

7.865



1
00:00:06,230 --> 00:00:04,390
good afternoon and welcome to the

2
00:00:08,470 --> 00:00:06,240
science portion of today's briefings

3
00:00:09,350 --> 00:00:08,480
about nasa's new mission to study the

4
00:00:12,390 --> 00:00:09,360
sky

5
00:00:13,910 --> 00:00:12,400
of our near celestial neighbor the moon

6
00:00:16,390 --> 00:00:13,920
the mission is called the lunar

7
00:00:17,750 --> 00:00:16,400
atmosphere and dust environment explorer

8
00:00:19,830 --> 00:00:17,760
or laddie

9
00:00:21,750 --> 00:00:19,840
i'm rachel hoover in the public affairs

10
00:00:23,590 --> 00:00:21,760
office at nasa's ames research center in

11
00:00:26,150 --> 00:00:23,600
moffett field california where the

12
00:00:28,470 --> 00:00:26,160
mission was designed tested integrated

13
00:00:30,310 --> 00:00:28,480

and will be managed after launch

14

00:00:33,270 --> 00:00:30,320

earlier today we heard from lady team

15

00:00:35,270 --> 00:00:33,280

members about the spacecraft design

16

00:00:36,870 --> 00:00:35,280

it's right into space and the conditions

17

00:00:39,190 --> 00:00:36,880

leading up to tomorrow night's launch at

18

00:00:40,869 --> 00:00:39,200

11 27 pm eastern

19

00:00:42,869 --> 00:00:40,879

right here from nasa's wab's flight

20

00:00:44,229 --> 00:00:42,879

facility in virginia

21

00:00:46,549 --> 00:00:44,239

now we'll turn our attention to the

22

00:00:48,470 --> 00:00:46,559

science goals of the mission and a lunar

23

00:00:49,510 --> 00:00:48,480

laser communications demonstration on

24

00:00:51,590 --> 00:00:49,520

board

25

00:00:53,189 --> 00:00:51,600

before i turn our attention to the panel

26

00:00:54,709 --> 00:00:53,199

i'd like to make a take a moment to

27

00:00:57,110 --> 00:00:54,719

point out that you can learn more about

28

00:01:00,310 --> 00:00:57,120

the mission by visiting us online at

29

00:01:03,750 --> 00:01:01,430

lady

30

00:01:06,950 --> 00:01:03,760

or by following us on social media

31

00:01:08,070 --> 00:01:06,960

including twitter at nasaladdy

32

00:01:10,070 --> 00:01:08,080

in a moment we'll hear brief

33

00:01:11,510 --> 00:01:10,080

presentations from our panel and then

34

00:01:14,390 --> 00:01:11,520

we'll open it up to questions here at

35

00:01:17,350 --> 00:01:14,400

nasa wallops from nasa field centers and

36

00:01:18,870 --> 00:01:17,360

participants joining us from the phone

37

00:01:20,469 --> 00:01:18,880

it is now my pleasure to introduce

38

00:01:23,510 --> 00:01:20,479

today's panel

39

00:01:25,670 --> 00:01:23,520

joining us today is sarah noble

40

00:01:27,990 --> 00:01:25,680

lady program scientist from nasa

41

00:01:29,429 --> 00:01:28,000

headquarters

42

00:01:32,149 --> 00:01:29,439

rick elfic

43

00:01:34,149 --> 00:01:32,159

lady project scientist at nasa ames

44

00:01:36,550 --> 00:01:34,159

research center

45

00:01:38,469 --> 00:01:36,560

and don cornwell the lunar laser

46

00:01:40,870 --> 00:01:38,479

communications demonstration mission

47

00:01:43,510 --> 00:01:40,880

manager from nasa's goddard space flight

48

00:01:45,190 --> 00:01:43,520

center in greenbelt maryland

49

00:01:46,630 --> 00:01:45,200

and with that i'd like to pass it over

50

00:01:48,310 --> 00:01:46,640

to our panel

51
00:01:50,469 --> 00:01:48,320
thanks rachel i'd like to give you guys

52
00:01:52,550 --> 00:01:50,479
a quick overview of the science of lady

53
00:01:54,550 --> 00:01:52,560
lady has two major science goals to

54
00:01:56,709 --> 00:01:54,560
understand the lunar atmosphere as well

55
00:01:57,990 --> 00:01:56,719
as the dust environment around the moon

56
00:01:59,510 --> 00:01:58,000
and i think sometimes we get a little

57
00:02:01,350 --> 00:01:59,520
surprised when we start talking about a

58
00:02:02,709 --> 00:02:01,360
lunar atmosphere because most of us were

59
00:02:04,469 --> 00:02:02,719
taught in school that the moon doesn't

60
00:02:06,789 --> 00:02:04,479
actually have an atmosphere

61
00:02:08,469 --> 00:02:06,799
it does but it's it's very very thin

62
00:02:10,469 --> 00:02:08,479
it's so thin that the individual

63
00:02:11,990 --> 00:02:10,479

molecules that make up the atmosphere

64

00:02:13,750 --> 00:02:12,000

never see each other they don't interact

65

00:02:15,830 --> 00:02:13,760

they don't collide

66

00:02:19,350 --> 00:02:15,840

this is something we call an exosphere

67

00:02:22,550 --> 00:02:20,710

yes

68

00:02:24,550 --> 00:02:22,560

the earth actually has an exosphere as

69

00:02:26,070 --> 00:02:24,560

well but in fact you have to go out past

70

00:02:28,070 --> 00:02:26,080

where the international space station

71

00:02:29,589 --> 00:02:28,080

orbits before you get to this condition

72

00:02:30,790 --> 00:02:29,599

where the molecules are so far apart

73

00:02:32,550 --> 00:02:30,800

they don't collide

74

00:02:34,470 --> 00:02:32,560

on the moon that actually happens right

75

00:02:36,790 --> 00:02:34,480

at the surface so the term we use for

76

00:02:38,470 --> 00:02:36,800

this class of atmosphere is a surface

77

00:02:40,070 --> 00:02:38,480

boundary exosphere

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00:02:42,390 --> 00:02:40,080

and in fact the moon is not the only

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00:02:44,550 --> 00:02:42,400

example we have mercury

80

00:02:46,070 --> 00:02:44,560

a lot of the moons of outer planets

81

00:02:47,750 --> 00:02:46,080

as well as some of the larger asteroids

82

00:02:49,430 --> 00:02:47,760

in our in our solar system all have

83

00:02:51,110 --> 00:02:49,440

surface boundary exospheres it turns out

84

00:02:53,110 --> 00:02:51,120

to be the most common class of

85

00:02:54,949 --> 00:02:53,120

atmosphere we have and yet it's one that

86

00:02:56,550 --> 00:02:54,959

we don't really know very much about so

87

00:02:58,710 --> 00:02:56,560

ladies a really great opportunity to go

88

00:02:59,670 --> 00:02:58,720

to learn not only about the moon but

89

00:03:01,350 --> 00:02:59,680

about

90

00:03:02,710 --> 00:03:01,360

many many of the bodies in our solar

91

00:03:04,869 --> 00:03:02,720

system

92

00:03:05,830 --> 00:03:04,879

it's also a really good time for us to

93

00:03:08,309 --> 00:03:05,840

go and be

94

00:03:10,390 --> 00:03:08,319

working this mission uh the moon because

95

00:03:12,149 --> 00:03:10,400

the exosphere of the moon is so thin and

96

00:03:14,869 --> 00:03:12,159

so delicate it's easily disturbed by

97

00:03:17,270 --> 00:03:14,879

things like spacecraft landings and

98

00:03:18,550 --> 00:03:17,280

then this the moon has been pretty quiet

99

00:03:20,470 --> 00:03:18,560

lately in terms of landings we haven't

100

00:03:22,550 --> 00:03:20,480

landed anything there for a few decades

101
00:03:23,830 --> 00:03:22,560
but that's going to change there are a

102
00:03:25,190 --> 00:03:23,840
number of countries and even some

103
00:03:26,470 --> 00:03:25,200
private companies

104
00:03:28,390 --> 00:03:26,480
who are looking to land things on the

105
00:03:29,589 --> 00:03:28,400
moon in the upcoming years and so now is

106
00:03:31,190 --> 00:03:29,599
a really good time while the moon's

107
00:03:32,949 --> 00:03:31,200
atmosphere is still sort of pristine in

108
00:03:37,110 --> 00:03:32,959
its natural state for us to go and learn

109
00:03:39,270 --> 00:03:37,120
about it before we go and and impact it

110
00:03:41,190 --> 00:03:39,280
uh the d in latin stands for dust our

111
00:03:42,470 --> 00:03:41,200
other our other major science goals to

112
00:03:44,470 --> 00:03:42,480
understand the dust environment if i can

113
00:03:46,630 --> 00:03:44,480

get the second visual

114

00:03:48,470 --> 00:03:46,640

we've actually had questions about the

115

00:03:51,830 --> 00:03:48,480

dust environment on the moon since even

116

00:03:53,190 --> 00:03:51,840

before apollo uh on the on the left here

117

00:03:55,589 --> 00:03:53,200

you can see some images from the

118

00:03:57,350 --> 00:03:55,599

surveyor spacecraft which saw this

119

00:03:59,589 --> 00:03:57,360

strange thing on the horizon just before

120

00:04:01,030 --> 00:03:59,599

sunrise this sort of glow

121

00:04:02,550 --> 00:04:01,040

and we think that that actually might be

122

00:04:04,869 --> 00:04:02,560

due to dust getting lofted into the

123

00:04:07,350 --> 00:04:04,879

atmosphere and reflecting the light

124

00:04:09,350 --> 00:04:07,360

the apollo astronauts also saw saw this

125

00:04:11,270 --> 00:04:09,360

horizon glow on the left on the right

126

00:04:12,949 --> 00:04:11,280

there is a is a

127

00:04:15,270 --> 00:04:12,959

sketch from gene cernan's notebook

128

00:04:17,189 --> 00:04:15,280

apollo 17 astronaut who not only saw

129

00:04:19,430 --> 00:04:17,199

that horizon glow he saw these things

130

00:04:21,030 --> 00:04:19,440

that he called streamers going up high

131

00:04:25,110 --> 00:04:21,040

into the atmosphere tens of kilometers

132

00:04:26,790 --> 00:04:25,120

which we also think is due to the dust

133

00:04:31,350 --> 00:04:26,800

so we have three instruments on lady if

134

00:04:34,870 --> 00:04:32,870

we have three instruments on lady in

135

00:04:37,590 --> 00:04:34,880

which to look at

136

00:04:39,189 --> 00:04:37,600

our two science goals there is a lunar

137

00:04:40,469 --> 00:04:39,199

dust experiment

138

00:04:41,670 --> 00:04:40,479

designed and built by the university of

139

00:04:43,670 --> 00:04:41,680

colorado

140

00:04:45,510 --> 00:04:43,680

which will look at individual dust

141

00:04:48,310 --> 00:04:45,520

grains in situ

142

00:04:50,629 --> 00:04:48,320

there's a neutral mass spectrometer nms

143

00:04:52,230 --> 00:04:50,639

designed and built at nasa goddard space

144

00:04:53,909 --> 00:04:52,240

flight center which will look at the

145

00:04:56,790 --> 00:04:53,919

atmosphere

146

00:04:58,390 --> 00:04:56,800

and finally there's a uv spectrometer

147

00:04:59,830 --> 00:04:58,400

not the first spectrometer we've sent to

148

00:05:01,590 --> 00:04:59,840

the moon we've sent many spectrometers

149

00:05:03,110 --> 00:05:01,600

there but generally when you send a

150

00:05:04,950 --> 00:05:03,120

spectrometer it's looking down at the

151
00:05:07,430 --> 00:05:04,960
surface to look at the the minerals that

152
00:05:09,110 --> 00:05:07,440
make up the moon itself we'll actually

153
00:05:10,629 --> 00:05:09,120
be looking sideways through the

154
00:05:13,029 --> 00:05:10,639
atmosphere in the dust to understand

155
00:05:14,950 --> 00:05:13,039
what's going on just above the surface

156
00:05:16,070 --> 00:05:14,960
so that's a quick look at our science

157
00:05:17,430 --> 00:05:16,080
payload but i'm going to turn it over to

158
00:05:19,110 --> 00:05:17,440
rick now so he can give you a more

159
00:05:21,590 --> 00:05:19,120
in-depth view

160
00:05:24,150 --> 00:05:21,600
well as sarah just told you the the lady

161
00:05:25,830 --> 00:05:24,160
mission is about it's a tale of two

162
00:05:28,390 --> 00:05:25,840
mysteries the first being the thin

163
00:05:30,310 --> 00:05:28,400

tenuous very exotic lunar atmosphere

164

00:05:33,590 --> 00:05:30,320

utterly unlike our own and the second

165

00:05:35,510 --> 00:05:33,600

being this mysterious lofted substance

166

00:05:37,670 --> 00:05:35,520

purportedly dust that the apollo

167

00:05:38,629 --> 00:05:37,680

astronauts saw above the surface

168

00:05:40,790 --> 00:05:38,639

and so

169

00:05:43,350 --> 00:05:40,800

in the first video i'll show you it kind

170

00:05:45,830 --> 00:05:43,360

of illustrates uh the second mystery

171

00:05:48,390 --> 00:05:45,840

there's lady in orbit around the moon

172

00:05:50,070 --> 00:05:48,400

and the sun going down over the horizon

173

00:05:51,670 --> 00:05:50,080

and you can see this glow

174

00:05:53,990 --> 00:05:51,680

behind the spacecraft and that's meant

175

00:05:55,590 --> 00:05:54,000

to represent this possible dust cloud

176
00:05:57,909 --> 00:05:55,600
that exists around the moon near the

177
00:06:00,150 --> 00:05:57,919
terminator of the moon near the dark

178
00:06:00,870 --> 00:06:00,160
sunlit portion so those are the things

179
00:06:03,430 --> 00:06:00,880
that

180
00:06:06,390 --> 00:06:03,440
lady is equipped to look aft look at and

181
00:06:09,189 --> 00:06:06,400
try to explain and this next video shows

182
00:06:10,550 --> 00:06:09,199
you ladie pure wedding in space and i

183
00:06:12,150 --> 00:06:10,560
want to use this video to kind of

184
00:06:14,629 --> 00:06:12,160
illustrate the different instruments and

185
00:06:16,790 --> 00:06:14,639
their locations on the spacecraft so

186
00:06:19,430 --> 00:06:16,800
coming up actually is don cornell's

187
00:06:21,909 --> 00:06:19,440
instrument the laser com instrument on

188
00:06:24,629 --> 00:06:21,919

the side but if you look at the very top

189

00:06:26,070 --> 00:06:24,639

of the spacecraft the small tube looking

190

00:06:28,309 --> 00:06:26,080

outward is the ultraviolet invisible

191

00:06:30,390 --> 00:06:28,319

spectrometer the

192

00:06:31,430 --> 00:06:30,400

neutral mass spectrometer is down on the

193

00:06:34,790 --> 00:06:31,440

mid deck

194

00:06:37,270 --> 00:06:34,800

side of the spacecraft and the lunar

195

00:06:39,110 --> 00:06:37,280

dust experiment is at the top above the

196

00:06:40,950 --> 00:06:39,120

neutral mass spectrometer it's the sort

197

00:06:42,710 --> 00:06:40,960

of coffee can size thing that you saw at

198

00:06:44,629 --> 00:06:42,720

the top there so those are the three

199

00:06:45,749 --> 00:06:44,639

instruments that are meant to to

200

00:06:48,629 --> 00:06:45,759

address these

201
00:06:50,070 --> 00:06:48,639
two mysterious questions and i'd like to

202
00:06:51,430 --> 00:06:50,080
tell you a little bit about how one of

203
00:06:53,749 --> 00:06:51,440
those instruments is actually going to

204
00:06:55,990 --> 00:06:53,759
operate so the next video illustrates

205
00:06:58,469 --> 00:06:56,000
how the lunar dust experiment actually

206
00:07:00,390 --> 00:06:58,479
captures dust and analyzes it on its

207
00:07:02,629 --> 00:07:00,400
path around the moon

208
00:07:04,550 --> 00:07:02,639
basically it'll it will intersect and

209
00:07:07,270 --> 00:07:04,560
analyze any particles that are in its

210
00:07:09,510 --> 00:07:07,280
way as lady moves at 1.6 kilometers per

211
00:07:11,510 --> 00:07:09,520
second around the moon these particles

212
00:07:14,309 --> 00:07:11,520
come in and create little charges that

213
00:07:15,589 --> 00:07:14,319

are then registered on a detector and

214

00:07:17,270 --> 00:07:15,599

the size of those charges actually

215

00:07:19,430 --> 00:07:17,280

corresponds to the sizes of the grains

216

00:07:21,350 --> 00:07:19,440

that are being impacted the neutral mass

217

00:07:23,270 --> 00:07:21,360

spectrometer operates in a very similar

218

00:07:24,629 --> 00:07:23,280

fashion but it has a smaller aperture

219

00:07:26,710 --> 00:07:24,639

and it's really aimed at looking for the

220

00:07:28,469 --> 00:07:26,720

gas particles the atoms and the

221

00:07:30,230 --> 00:07:28,479

molecules in the tenuous lunar

222

00:07:32,469 --> 00:07:30,240

atmosphere and it identifies those

223

00:07:34,390 --> 00:07:32,479

molecules on the basis of their mass so

224

00:07:36,550 --> 00:07:34,400

you can identify things like calcium and

225

00:07:38,150 --> 00:07:36,560

titanium and iron that may be in present

226

00:07:39,350 --> 00:07:38,160

in the lunar atmosphere but we haven't

227

00:07:41,430 --> 00:07:39,360

measured them yet we don't know if

228

00:07:43,830 --> 00:07:41,440

they're really there or not the final

229

00:07:46,790 --> 00:07:43,840

video i wanted to show you folks is

230

00:07:49,029 --> 00:07:46,800

actually takes us back to 2009 and the I

231

00:07:52,230 --> 00:07:49,039

cross mission so this mission uh

232

00:07:54,629 --> 00:07:52,240

involved taking a a a an empty centaur

233

00:07:55,430 --> 00:07:54,639

space sorry launch vehicle

234

00:07:56,950 --> 00:07:55,440

and

235

00:07:59,510 --> 00:07:56,960

impacting it into the south pole of the

236

00:08:02,390 --> 00:07:59,520

moon into a location of permanent shadow

237

00:08:03,909 --> 00:08:02,400

and ultra ultra cold in places like that

238

00:08:06,390 --> 00:08:03,919

where there's no sunlight it gets so

239

00:08:08,629 --> 00:08:06,400

cold that ice if you can put it there

240

00:08:11,670 --> 00:08:08,639

will last for billions of years without

241

00:08:14,070 --> 00:08:11,680

going away and I cross was meant to to

242

00:08:15,749 --> 00:08:14,080

check out whether or not that actually

243

00:08:17,830 --> 00:08:15,759

occurs we had hints from lunar

244

00:08:19,589 --> 00:08:17,840

prospector but it wasn't until el cross

245

00:08:21,749 --> 00:08:19,599

actually impacted the surface that we

246

00:08:24,869 --> 00:08:21,759

could actually see ice lofted up into

247

00:08:27,189 --> 00:08:24,879

sunlight and uh the ultra the infrared

248

00:08:29,270 --> 00:08:27,199

spectrometer aboard I cross

249

00:08:31,430 --> 00:08:29,280

actually measured the the features of

250

00:08:32,709 --> 00:08:31,440

the ice that was present there so now we

251

00:08:34,389 --> 00:08:32,719

know there's ice there but how did it

252

00:08:36,230 --> 00:08:34,399

get there that's the question

253

00:08:37,829 --> 00:08:36,240

and so you can imagine a number of

254

00:08:39,909 --> 00:08:37,839

scenarios that would deliver ice to the

255

00:08:42,230 --> 00:08:39,919

cold regions of the moon one might be a

256

00:08:44,550 --> 00:08:42,240

cometary impact but there's another

257

00:08:45,990 --> 00:08:44,560

possibility that slowly over the

258

00:08:48,710 --> 00:08:46,000

millennia

259

00:08:50,870 --> 00:08:48,720

molecule by molecule water molecules

260

00:08:52,949 --> 00:08:50,880

have migrated hopping across the surface

261

00:08:54,470 --> 00:08:52,959

of the moon and finally some of them get

262

00:08:56,630 --> 00:08:54,480

cold trapped in these locations where

263

00:08:58,550 --> 00:08:56,640

there's no sunlight at all and and it's

264

00:09:00,230 --> 00:08:58,560

ultra ultra cold and they're stuck for

265

00:09:02,550 --> 00:09:00,240

basically forever

266

00:09:05,190 --> 00:09:02,560

ladies in a perfect position to look at

267

00:09:08,389 --> 00:09:05,200

those at the possibility of water and

268

00:09:10,470 --> 00:09:08,399

hydroxyl oh in the lunar atmosphere and

269

00:09:13,110 --> 00:09:10,480

so we'll be able to check that pathway

270

00:09:14,870 --> 00:09:13,120

that water cycle if you will that takes

271

00:09:17,829 --> 00:09:14,880

the possible water from the

272

00:09:19,990 --> 00:09:17,839

mid-latitudes up into the cold traps

273

00:09:21,750 --> 00:09:20,000

and the fourth instrument

274

00:09:23,750 --> 00:09:21,760

on the on the spacecraft is the lunar

275

00:09:25,190 --> 00:09:23,760

laser communications system a whole new

276

00:09:27,110 --> 00:09:25,200

way of doing business in terms of

277

00:09:28,949 --> 00:09:27,120

communications from deep space and don

278

00:09:30,389 --> 00:09:28,959

cornwall will tell you about that next

279

00:09:32,630 --> 00:09:30,399

thank you rick i'd also like to take

280

00:09:34,630 --> 00:09:32,640

this time to uh to thank the nasa

281

00:09:36,470 --> 00:09:34,640

science mission directorate and the lady

282

00:09:37,670 --> 00:09:36,480

project for the ride to the moon that

283

00:09:39,990 --> 00:09:37,680

that we're going to have for our

284

00:09:41,990 --> 00:09:40,000

technology uh demonstration

285

00:09:43,750 --> 00:09:42,000

uh as rick said we're not actually a

286

00:09:45,750 --> 00:09:43,760

science instrument but we are the lunar

287

00:09:47,990 --> 00:09:45,760

laser communications demonstration we're

288

00:09:50,310 --> 00:09:48,000

going to demonstrate the first

289

00:09:53,269 --> 00:09:50,320

high-speed two-way laser communications

290

00:09:54,630 --> 00:09:53,279

uh really for nasa and uh from the moon

291

00:09:56,870 --> 00:09:54,640

back to the earth

292

00:09:58,870 --> 00:09:56,880

and just as a point of reference uh we

293

00:10:00,310 --> 00:09:58,880

are six times the bandwidth the amount

294

00:10:01,829 --> 00:10:00,320

of data that we can send back in a

295

00:10:03,269 --> 00:10:01,839

certain amount of time

296

00:10:04,949 --> 00:10:03,279

as compared to the the most

297

00:10:05,750 --> 00:10:04,959

state-of-the-art radio system that was

298

00:10:07,509 --> 00:10:05,760

sent

299

00:10:10,230 --> 00:10:07,519

to the moon on the lunar reconnaissance

300

00:10:12,949 --> 00:10:10,240

orbiter in 2009 and at the same time we

301
00:10:15,430 --> 00:10:12,959
use half the weight and 25 less power so

302
00:10:18,389 --> 00:10:15,440
we're more efficient

303
00:10:19,750 --> 00:10:18,399
my first slide actually uh is an

304
00:10:21,350 --> 00:10:19,760
excellent illustration of the mission

305
00:10:22,790 --> 00:10:21,360
concept it's very straightforward when

306
00:10:24,630 --> 00:10:22,800
you look at it there's our optical

307
00:10:26,949 --> 00:10:24,640
terminal on the side of lady and uh

308
00:10:28,230 --> 00:10:26,959
we're exchanging uh laser beams uh

309
00:10:29,990 --> 00:10:28,240
between the earth and the moon and

310
00:10:32,870 --> 00:10:30,000
there's data imparted on each of those

311
00:10:34,230 --> 00:10:32,880
laser beams in the form of of hundreds

312
00:10:35,430 --> 00:10:34,240
of millions of little pulses every

313
00:10:36,230 --> 00:10:35,440

second

314

00:10:38,310 --> 00:10:36,240

uh

315

00:10:39,590 --> 00:10:38,320

so the next slide please

316

00:10:41,190 --> 00:10:39,600

so why are we interested in laser

317

00:10:43,670 --> 00:10:41,200

communications so

318

00:10:45,110 --> 00:10:43,680

over the last 50 years radio has served

319

00:10:47,670 --> 00:10:45,120

nasa very well

320

00:10:49,030 --> 00:10:47,680

for uh for providing space

321

00:10:51,670 --> 00:10:49,040

communications

322

00:10:53,430 --> 00:10:51,680

but uh like everyone uh everyone else

323

00:10:55,590 --> 00:10:53,440

nasa has needs for faster download

324

00:10:57,750 --> 00:10:55,600

speeds

325

00:11:01,590 --> 00:10:57,760

to bring back our

326

00:11:03,829 --> 00:11:01,600

data video and images high speed uh

327

00:11:05,590 --> 00:11:03,839

high resolution images and and 3d high

328

00:11:07,829 --> 00:11:05,600

definition video from satellites that

329

00:11:09,590 --> 00:11:07,839

orbit the earth and probes going to the

330

00:11:11,030 --> 00:11:09,600

moon and beyond

331

00:11:12,470 --> 00:11:11,040

so

332

00:11:14,550 --> 00:11:12,480

light waves are much shorter in

333

00:11:16,389 --> 00:11:14,560

wavelength than radio waves which means

334

00:11:18,069 --> 00:11:16,399

that we can pack more bits of data into

335

00:11:19,910 --> 00:11:18,079

every second on a light beam and also

336

00:11:22,470 --> 00:11:19,920

use smaller transmitters and receivers

337

00:11:25,350 --> 00:11:22,480

and if you can play the animation please

338

00:11:27,829 --> 00:11:25,360

so for example uh the the antenna on the

339

00:11:29,750 --> 00:11:27,839

left is a radio antenna it's many many

340

00:11:31,509 --> 00:11:29,760

uh tens of feet across

341

00:11:33,430 --> 00:11:31,519

and the the uh

342

00:11:35,430 --> 00:11:33,440

on the right that the animation where

343

00:11:37,350 --> 00:11:35,440

you saw the ground terminal got smaller

344

00:11:39,030 --> 00:11:37,360

that's our new

345

00:11:40,949 --> 00:11:39,040

uh optical communications ground

346

00:11:42,870 --> 00:11:40,959

terminal it'll be based in white sands

347

00:11:44,310 --> 00:11:42,880

it again leverages the fact that light

348

00:11:45,350 --> 00:11:44,320

waves are shorter and so you can keep

349

00:11:47,670 --> 00:11:45,360

the beams

350

00:11:49,990 --> 00:11:47,680

more collimated more focused and deliver

351
00:11:51,269 --> 00:11:50,000
more energy at a distant point so we can

352
00:11:53,030 --> 00:11:51,279
get more bandwidth with optical

353
00:11:57,829 --> 00:11:53,040
communications using a smaller size and

354
00:12:01,829 --> 00:11:59,670
so we have an animation here

355
00:12:03,910 --> 00:12:01,839
that actually shows how our system will

356
00:12:06,629 --> 00:12:03,920
work we have three ground stations one

357
00:12:08,870 --> 00:12:06,639
is at nasa jpl it's actually a site that

358
00:12:10,949 --> 00:12:08,880
they have in california the european

359
00:12:11,910 --> 00:12:10,959
space agency has a site and mit has a

360
00:12:17,110 --> 00:12:11,920
site

361
00:12:19,509 --> 00:12:17,120
will scan for laddie around the moon and

362
00:12:21,430 --> 00:12:19,519
when laddie sees that it sends a pulse

363
00:12:23,190 --> 00:12:21,440

back i'm a little bit behind on this and

364

00:12:25,110 --> 00:12:23,200

then that

365

00:12:27,190 --> 00:12:25,120

causes the ground station to then lock

366

00:12:29,430 --> 00:12:27,200

its beam to the uplink to the downlink

367

00:12:31,670 --> 00:12:29,440

beam and then we start communicating and

368

00:12:33,829 --> 00:12:31,680

we can send up to 220 megabits per

369

00:12:37,430 --> 00:12:33,839

second of data on the uplink from the

370

00:12:39,430 --> 00:12:37,440

earth to the moon and then as much as

371

00:12:40,550 --> 00:12:39,440

megabits per second from the moon down

372

00:12:43,110 --> 00:12:40,560

to the earth

373

00:12:45,509 --> 00:12:43,120

and uh i'd like to again point out that

374

00:12:47,590 --> 00:12:45,519

mit lincoln laboratory designed built

375

00:12:49,509 --> 00:12:47,600

tested and delivered at both our flight

376

00:12:51,030 --> 00:12:49,519

terminal and our first ground terminal

377

00:12:52,389 --> 00:12:51,040

and that we are partnering partnering

378

00:12:54,069 --> 00:12:52,399

with nasa jpl

379

00:12:55,750 --> 00:12:54,079

and the european space agency for our

380

00:12:58,150 --> 00:12:55,760

other two ground terminals

381

00:12:59,670 --> 00:12:58,160

and uh with that uh

382

00:13:01,269 --> 00:12:59,680

i return the

383

00:13:03,269 --> 00:13:01,279

stage to rachel

384

00:13:04,949 --> 00:13:03,279

thank you panel we'll now open it up for

385

00:13:07,110 --> 00:13:04,959

questions here in the audience at nasa

386

00:13:09,190 --> 00:13:07,120

wallops if you'd have a question please

387

00:13:12,550 --> 00:13:09,200

raise your hand wait for mike's and

388

00:13:14,230 --> 00:13:12,560

state your name and affiliation

389

00:13:16,550 --> 00:13:14,240

yes i have a question about the laser

390

00:13:17,430 --> 00:13:16,560

communication system uh

391

00:13:20,629 --> 00:13:17,440

can

392

00:13:23,350 --> 00:13:20,639

if you increase the wattage does it make

393

00:13:25,990 --> 00:13:23,360

it better or is it just you only need

394

00:13:28,790 --> 00:13:26,000

that minimum wattage to make it at peak

395

00:13:30,790 --> 00:13:28,800

efficiency i mean is it like with

396

00:13:32,230 --> 00:13:30,800

regular radio the bigger the antenna the

397

00:13:34,389 --> 00:13:32,240

more the wattage

398

00:13:36,150 --> 00:13:34,399

the better the signal so that's a good

399

00:13:37,990 --> 00:13:36,160

question this is a certain design point

400

00:13:39,829 --> 00:13:38,000

so we worked with the resources that

401

00:13:41,269 --> 00:13:39,839

that we had available to us

402

00:13:43,350 --> 00:13:41,279

and and

403

00:13:44,870 --> 00:13:43,360

and uh one of our you know we have some

404

00:13:46,790 --> 00:13:44,880

limits in power we're at the moon and

405

00:13:48,389 --> 00:13:46,800

we're on a small spacecraft and so this

406

00:13:50,470 --> 00:13:48,399

is a design point that was chosen for

407

00:13:53,030 --> 00:13:50,480

the transmitter power if the transmitter

408

00:13:56,069 --> 00:13:53,040

power were larger you could

409

00:13:59,030 --> 00:13:56,079

in theory send a higher data rate or

410

00:14:00,870 --> 00:13:59,040

more bits per second because

411

00:14:02,389 --> 00:14:00,880

or over a longer distance as well that's

412

00:14:04,069 --> 00:14:02,399

right thanks for the help on the

413

00:14:05,750 --> 00:14:04,079

question yes

414

00:14:07,509 --> 00:14:05,760

our next question also comes here from

415

00:14:09,509 --> 00:14:07,519

nasa wallops if you could please state

416

00:14:10,949 --> 00:14:09,519

your name and your affiliation hi ken

417

00:14:13,430 --> 00:14:10,959

kramer universe today i have two

418

00:14:15,590 --> 00:14:13,440

questions please uh first for don can

419

00:14:17,509 --> 00:14:15,600

you tell us i think

420

00:14:19,829 --> 00:14:17,519

the length of your experiment is is

421

00:14:22,230 --> 00:14:19,839

restricted to 30 days or so after you

422

00:14:24,949 --> 00:14:22,240

get to orbit can you talk about uh why

423

00:14:26,790 --> 00:14:24,959

that is and um i believe also the

424

00:14:29,750 --> 00:14:26,800

spacecraft is going into an elliptical

425

00:14:32,949 --> 00:14:29,760

orbit why why is it elliptical not

426

00:14:36,710 --> 00:14:34,790

okay so uh

427

00:14:39,189 --> 00:14:36,720

30 days is what we believe is sufficient

428

00:14:41,750 --> 00:14:39,199

to do our demonstration and we are along

429

00:14:43,590 --> 00:14:41,760

for the ride it is a science mission and

430

00:14:45,269 --> 00:14:43,600

we can't deprive our science team here

431

00:14:46,790 --> 00:14:45,279

of answering their very important

432

00:14:48,550 --> 00:14:46,800

questions as well

433

00:14:50,550 --> 00:14:48,560

so we think we can do everything we need

434

00:14:52,550 --> 00:14:50,560

to do within the 30-day period and we

435

00:14:54,470 --> 00:14:52,560

have a follow-on mission uh called the

436

00:14:56,150 --> 00:14:54,480

laser communications relay demonstration

437

00:14:58,870 --> 00:14:56,160

that'll be launched in 2017. it's a

438

00:15:00,949 --> 00:14:58,880

funded mission again based on mit

439

00:15:03,509 --> 00:15:00,959

technology but will be built at nasa

440

00:15:05,030 --> 00:15:03,519

goddard and that will will be a duration

441

00:15:06,150 --> 00:15:05,040

of two to five years where we hope to

442

00:15:08,629 --> 00:15:06,160

really

443

00:15:10,230 --> 00:15:08,639

demonstrate long-term performance

444

00:15:12,470 --> 00:15:10,240

and i can take the question about the

445

00:15:14,150 --> 00:15:12,480

elliptical orbit

446

00:15:16,310 --> 00:15:14,160

even if you start off with a circular

447

00:15:18,470 --> 00:15:16,320

orbit at low altitudes where we want to

448

00:15:20,069 --> 00:15:18,480

operate it very very quickly gets

449

00:15:21,670 --> 00:15:20,079

perturbed into an eccentric or

450

00:15:23,670 --> 00:15:21,680

elliptical orbit

451
00:15:25,509 --> 00:15:23,680
and so it's just a question of managing

452
00:15:26,949 --> 00:15:25,519
those perturbations which are induced by

453
00:15:28,470 --> 00:15:26,959
the gravity field of the moon which is

454
00:15:31,189 --> 00:15:28,480
very irregular compared to that of

455
00:15:34,470 --> 00:15:31,199
earth's as we know from grail now

456
00:15:35,590 --> 00:15:34,480
so it's that which perturbs the orbit

457
00:15:37,590 --> 00:15:35,600
and that

458
00:15:40,710 --> 00:15:37,600
changed orbit is something we need to

459
00:15:42,790 --> 00:15:40,720
adjust periodically so every week or so

460
00:15:45,350 --> 00:15:42,800
we perform a burn to attempt to

461
00:15:47,829 --> 00:15:45,360
basically re-sort of circula circularize

462
00:15:49,829 --> 00:15:47,839
the orbit and maintain periapsis the

463
00:15:51,350 --> 00:15:49,839

point of closest approach high enough so

464

00:15:54,470 --> 00:15:51,360

that frankly we don't crash into the

465

00:15:56,949 --> 00:15:54,480

surface of the moon

466

00:15:59,590 --> 00:15:56,959

it's the gravity lumpy gravity field

467

00:16:01,189 --> 00:15:59,600

that causes our orbit to perturb

468

00:16:08,310 --> 00:16:01,199

science

469

00:16:10,389 --> 00:16:08,320

safely get with the spacecraft lower is

470

00:16:11,590 --> 00:16:10,399

better for lady lowers better because

471

00:16:13,189 --> 00:16:11,600

because we've got two instruments that

472

00:16:14,870 --> 00:16:13,199

make in-situ measurements one's going

473

00:16:17,030 --> 00:16:14,880

for the dust the other is going for

474

00:16:19,189 --> 00:16:17,040

actual in in situ

475

00:16:20,870 --> 00:16:19,199

gas species and so the lower you go the

476

00:16:22,629 --> 00:16:20,880

more there are the better your signal

477

00:16:24,389 --> 00:16:22,639

the more you learn but we'll be

478

00:16:25,590 --> 00:16:24,399

wandering around in altitudes as the

479

00:16:27,110 --> 00:16:25,600

orbit gets

480

00:16:29,110 --> 00:16:27,120

perturbed by the gravity field of the

481

00:16:31,350 --> 00:16:29,120

moon we'll always try to get back to the

482

00:16:33,990 --> 00:16:31,360

low altitudes again

483

00:16:36,069 --> 00:16:34,000

i hope that helps you

484

00:16:38,069 --> 00:16:36,079

joe papillardo with uh popular mechanics

485

00:16:39,110 --> 00:16:38,079

um i'm just wondering if there's any uh

486

00:16:40,629 --> 00:16:39,120

if you could describe some of the

487

00:16:42,550 --> 00:16:40,639

differences between the light and dark

488

00:16:43,829 --> 00:16:42,560

sides of the moon in terms of the x

489

00:16:46,389 --> 00:16:43,839

exosphere

490

00:16:47,990 --> 00:16:46,399

oh sure um actually we've got a resident

491

00:16:49,590 --> 00:16:48,000

expert in the audience who made

492

00:16:50,629 --> 00:16:49,600

measurements of that very thing back on

493

00:16:54,470 --> 00:16:50,639

apollo

494

00:16:56,629 --> 00:16:54,480

audience and and

495

00:16:59,189 --> 00:16:56,639

i hope i do justice to what what i found

496

00:17:02,870 --> 00:17:01,110

certain of the species

497

00:17:05,510 --> 00:17:02,880

can basically

498

00:17:07,350 --> 00:17:05,520

freeze out on the surface as you as the

499

00:17:09,270 --> 00:17:07,360

the night side as you probably know of

500

00:17:10,630 --> 00:17:09,280

the moon since it's not in sunlight and

501
00:17:12,949 --> 00:17:10,640
there's very little atmosphere to

502
00:17:14,630 --> 00:17:12,959
conduct heat or it can convect heat it

503
00:17:16,949 --> 00:17:14,640
gets very very cold it gets below 100

504
00:17:19,829 --> 00:17:16,959
kelvins on the night side just before

505
00:17:21,669 --> 00:17:19,839
dawn that's cold enough so that when an

506
00:17:24,150 --> 00:17:21,679
atom or a molecule comes down and

507
00:17:26,470 --> 00:17:24,160
interacts with the surface grain

508
00:17:28,150 --> 00:17:26,480
it basically chills down too and so it's

509
00:17:30,630 --> 00:17:28,160
resident's time that molecule's

510
00:17:33,190 --> 00:17:30,640
resonance time on that grain can become

511
00:17:34,789 --> 00:17:33,200
very very long before it hops off again

512
00:17:37,350 --> 00:17:34,799
and when it does hop off it doesn't go

513
00:17:39,350 --> 00:17:37,360

nearly as high so the atmosphere kind of

514

00:17:42,070 --> 00:17:39,360

collapses or parts of the atmosphere can

515

00:17:43,430 --> 00:17:42,080

actually collapse at night whereas on

516

00:17:44,950 --> 00:17:43,440

the day side it gets warm enough that

517

00:17:47,029 --> 00:17:44,960

these guys are hopping around i think

518

00:17:50,070 --> 00:17:47,039

someone described it as like bunnies

519

00:17:53,590 --> 00:17:51,430

that's a picture i won't be able to get

520

00:17:54,789 --> 00:17:53,600

out of my head very soon

521

00:17:56,150 --> 00:17:54,799

but

522

00:17:57,590 --> 00:17:56,160

that's basically what the molecules of

523

00:17:59,990 --> 00:17:57,600

the exosphere are doing they're hopping

524

00:18:02,070 --> 00:18:00,000

around but they're sticking time the

525

00:18:03,510 --> 00:18:02,080

residence time on surface grains is

526

00:18:05,029 --> 00:18:03,520

strongly controlled by the temperature

527

00:18:14,549 --> 00:18:05,039

and therefore there's a day to night

528

00:18:19,190 --> 00:18:17,430

hi just a question about the uh

529

00:18:22,390 --> 00:18:19,200

given that it's a

530

00:18:25,350 --> 00:18:22,400

highly rarified exosphere what rate of

531

00:18:27,590 --> 00:18:25,360

detection are you expecting for the uh

532

00:18:28,789 --> 00:18:27,600

for the dust and for the uh for the

533

00:18:30,789 --> 00:18:28,799

elements are you expecting that to be

534

00:18:33,110 --> 00:18:30,799

fairly continuous or just

535

00:18:35,029 --> 00:18:33,120

once every few seconds or what that's a

536

00:18:36,870 --> 00:18:35,039

that's a really good question um the

537

00:18:39,190 --> 00:18:36,880

density of the dust that we are we have

538

00:18:42,390 --> 00:18:39,200

in our requirements for measurement at

539

00:18:45,830 --> 00:18:42,400

about 50 kilometers altitude is a pretty

540

00:18:48,310 --> 00:18:45,840

small number it's like only 100 or so

541

00:18:50,630 --> 00:18:48,320

dust particles per cubic meter

542

00:18:54,310 --> 00:18:50,640

that's not much i mean that's

543

00:18:58,070 --> 00:18:55,190

so

544

00:19:00,549 --> 00:18:58,080

uh running through that however at 1.6

545

00:19:02,310 --> 00:19:00,559

km 1600 meters per second you can

546

00:19:05,430 --> 00:19:02,320

imagine smacking into those things with

547

00:19:07,510 --> 00:19:05,440

the with the aperture of ldx uh fairly

548

00:19:09,990 --> 00:19:07,520

frequently and so if the dust is there

549

00:19:12,390 --> 00:19:10,000

in that density we'll see at a few

550

00:19:14,950 --> 00:19:12,400

counts per minute uh possibly even

551
00:19:16,390 --> 00:19:14,960
higher rates just how much is there and

552
00:19:17,510 --> 00:19:16,400
if we don't see anything that says

553
00:19:19,110 --> 00:19:17,520
pretty much

554
00:19:21,270 --> 00:19:19,120
we can place a very

555
00:19:22,870 --> 00:19:21,280
stringent lower upper limit on on how

556
00:19:24,549 --> 00:19:22,880
much dust is actually there but we'll

557
00:19:27,029 --> 00:19:24,559
know right away as soon as we drop down

558
00:19:28,390 --> 00:19:27,039
to those low altitudes

559
00:19:29,430 --> 00:19:28,400
as far as oh and the other instruments

560
00:19:31,190 --> 00:19:29,440
for for

561
00:19:31,990 --> 00:19:31,200
dust detection

562
00:19:34,470 --> 00:19:32,000
um

563
00:19:36,549 --> 00:19:34,480

the ultraviolet invisible spectrometer

564

00:19:38,630 --> 00:19:36,559

can look at a distance and integrate

565

00:19:40,230 --> 00:19:38,640

over a fairly large column at whatever

566

00:19:42,870 --> 00:19:40,240

dust is there the challenge that they

567

00:19:44,789 --> 00:19:42,880

have is for some of their measurements

568

00:19:47,350 --> 00:19:44,799

they're looking against the coronal and

569

00:19:48,789 --> 00:19:47,360

zodiacal light of the sun if you're

570

00:19:50,549 --> 00:19:48,799

looking back across the limb of the moon

571

00:19:52,390 --> 00:19:50,559

you'll see not just the dust that's

572

00:19:54,470 --> 00:19:52,400

scattering light toward you

573

00:19:57,029 --> 00:19:54,480

but also the zodiacal light in the inner

574

00:19:59,029 --> 00:19:57,039

solar system plus the coronal

575

00:20:00,470 --> 00:19:59,039

structure as well so it's a challenge

576

00:20:04,549 --> 00:20:00,480

but they've shown they can do it so

577

00:20:08,470 --> 00:20:06,149

so this is more of a practical question

578

00:20:10,230 --> 00:20:08,480

with the laser communication um

579

00:20:16,470 --> 00:20:10,240

what's the cost difference between a

580

00:20:19,669 --> 00:20:17,270

well

581

00:20:21,909 --> 00:20:19,679

we did a lot of development here to

582

00:20:23,110 --> 00:20:21,919

to solve a lot of the

583

00:20:24,630 --> 00:20:23,120

issues that are

584

00:20:26,950 --> 00:20:24,640

you know part of doing this this

585

00:20:28,230 --> 00:20:26,960

complicated mission so

586

00:20:30,950 --> 00:20:28,240

um

587

00:20:32,950 --> 00:20:30,960

initially it's it's it's expensive but

588

00:20:34,789 --> 00:20:32,960

but as we build more and more copies we

589

00:20:36,710 --> 00:20:34,799

expect that cost to go down just like

590

00:20:39,029 --> 00:20:36,720

for any system so there's a lot of

591

00:20:47,990 --> 00:20:39,039

non-recurring engineering that happened

592

00:20:57,270 --> 00:20:50,470

perhaps we can talk offline yeah

593

00:21:02,870 --> 00:20:59,830

matthew oh is it on matthew franco's

594

00:21:05,590 --> 00:21:02,880

popular science um question two

595

00:21:08,470 --> 00:21:05,600

questions one is how much dispersion is

596

00:21:11,510 --> 00:21:08,480

there in the laser beam between moon and

597

00:21:13,029 --> 00:21:11,520

earth i know in lunar ranging

598

00:21:14,630 --> 00:21:13,039

missions there's a fair amount of

599

00:21:17,190 --> 00:21:14,640

dispersion

600

00:21:20,149 --> 00:21:17,200

how big is the does the station need to

601
00:21:22,950 --> 00:21:20,159
be to reliably pick up the laser on the

602
00:21:24,870 --> 00:21:22,960
earth end and vice versa okay so when

603
00:21:26,230 --> 00:21:24,880
you say dispersion i think you mean uh

604
00:21:27,990 --> 00:21:26,240
actually the spread of the beam that's

605
00:21:30,549 --> 00:21:28,000
right so to speak yeah so it starts out

606
00:21:33,029 --> 00:21:30,559
at four inches in diameter

607
00:21:34,630 --> 00:21:33,039
from the spacecraft telescope and by the

608
00:21:37,350 --> 00:21:34,640
time it gets to the earth it's about

609
00:21:39,190 --> 00:21:37,360
three and a half miles in diameter six

610
00:21:41,430 --> 00:21:39,200
kilometers

611
00:21:43,270 --> 00:21:41,440
so it's it's still large but at the same

612
00:21:44,870 --> 00:21:43,280
time it's a very small point when seen

613
00:21:46,549 --> 00:21:44,880

from the moon and one of the big

614

00:21:48,390 --> 00:21:46,559

challenges we have is keeping that

615

00:21:50,070 --> 00:21:48,400

pointed accurately

616

00:21:53,190 --> 00:21:50,080

over the entire time you're trying to

617

00:21:56,870 --> 00:21:55,510

and the the second question was about

618

00:21:59,270 --> 00:21:56,880

the dust

619

00:22:01,350 --> 00:21:59,280

detection device and i'm not sure which

620

00:22:04,310 --> 00:22:01,360

of the two of you it should be directed

621

00:22:07,110 --> 00:22:04,320

to but uh you you mentioned that the

622

00:22:09,430 --> 00:22:07,120

size of the grain was correlated with

623

00:22:10,830 --> 00:22:09,440

the electric charge on it

624

00:22:13,909 --> 00:22:10,840

um

625

00:22:15,430 --> 00:22:13,919

so is that you want me to tell you a

626
00:22:17,190 --> 00:22:15,440
little more about yes if you would

627
00:22:20,149 --> 00:22:17,200
please

628
00:22:22,549 --> 00:22:20,159
actually as when the grains come in

629
00:22:24,070 --> 00:22:22,559
they uh they impact that witness plate

630
00:22:26,230 --> 00:22:24,080
at the back end of the instrument and

631
00:22:27,990 --> 00:22:26,240
they create a little plasma cloud and

632
00:22:30,789 --> 00:22:28,000
the amount of charge that's created by

633
00:22:32,950 --> 00:22:30,799
that is controlled by two mostly by two

634
00:22:34,310 --> 00:22:32,960
really important factors one is mass and

635
00:22:37,190 --> 00:22:34,320
the other is the velocity at which it

636
00:22:39,270 --> 00:22:37,200
comes in there are various

637
00:22:40,710 --> 00:22:39,280
formulae that relate those two things

638
00:22:42,310 --> 00:22:40,720

but we know what the velocity of the

639

00:22:44,470 --> 00:22:42,320

spacecraft is so that

640

00:22:46,070 --> 00:22:44,480

particular issue is taken care of in

641

00:22:48,070 --> 00:22:46,080

that way that way you can look at the

642

00:22:52,470 --> 00:22:48,080

charge and relate it directly to the

643

00:22:56,310 --> 00:22:55,029

hi john pritchard a nasa social

644

00:22:57,830 --> 00:22:56,320

participant

645

00:22:59,909 --> 00:22:57,840

um

646

00:23:02,549 --> 00:22:59,919

with the lady science with the study of

647

00:23:04,070 --> 00:23:02,559

the exosphere and the scientific results

648

00:23:05,750 --> 00:23:04,080

that come out of that

649

00:23:08,470 --> 00:23:05,760

i think we're looking at

650

00:23:11,029 --> 00:23:08,480

evolution of the earth moon system and

651
00:23:12,870 --> 00:23:11,039
then getting into some earth science

652
00:23:14,789 --> 00:23:12,880
so what

653
00:23:17,510 --> 00:23:14,799
can we point to in earth science that we

654
00:23:18,789 --> 00:23:17,520
could learn about in future from

655
00:23:20,950 --> 00:23:18,799
this work

656
00:23:27,750 --> 00:23:20,960
for example is it possible to learn

657
00:23:27,760 --> 00:23:31,190
okay

658
00:23:34,630 --> 00:23:33,029
i'm not sure i follow where you're going

659
00:23:36,310 --> 00:23:34,640
with that question we've measured the

660
00:23:38,630 --> 00:23:36,320
terrestrial magnetic field multiple

661
00:23:40,070 --> 00:23:38,640
times with very very high precision

662
00:23:41,990 --> 00:23:40,080
dynamics

663
00:23:43,510 --> 00:23:42,000

and maintenance okay well

664

00:23:45,190 --> 00:23:43,520

okay but the earth and the moon have

665

00:23:47,430 --> 00:23:45,200

evolved down two very very different

666

00:23:48,789 --> 00:23:47,440

paths since their birth together you

667

00:23:51,269 --> 00:23:48,799

know roughly four and a half billion

668

00:23:53,750 --> 00:23:51,279

years ago the earth is retained and

669

00:23:55,350 --> 00:23:53,760

accumulated more volatiles hence oceans

670

00:23:57,990 --> 00:23:55,360

and things like that and that is that

671

00:23:59,190 --> 00:23:58,000

along with its very very active geologic

672

00:24:00,950 --> 00:23:59,200

processes

673

00:24:02,070 --> 00:24:00,960

have really sculpted and changed the

674

00:24:03,430 --> 00:24:02,080

surface of the earth we've got

675

00:24:05,669 --> 00:24:03,440

continents that drift around because the

676
00:24:07,750 --> 00:24:05,679
mantle is convecting there's an interior

677
00:24:09,269 --> 00:24:07,760
dynamo that gives rise to the magnetic

678
00:24:11,110 --> 00:24:09,279
field that

679
00:24:13,990 --> 00:24:11,120
constantly change the surface of the

680
00:24:16,470 --> 00:24:14,000
earth the moon on the other hand has one

681
00:24:18,310 --> 00:24:16,480
geologic process going on today and one

682
00:24:20,149 --> 00:24:18,320
only and that's impact

683
00:24:21,750 --> 00:24:20,159
asteroids come in and they smack into

684
00:24:24,310 --> 00:24:21,760
the surface of the moon and they create

685
00:24:26,230 --> 00:24:24,320
craters so material is excavated and

686
00:24:27,990 --> 00:24:26,240
redistributed around

687
00:24:30,950 --> 00:24:28,000
but you know they're they're really

688
00:24:32,390 --> 00:24:30,960

different worlds fortunately for us

689

00:24:35,190 --> 00:24:32,400

unfortunately for the russians you know

690

00:24:36,710 --> 00:24:35,200

the the uh impacts don't occur very

691

00:24:38,070 --> 00:24:36,720

often on the earth

692

00:24:38,950 --> 00:24:38,080

they're happening all the time on the

693

00:24:41,110 --> 00:24:38,960

moon

694

00:24:43,029 --> 00:24:41,120

now that said there's one other aspect

695

00:24:45,510 --> 00:24:43,039

of this that's kind of interesting if

696

00:24:47,510 --> 00:24:45,520

the moon has maintained this this low

697

00:24:49,590 --> 00:24:47,520

obliquity this very low inclination the

698

00:24:51,029 --> 00:24:49,600

earth's inclination is 23.5 degrees

699

00:24:53,350 --> 00:24:51,039

that's why we have seasons the moon

700

00:24:55,990 --> 00:24:53,360

really doesn't have seasons it's a very

701
00:24:57,430 --> 00:24:56,000
stable system that means the locations

702
00:24:59,350 --> 00:24:57,440
that the boat at the north pole and the

703
00:25:01,269 --> 00:24:59,360
south pole some of those locations are

704
00:25:03,029 --> 00:25:01,279
in permanent shadow that also means that

705
00:25:05,510 --> 00:25:03,039
stuff that has been delivered to those

706
00:25:07,830 --> 00:25:05,520
locations from the earliest times of the

707
00:25:09,430 --> 00:25:07,840
solar system is still there

708
00:25:11,350 --> 00:25:09,440
that's stuff that was delivered to the

709
00:25:13,350 --> 00:25:11,360
earth in the earliest times of the solar

710
00:25:14,789 --> 00:25:13,360
system too but it's been lost the stuff

711
00:25:17,269 --> 00:25:14,799
that was delivered in the very earliest

712
00:25:19,110 --> 00:25:17,279
times has been lost by the same geologic

713
00:25:21,590 --> 00:25:19,120

process as i was just talking about the

714

00:25:23,669 --> 00:25:21,600

geology covers it up it's gone we can't

715

00:25:25,750 --> 00:25:23,679

recover it anymore the moon is still

716

00:25:28,070 --> 00:25:25,760

there it's still sequestered so if we go

717

00:25:29,990 --> 00:25:28,080

there to the poles of the moon and start

718

00:25:32,789 --> 00:25:30,000

digging this stuff up we might be

719

00:25:34,950 --> 00:25:32,799

looking at the prebiotic materials

720

00:25:38,390 --> 00:25:34,960

that gave rise to life on earth the same

721

00:25:42,710 --> 00:25:40,390

thank you we have time for a few more

722

00:25:44,789 --> 00:25:42,720

questions

723

00:25:46,149 --> 00:25:44,799

i have a real quick question and it

724

00:25:48,310 --> 00:25:46,159

involves

725

00:25:51,029 --> 00:25:48,320

what what do we know about the moon's

726

00:25:53,669 --> 00:25:51,039

outgassing and how does that tell us

727

00:25:56,710 --> 00:25:53,679

about the interior and its state of

728

00:26:01,669 --> 00:25:58,149

is it fair for jim green to ask

729

00:26:06,230 --> 00:26:04,070

we do know that argon 40 is out gassing

730

00:26:07,190 --> 00:26:06,240

from the interior of the moon that was

731

00:26:09,669 --> 00:26:07,200

the

732

00:26:11,510 --> 00:26:09,679

experimental results that dick hodes

733

00:26:14,950 --> 00:26:11,520

over there sitting in the audience got

734

00:26:15,669 --> 00:26:14,960

back in the 70s on apollo 17. argon 40

735

00:26:18,470 --> 00:26:15,679

is

736

00:26:21,029 --> 00:26:18,480

comes from radiogenic decay of potassium

737

00:26:22,070 --> 00:26:21,039

40 of which there is a fair amount on

738

00:26:24,230 --> 00:26:22,080

the moon

739

00:26:25,750 --> 00:26:24,240

we see it actually in distinct locations

740

00:26:27,510 --> 00:26:25,760

on the moon and that's really strongly

741

00:26:29,269 --> 00:26:27,520

related to the crystal history of the

742

00:26:30,149 --> 00:26:29,279

moon and the interior history of the

743

00:26:31,990 --> 00:26:30,159

moon

744

00:26:33,110 --> 00:26:32,000

another thing we observe that may some

745

00:26:34,390 --> 00:26:33,120

of which may be coming out of the

746

00:26:35,430 --> 00:26:34,400

interior and should be expected is

747

00:26:38,310 --> 00:26:35,440

helium

748

00:26:40,549 --> 00:26:38,320

but it looks like based on Iro results

749

00:26:43,029 --> 00:26:40,559

that the helium that is seen in the

750

00:26:44,710 --> 00:26:43,039

lunar atmosphere mostly derives from the

751
00:26:46,630 --> 00:26:44,720
solar wind so that's something that's

752
00:26:47,750 --> 00:26:46,640
coming from the outside in

753
00:26:49,110 --> 00:26:47,760
now

754
00:26:50,470 --> 00:26:49,120
more about the interior of the moon

755
00:26:52,310 --> 00:26:50,480
there may be other things that are

756
00:26:53,590 --> 00:26:52,320
leaking out argon 40 gets out because

757
00:26:55,590 --> 00:26:53,600
it's a noble gas and it doesn't

758
00:26:58,470 --> 00:26:55,600
chemically react with anything

759
00:27:00,390 --> 00:26:58,480
other substances such as water may not

760
00:27:01,830 --> 00:27:00,400
be so lucky there may be juvenile water

761
00:27:03,510 --> 00:27:01,840
still in the interior of the moon in

762
00:27:05,110 --> 00:27:03,520
fact mineral samples have revealed the

763
00:27:07,830 --> 00:27:05,120

presence of water in those earliest

764

00:27:09,669 --> 00:27:07,840

minerals appetite grains

765

00:27:11,350 --> 00:27:09,679

and i'm getting way deep into the the

766

00:27:12,470 --> 00:27:11,360

science of that but the water probably

767

00:27:14,549 --> 00:27:12,480

would have a hard time getting out

768

00:27:16,950 --> 00:27:14,559

because it's so reactive so anything we

769

00:27:19,190 --> 00:27:16,960

see near this near or on the surface

770

00:27:21,590 --> 00:27:19,200

either was excavated delivered or

771

00:27:23,669 --> 00:27:21,600

migrated from low latitudes and got cold

772

00:27:25,350 --> 00:27:23,679

trap

773

00:27:27,909 --> 00:27:25,360

thank you we have time for one more

774

00:27:32,870 --> 00:27:27,919

question from social media or media here

775

00:27:32,880 --> 00:27:36,230

oh man

776

00:27:41,590 --> 00:27:38,389

if jim green can answer ask a question i

777

00:27:43,830 --> 00:27:41,600

guess i can too uh of course the apollo

778

00:27:45,750 --> 00:27:43,840

astronauts left lunar

779

00:27:47,110 --> 00:27:45,760

uh corner cubes

780

00:27:48,389 --> 00:27:47,120

reflectors on the surface of the moon

781

00:27:49,830 --> 00:27:48,399

and we've been pinging them with lasers

782

00:27:52,710 --> 00:27:49,840

for years to measure the earth moon

783

00:27:55,990 --> 00:27:54,230

the laser common principle also has

784

00:27:58,070 --> 00:27:56,000

arranged an instrument how much more

785

00:27:59,750 --> 00:27:58,080

accurate now of course ladies in orbit

786

00:28:02,149 --> 00:27:59,760

how much more accurate will the laser

787

00:28:04,149 --> 00:28:02,159

come give us a measurement of distance

788

00:28:08,149 --> 00:28:04,159

to at least lady

789

00:28:09,430 --> 00:28:08,159

then than the lunar reflectors

790

00:28:10,389 --> 00:28:09,440

well we're really good at measuring

791

00:28:12,310 --> 00:28:10,399

relative

792

00:28:14,070 --> 00:28:12,320

changes in the distance along the path

793

00:28:15,669 --> 00:28:14,080

and and we're working with some of the

794

00:28:18,070 --> 00:28:15,679

science folks

795

00:28:20,230 --> 00:28:18,080

at nasa to see if we can turn that into

796

00:28:21,909 --> 00:28:20,240

absolute range measurements but we know

797

00:28:23,990 --> 00:28:21,919

we can measure relative changes down to

798

00:28:26,389 --> 00:28:24,000

the centimeters and with a lot of

799

00:28:28,470 --> 00:28:26,399

averaging uh the variations in maybe

800

00:28:29,669 --> 00:28:28,480

microns per second even as what's been

801
00:28:31,110 --> 00:28:29,679
discussed

802
00:28:32,389 --> 00:28:31,120
so uh

803
00:28:33,510 --> 00:28:32,399
there are a lot of variables when you're

804
00:28:34,950 --> 00:28:33,520
actually doing the ranging you have to

805
00:28:36,710 --> 00:28:34,960
account for the atmosphere and what that

806
00:28:38,950 --> 00:28:36,720
does because sometimes the path like

807
00:28:41,350 --> 00:28:38,960
changes there and and so uh

808
00:28:43,029 --> 00:28:41,360
but as i said we're working with them to

809
00:28:44,470 --> 00:28:43,039
see what we can back out to be able to

810
00:28:49,110 --> 00:28:44,480
get absolute range measurements but

811
00:28:53,269 --> 00:28:51,029
we have time for one more question from

812
00:28:54,950 --> 00:28:53,279
a member of the social media team from

813
00:28:59,909 --> 00:28:54,960

headquarters news media here in the

814

00:29:04,789 --> 00:29:02,310

hi i'm miriam kramer i'm with space.com

815

00:29:05,990 --> 00:29:04,799

uh and i was just wondering

816

00:29:08,310 --> 00:29:06,000

uh

817

00:29:10,470 --> 00:29:08,320

are there engineering implications that

818

00:29:12,470 --> 00:29:10,480

could potentially come from the science

819

00:29:13,909 --> 00:29:12,480

of this mission for instance at

820

00:29:17,029 --> 00:29:13,919

something having to do with the lander

821

00:29:19,110 --> 00:29:17,039

or even probes to

822

00:29:28,149 --> 00:29:19,120

various asteroids or

823

00:29:32,070 --> 00:29:29,990

um if you're asking about what the

824

00:29:34,630 --> 00:29:32,080

science instruments can bring

825

00:29:36,950 --> 00:29:34,640

to future exploration well there are

826

00:29:38,230 --> 00:29:36,960

similar problems that other bodies we'd

827

00:29:40,310 --> 00:29:38,240

love to know

828

00:29:42,630 --> 00:29:40,320

whether loft of dust occurs at larger

829

00:29:44,230 --> 00:29:42,640

asteroids whether lofty dust occurs

830

00:29:46,549 --> 00:29:44,240

leaks expect that if it happens at the

831

00:29:48,549 --> 00:29:46,559

moon it happens elsewhere as well

832

00:29:50,389 --> 00:29:48,559

so sending similar instruments to those

833

00:29:51,510 --> 00:29:50,399

bodies will will confirm and further

834

00:29:54,310 --> 00:29:51,520

inform us

835

00:29:56,230 --> 00:29:54,320

uh of that physical process as exotic as

836

00:29:58,789 --> 00:29:56,240

it is

837

00:30:00,310 --> 00:29:58,799

so you can make second use of anything

838

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

that you developed for space flight but

839

00:30:03,510 --> 00:30:01,600

i was wondering if you were going in a

840

00:30:04,470 --> 00:30:03,520

different direction with maybe the reuse

841

00:30:05,909 --> 00:30:04,480

of

842

00:30:11,110 --> 00:30:05,919

the lady

843

00:30:13,909 --> 00:30:13,110

okay all right thank you

844

00:30:16,230 --> 00:30:13,919

okay

845

00:30:18,230 --> 00:30:16,240

i'll stop there then

846

00:30:20,389 --> 00:30:18,240

thank you panel that concludes today's

847

00:30:21,830 --> 00:30:20,399

science briefing about the lady mission

848

00:30:25,590 --> 00:30:21,840

you can learn more about the mission by

849

00:30:27,430 --> 00:30:25,600

visiting us online at nasa.gov lady or

850

00:30:31,110 --> 00:30:27,440

by following the mission on our social

851

00:30:33,510 --> 00:30:31,120

media including twitter at nasaladdy and

852

00:30:35,430 --> 00:30:33,520

tune in tomorrow at 9 30 pm eastern when

853

00:30:36,549 --> 00:30:35,440

nasa tv begins its live mission

854

00:30:39,750 --> 00:30:36,559

broadcast

855

00:30:41,830 --> 00:30:39,760

and launch is scheduled for 11 27 pm