:27,039
an hour and while on the right you can

1545
01:05:32,309 --> 01:05:30,240
see the altitude is at 175 kilometers uh

1546
01:05:35,109 --> 01:05:32,319
what goes up must come down and we will

1547
01:05:52,870 --> 01:05:35,119
lower ourselves into that 165 kilometer

1548
01:06:03,670 --> 01:06:01,670
[Applause]

1549
01:06:06,069 --> 01:06:03,680
so with the rutherford engine cooling

1550
01:06:08,549 --> 01:06:06,079
down that tells us that second engine

1551
01:06:11,109 --> 01:06:08,559
cutoff was successful on electrons

1552
01:06:13,349 --> 01:06:11,119
second stage and the photon luna upper

1553
01:06:16,069 --> 01:06:13,359
stage has now departed into its low

1554
01:06:19,109 --> 01:06:16,079
earth orbit with the moon bound capstone

1555
01:06:21,270 --> 01:06:19,119
spacecraft on board now as a reminder

1556
01:06:23,670 --> 01:06:21,280
from here photon is in charge of the

1557
01:06:25,829 --> 01:06:23,680
mission with its reliable hypercurie

1558
01:06:28,069 --> 01:06:25,839
engine photon will begin maneuvering

1559
01:06:30,470 --> 01:06:28,079
into a parking orbit just above

1560
01:06:33,109 --> 01:06:30,480
substantial atmospheric drag but below

1561
01:06:35,430 --> 01:06:33,119
the van allen radiation belts it is the

1562
01:06:37,990 --> 01:06:35,440
perfect stable platform from which to

1563
01:06:39,829 --> 01:06:38,000

prepare for lunar departure now once

1564
01:06:41,910 --> 01:06:39,839
photon is in the correct orbital

1565
01:06:44,470 --> 01:06:41,920
alignment the hypercurie engine will

1566
01:06:46,789 --> 01:06:44,480
ignite again for forming a burn to lift

1567
01:06:50,150 --> 01:06:46,799
the highest point of photons orbit the

1568
01:06:53,029 --> 01:06:50,160
apogee now as it gains altitude and also

1569
01:06:55,750 --> 01:06:53,039
loses velocity and so what goes up comes

1570
01:06:57,349 --> 01:06:55,760
back down as earth gravity pulls it back

1571
01:06:59,109 --> 01:06:57,359
towards the planet

1572
01:07:01,829 --> 01:06:59,119
when it reaches the lowest point or

1573
01:07:04,630 --> 01:07:01,839
perigee once again photons hyper curie

1574
01:07:06,789 --> 01:07:04,640
engine ignites to increase velocity and

1575
01:07:09,270 --> 01:07:06,799
raise its apogee higher so if you've

1576
01:07:11,670 --> 01:07:09,280
ever been on a swing set swung to the

1577
01:07:13,589 --> 01:07:11,680
top came back down and then kicked your

1578
01:07:16,069 --> 01:07:13,599
legs out to throw your weight forward to

1579
01:07:17,670 --> 01:07:16,079
reach even higher on the next swing then

1580
01:07:19,349 --> 01:07:17,680
you've followed similar principles to

1581
01:07:20,950 --> 01:07:19,359
what our photon upper stage will be

1582
01:07:22,870 --> 01:07:20,960
doing in space

1583
01:07:25,589 --> 01:07:22,880
now as these phasing orbits get bigger

1584
01:07:27,750 --> 01:07:25,599
they take longer to complete the first

1585
01:07:31,270 --> 01:07:27,760
will only take around 90 minutes while

1586
01:07:33,589 --> 01:07:31,280
the last one will take around 15 hours

1587
01:07:36,150 --> 01:07:33,599
then on the final phasing pass photon

1588
01:07:38,150 --> 01:07:36,160

will ignite hypercure for a precision

1589
01:07:40,069 --> 01:07:38,160
translunar injection burn

1590
01:07:42,630 --> 01:07:40,079
accelerating the upper stage and

1591
01:07:45,670 --> 01:07:42,640
capstone to a top speed of nearly 11

1592
01:07:48,309 --> 01:07:45,680
kilometers per second fast enough to

1593
01:07:50,230 --> 01:07:48,319
break free of low earth orbit on its way

1594
01:07:51,910 --> 01:07:50,240
to the moon the speed photon is

1595
01:07:53,910 --> 01:07:51,920
traveling at this point we'll shoot it

1596
01:07:55,910 --> 01:07:53,920
well past the moon's orbit and to the

1597
01:07:57,430 --> 01:07:55,920
edge of the earth moon system on a

1598
01:07:59,190 --> 01:07:57,440
transfer orbit

1599
01:08:01,190 --> 01:07:59,200
lined up with the sun and using its

1600
01:08:03,670 --> 01:08:01,200
gravitational pull to shape photons

1601
01:08:06,069 --> 01:08:03,680
orbit to match speed with the moon

1602
01:08:07,670 --> 01:08:06,079
capstone will then be deployed and carry

1603
01:08:09,589 --> 01:08:07,680
on the mission solo

1604
01:08:11,670 --> 01:08:09,599
and so with those first few hypercurie

1605
01:08:13,910 --> 01:08:11,680
burns scheduled in the coming hours i'm

1606
01:08:16,390 --> 01:08:13,920
going to send it back to daryl and the

1607
01:08:17,749 --> 01:08:16,400
team at the kennedy space center daryl i

1608
01:08:19,910 --> 01:08:17,759
know you weren't here in person but how

1609
01:08:22,309 --> 01:08:19,920
was that for you guys over at ksc my

1610
01:08:24,149 --> 01:08:22,319
heart is still pounding i know our team

1611
01:08:26,149 --> 01:08:24,159
is thrilled at the successful first

1612
01:08:28,070 --> 01:08:26,159
phase of this mission oh absolutely

1613
01:08:30,789 --> 01:08:28,080

muriel wish i could have been there to

1614
01:08:33,149 --> 01:08:30,799
watch it with you and uh boy what a

1615
01:08:35,349 --> 01:08:33,159
beautiful picture from here and

1616
01:08:37,749 --> 01:08:35,359
congratulations so far

1617
01:08:40,709 --> 01:08:37,759
on the success of the launch obviously a

1618
01:08:42,709 --> 01:08:40,719
lot more steps to go before capstone

1619
01:08:44,789 --> 01:08:42,719
gets into its orbit

1620
01:08:46,950 --> 01:08:44,799
but looking good so far with a great

1621
01:08:49,189 --> 01:08:46,960
beginning quick note on this rocket

1622
01:08:51,510 --> 01:08:49,199
right behind me the space launch system

1623
01:08:54,550 --> 01:08:51,520
nasa's mega moon rocket it completed its

1624
01:08:56,950 --> 01:08:54,560
wet dress rehearsal it will be returning

1625
01:08:58,870 --> 01:08:56,960
to the vehicle assembly building in just

1626
01:09:00,309 --> 01:08:58,880
a matter of days it's going back on

1627
01:09:02,870 --> 01:09:00,319
friday

1628
01:09:04,709 --> 01:09:02,880
repair to the hydrogen leak will be made

1629
01:09:06,550 --> 01:09:04,719
and then the next time it rolls back out

1630
01:09:08,229 --> 01:09:06,560
to the pad right there

1631
01:09:10,630 --> 01:09:08,239
it will be ready to go to the moon and

1632
01:09:13,030 --> 01:09:10,640
what a beautiful shot that we see there

1633
01:09:14,870 --> 01:09:13,040
we are at daybreak here on the east

1634
01:09:16,390 --> 01:09:14,880
coast of florida six

1635
01:09:19,269 --> 01:09:16,400
5 59

1636
01:09:21,269 --> 01:09:19,279
is when first light arrived and we've

1637
01:09:23,110 --> 01:09:21,279
got some beautiful pictures there

1638
01:09:25,990 --> 01:09:23,120

of our moon rocket

1639
01:09:28,390 --> 01:09:26,000
and now let's uh go back down to new

1640
01:09:30,950 --> 01:09:28,400
zealand and joining us now is bradley

1641
01:09:32,550 --> 01:09:30,960
smith the director of launch services at

1642
01:09:35,030 --> 01:09:32,560
nasa's kennedy space center he's with

1643
01:09:37,590 --> 01:09:35,040
the launch team in new zealand and i

1644
01:09:39,430 --> 01:09:37,600
want to ask you uh bradley first of all

1645
01:09:41,110 --> 01:09:39,440
um you're a half world away and there's

1646
01:09:42,550 --> 01:09:41,120
a little bit of a small delay between us

1647
01:09:49,110 --> 01:09:42,560
but i want to ask you how did the launch

1648
01:09:53,349 --> 01:09:52,149
oh i i i am definitely half a world away

1649
01:09:56,550 --> 01:09:53,359
i um

1650
01:09:57,750 --> 01:09:56,560
landed in auckland and my uh my my

1651
01:10:00,790 --> 01:09:57,760
my first

1652
01:10:02,950 --> 01:10:00,800
uh 4a into new zealand soil was a lost

1653
01:10:05,990 --> 01:10:02,960
bag so i had to go buy a new suit as

1654
01:10:08,149 --> 01:10:06,000
soon as i landed but um but yeah i mean

1655
01:10:09,990 --> 01:10:08,159
the launch was absolutely fantastic i

1656
01:10:13,189 --> 01:10:10,000
mean this has been

1657
01:10:15,990 --> 01:10:13,199
uh for me um gosh eight years in the

1658
01:10:18,390 --> 01:10:16,000
making you know all the way back to 2014

1659
01:10:21,030 --> 01:10:18,400
uh when we put our trust in rocket lab

1660
01:10:23,750 --> 01:10:21,040
uh with our initial vcls uh demo one

1661
01:10:26,550 --> 01:10:23,760
award contract award right and here we

1662
01:10:27,910 --> 01:10:26,560
are um you know that was

1663
01:10:31,189 --> 01:10:27,920

that was a payload to go launch

1664
01:10:34,310 --> 01:10:31,199
university cubesats and now here we are

1665
01:10:35,750 --> 01:10:34,320
not even a decade later and uh this this

1666
01:10:38,790 --> 01:10:35,760
incredible team

1667
01:10:41,350 --> 01:10:38,800
has just sent uh capstone on a ballistic

1668
01:10:43,669 --> 01:10:41,360
trajectory to uh to the to

1669
01:10:46,310 --> 01:10:43,679
to the lunar orbit right i mean it's

1670
01:10:48,870 --> 01:10:46,320
amazing how far uh pete beck and his

1671
01:10:50,790 --> 01:10:48,880
company have come in the last 10 years

1672
01:10:52,229 --> 01:10:50,800
and we couldn't be prouder

1673
01:10:53,669 --> 01:10:52,239
and you've been there on the journey

1674
01:10:55,350 --> 01:10:53,679
most recently

1675
01:10:56,790 --> 01:10:55,360
did you ever imagine got to ask you did

1676
01:10:59,669 --> 01:10:56,800
you ever imagine that you would launch a

1677
01:11:04,870 --> 01:10:59,679
mission to the moon on a 59 foot tall

1678
01:11:07,990 --> 01:11:06,390
i i did not

1679
01:11:10,390 --> 01:11:08,000
and for

1680
01:11:12,630 --> 01:11:10,400
on the order of 30 million dollars right

1681
01:11:16,229 --> 01:11:12,640
between the payload and the launch

1682
01:11:18,550 --> 01:11:16,239
service itself um it just goes to show

1683
01:11:20,870 --> 01:11:18,560
the direction that um

1684
01:11:23,750 --> 01:11:20,880
that the nasa is going right embracing

1685
01:11:26,070 --> 01:11:23,760
this uh truly commercial approach

1686
01:11:27,590 --> 01:11:26,080
to enable science and discovery for the

1687
01:11:35,430 --> 01:11:27,600
agency

1688
01:11:41,270 --> 01:11:38,790

yeah so for lsp um we've got

1689
01:11:42,950 --> 01:11:41,280
well you know it's as soon as i say we

1690
01:11:45,189 --> 01:11:42,960
have a certain number of launches those

1691
01:11:47,510 --> 01:11:45,199
launches will uh immediately slip to the

1692
01:11:49,830 --> 01:11:47,520
right right so we have somewhere in

1693
01:11:52,310 --> 01:11:49,840
between three to five launches coming up

1694
01:11:55,110 --> 01:11:52,320
we have two more uh venture class launch

1695
01:11:57,270 --> 01:11:55,120
service class launches uh one both with

1696
01:11:58,470 --> 01:11:57,280
providers that nasa has not flown with

1697
01:12:00,550 --> 01:11:58,480
before

1698
01:12:03,910 --> 01:12:00,560
one with relativity

1699
01:12:05,910 --> 01:12:03,920
and uh also one with firefly those will

1700
01:12:08,630 --> 01:12:05,920
one launch from the cape and one launch

1701
01:12:10,310 --> 01:12:08,640
from vandenberg air force base and then

1702
01:12:12,470 --> 01:12:10,320
we have two end-to-end missions coming

1703
01:12:16,070 --> 01:12:12,480
up as well from the west coast uh one is

1704
01:12:17,590 --> 01:12:16,080
the jpss-2 mission for our noaa partners

1705
01:12:19,430 --> 01:12:17,600
uh polar uh

1706
01:12:21,430 --> 01:12:19,440
earth observation satellite and then we

1707
01:12:23,990 --> 01:12:21,440
also have swat

1708
01:12:25,350 --> 01:12:24,000
which is a oceanography

1709
01:12:28,149 --> 01:12:25,360
payload that's

1710
01:12:31,110 --> 01:12:28,159
done jointly with canis

1711
01:12:34,310 --> 01:12:31,120
so that's what's next for lsp

1712
01:12:36,310 --> 01:12:34,320
programmatically of course we continue

1713
01:12:38,149 --> 01:12:36,320

to support our sister programs

1714
01:12:39,510 --> 01:12:38,159
commercial crew and commercial cargo

1715
01:12:41,590 --> 01:12:39,520
doing the launch vehicle work for those

1716
01:12:43,669 --> 01:12:41,600
payloads as well looking forward to

1717
01:12:45,910 --> 01:12:43,679
those yeah absolutely looking forward to

1718
01:12:47,430 --> 01:12:45,920
those missions bradley and thank you for

1719
01:12:49,669 --> 01:12:47,440
your time and sorry about the rough

1720
01:12:51,830 --> 01:12:49,679
start in new zealand but the new suit

1721
01:12:52,760 --> 01:12:51,840
looks good on you but that launch looks

1722
01:12:57,189 --> 01:12:52,770
even better

1723
01:13:02,149 --> 01:12:59,590
absolutely i appreciate it all right

1724
01:13:04,390 --> 01:13:02,159
thank you bradley and that concludes our

1725
01:13:06,550 --> 01:13:04,400
live coverage of the launch of capstone

1726
01:13:10,149 --> 01:13:06,560
spacecraft over the next six days

1727
01:13:12,550 --> 01:13:10,159
photons engines will periodically ignite

1728
01:13:15,189 --> 01:13:12,560
and they will basically accelerate

1729
01:13:17,350 --> 01:13:15,199
capstone beyond low earth orbit and send

1730
01:13:19,510 --> 01:13:17,360
it on a ballistic lunar transfer

1731
01:13:21,110 --> 01:13:19,520
trajectory to the moon if you'd like

1732
01:13:22,950 --> 01:13:21,120
updates on its progress and how it's

1733
01:13:24,870 --> 01:13:22,960
performing there are two ways you can do

1734
01:13:26,870 --> 01:13:24,880
it you can follow us on twitter we're

1735
01:13:28,070 --> 01:13:26,880
going to pull up a graphic here at nasa

1736
01:13:30,709 --> 01:13:28,080
technology

1737
01:13:32,070 --> 01:13:30,719
or you can click on a qr code that we

1738
01:13:33,510 --> 01:13:32,080

have we're going to pop that up on the

1739
01:13:35,350 --> 01:13:33,520
screen there it is

1740
01:13:37,750 --> 01:13:35,360
that will take you to our capstone blog

1741
01:13:39,990 --> 01:13:37,760
where you can also find nasa's eyes on

1742
01:13:42,390 --> 01:13:40,000
the solar system this is an interactive

1743
01:13:44,390 --> 01:13:42,400
real-time 3d data visualization where

1744
01:13:45,990 --> 01:13:44,400
you can virtually ride along with the

1745
01:13:48,870 --> 01:13:46,000
cubesat pretty cool we'll have that

1746
01:13:50,870 --> 01:13:48,880
ready in about a minute in about a week

1747
01:13:52,229 --> 01:13:50,880
and while you're capturing that qr code

1748
01:13:53,430 --> 01:13:52,239
i want to do one thing i want to boop

1749
01:13:54,790 --> 01:13:53,440
this rocket

1750
01:13:56,950 --> 01:13:54,800
boop

1751
01:13:58,950 --> 01:13:56,960
always wanted to do that

1752
01:14:01,350 --> 01:13:58,960
a special thank to thank you to all of

1753
01:14:03,669 --> 01:14:01,360
our guests on the show as well as nasa

1754
01:14:05,990 --> 01:14:03,679
space technology mission directorate

1755
01:14:08,149 --> 01:14:06,000
also to rocket lab for partnering with

1756
01:14:09,830 --> 01:14:08,159
us on this launch broadcast i'm darrell

1757
01:14:11,510 --> 01:14:09,840
nail signing off from the kennedy space

1758
01:14:13,350 --> 01:14:11,520
center with the space launch system

1759
01:14:15,350 --> 01:14:13,360
behind me at daybreak

1760
01:14:16,870 --> 01:14:15,360
for rocket labs muriel baker and

1761
01:14:19,590 --> 01:14:16,880
everyone here at nasa thank you for

1762
01:14:22,149 --> 01:14:19,600
watching we leave you now with a replay

1763
01:14:30,950 --> 01:14:22,159

of the capstone launch from new zealand

1764
01:14:33,030 --> 01:14:32,070
10

1765
01:14:33,910 --> 01:14:33,040
9

1766
01:14:34,870 --> 01:14:33,920
8

1767
01:14:35,830 --> 01:14:34,880
7

1768
01:14:36,870 --> 01:14:35,840
6

1769
01:14:37,830 --> 01:14:36,880
5

1770
01:14:38,870 --> 01:14:37,840
4

1771
01:14:39,910 --> 01:14:38,880
3

1772
01:14:40,970 --> 01:14:39,920
2

1773
01:14:50,040 --> 01:14:40,980
1.

1774
01:14:58,380 --> 01:14:56,310
[Music]