1
00:00:05,269 --> 00:00:01,829
the definition shows a distant

2
00:00:07,590 --> 00:00:05,279
retrograde orbit was to ensure that the

3
00:00:09,110 --> 00:00:07,600
we didn't leave a cloud of debris as

4
00:00:11,669 --> 00:00:09,120
someone mentioned but also it's a very

5
00:00:12,870 --> 00:00:11,679
stable orbit that could allow the rock

6
00:00:14,470 --> 00:00:12,880
to be

7
00:00:15,430 --> 00:00:14,480
in a position where it won't harm

8
00:00:16,950 --> 00:00:15,440
anything

9
00:00:19,510 --> 00:00:16,960
for quite a long time as some

10
00:00:20,870 --> 00:00:19,520
calculation showed as long as 100 years

11
00:00:22,070 --> 00:00:20,880
so i think

12
00:00:24,070 --> 00:00:22,080
it's interesting that people are

13
00:00:25,670 --> 00:00:24,080

thinking about you know what ways can we

14
00:00:28,150 --> 00:00:25,680
use the station and i think there's

15
00:00:29,589 --> 00:00:28,160
other studies that are being pursued to

16
00:00:31,429 --> 00:00:29,599
explore that but for the reference

17
00:00:32,470 --> 00:00:31,439
concept here we didn't explore that

18
00:00:33,830 --> 00:00:32,480
option

19
00:00:35,670 --> 00:00:33,840
very good

20
00:00:37,350 --> 00:00:35,680
another question or comment from the

21
00:00:38,950 --> 00:00:37,360
floor anybody

22
00:00:44,869 --> 00:00:38,960
any anything at all

23
00:00:49,350 --> 00:00:47,029
so i have to write the final report for

24
00:00:51,670 --> 00:00:49,360
this workshop and what i'd really like

25
00:00:54,229 --> 00:00:51,680
to see are some recommendations from

26
00:00:57,350 --> 00:00:54,239
this group not just findings

27
00:01:02,709 --> 00:00:57,360
on future steps and studies

28
00:01:06,789 --> 00:01:05,670
it seems like there's some

29
00:01:08,870 --> 00:01:06,799
potential

30
00:01:11,350 --> 00:01:08,880
strengths of the

31
00:01:12,390 --> 00:01:11,360
expandable or deployable boom concepts

32
00:01:14,149 --> 00:01:12,400
relative to

33
00:01:15,429 --> 00:01:14,159
inflatables

34
00:01:17,510 --> 00:01:15,439
so

35
00:01:18,789 --> 00:01:17,520
you know they might have less weight

36
00:01:20,789 --> 00:01:18,799
because you don't have an inflation

37
00:01:23,270 --> 00:01:20,799
system they might have better

38
00:01:24,830 --> 00:01:23,280

spin dynamics we really need to

39
00:01:28,070 --> 00:01:24,840
investigate that so

40
00:01:31,030 --> 00:01:28,080
one potential recommendation would be to

41
00:01:33,830 --> 00:01:31,040
do some comparative studies of

42
00:01:36,310 --> 00:01:33,840
deplorable boom concepts versus the

43
00:01:38,149 --> 00:01:36,320
inflatable concepts

44
00:01:39,350 --> 00:01:38,159
and

45
00:01:41,510 --> 00:01:39,360
the other

46
00:01:45,270 --> 00:01:41,520
thought was that the

47
00:01:47,510 --> 00:01:45,280
yo-yo d-span could be used

48
00:01:49,429 --> 00:01:47,520
with the

49
00:01:50,550 --> 00:01:49,439
mothership

50
00:01:51,590 --> 00:01:50,560
like

51
00:01:53,190 --> 00:01:51,600
the

52
00:01:55,429 --> 00:01:53,200
reference concept that brian shared at

53
00:01:56,630 --> 00:01:55,439
the beginning we've already captured

54
00:01:57,670 --> 00:01:56,640
asteroid

55
00:01:59,830 --> 00:01:57,680
and

56
00:02:04,149 --> 00:01:59,840
spacecraft goes to these

57
00:02:10,070 --> 00:02:07,749
maneuvers and so maybe we just deploy a

58
00:02:11,990 --> 00:02:10,080
cubesat off the back of the mothership

59
00:02:13,670 --> 00:02:12,000
mothership and

60
00:02:15,990 --> 00:02:13,680
that would reduce some of the burden on

61
00:02:17,750 --> 00:02:16,000
the rcs

62
00:02:19,589 --> 00:02:17,760
i don't know if it trades from a mass

63
00:02:22,070 --> 00:02:19,599

standpoint no you're saving propellant

64
00:02:23,510 --> 00:02:22,080
versus a cubesat but we should look into

65
00:02:25,750 --> 00:02:23,520
that

66
00:02:29,430 --> 00:02:27,510
we looked at yoyos for uh for

67
00:02:31,670 --> 00:02:29,440
de-spinning because we are

68
00:02:33,830 --> 00:02:31,680
planning to use you know up to about 200

69
00:02:36,790 --> 00:02:33,840
kilos of rcs propellant to do this job

70
00:02:39,670 --> 00:02:36,800
and so that's not a trivial amount

71
00:02:41,430 --> 00:02:39,680
the concern we had was that the the yoyo

72
00:02:43,589 --> 00:02:41,440
could get tangled in the solar panels

73
00:02:44,949 --> 00:02:43,599
and things like that solar array

74
00:02:46,710 --> 00:02:44,959
booms

75
00:02:48,550 --> 00:02:46,720
and so

76
00:02:51,030 --> 00:02:48,560
if you consider all the possible spin

77
00:02:53,270 --> 00:02:51,040
states

78
00:02:55,750 --> 00:02:53,280
it's not obvious that there's any place

79
00:02:58,149 --> 00:02:55,760
you can put a yoyo that doesn't risk

80
00:03:00,229 --> 00:02:58,159
entanglement and so that was why we

81
00:03:02,309 --> 00:03:00,239
decided because there definitely is a

82
00:03:05,270 --> 00:03:02,319
mass advantage you could get down to you

83
00:03:09,430 --> 00:03:05,280
know five or six kilos of yoyo

84
00:03:10,229 --> 00:03:09,440
to do this job with kilometers of tether

85
00:03:13,030 --> 00:03:10,239
but

86
00:03:16,229 --> 00:03:13,040
we could not see a way

87
00:03:18,309 --> 00:03:16,239
that in all the pathological spin states

88
00:03:24,070 --> 00:03:18,319

that you wouldn't risk entangling the

89
00:03:27,430 --> 00:03:25,270
well

90
00:03:29,030 --> 00:03:27,440
you know um our you know our driver the

91
00:03:31,509 --> 00:03:29,040
que the question that

92
00:03:33,589 --> 00:03:31,519
beau asks is is what about you know

93
00:03:35,270 --> 00:03:33,599
leaving and pulling back and just

94
00:03:37,750 --> 00:03:35,280
leaving the yoyo and

95
00:03:40,309 --> 00:03:37,760
the concern we had is is the separable

96
00:03:42,789 --> 00:03:40,319
spacecraft cost and so because our

97
00:03:45,350 --> 00:03:42,799
charter was to minimize the cost of this

98
00:03:49,910 --> 00:03:47,830
we elected not to

99
00:03:51,830 --> 00:03:49,920
study in any detail

100
00:03:53,270 --> 00:03:51,840
any of the concepts that had a separable

101
00:03:54,789 --> 00:03:53,280
spacecraft

102
00:03:56,630 --> 00:03:54,799
certainly you can imagine a separable

103
00:03:57,509 --> 00:03:56,640
spacecraft that doesn't have solar array

104
00:03:59,670 --> 00:03:57,519
booms

105
00:04:02,229 --> 00:03:59,680
are certainly not large ones

106
00:04:04,229 --> 00:04:02,239
that that goes up and and does something

107
00:04:05,030 --> 00:04:04,239
but the you know most people when they

108
00:04:07,509 --> 00:04:05,040
hear

109
00:04:09,350 --> 00:04:07,519
a second spacecraft the cash register

110
00:04:12,550 --> 00:04:09,360
rings you know some large number of

111
00:04:15,030 --> 00:04:12,560
millions of dollars and uh and and

112
00:04:16,949 --> 00:04:15,040
whether that's true or not that's the

113
00:04:18,949 --> 00:04:16,959

environment we live in and that's what

114
00:04:21,749 --> 00:04:18,959
you know reviewers are going to think

115
00:04:23,670 --> 00:04:21,759
and so we did not put any effort into

116
00:04:26,150 --> 00:04:23,680
studying that

117
00:04:27,270 --> 00:04:26,160
so just two more thoughts um

118
00:04:29,670 --> 00:04:27,280
one

119
00:04:32,230 --> 00:04:29,680
should we look at retractable solar rays

120
00:04:34,070 --> 00:04:32,240
so we don't have to worry so much about

121
00:04:36,310 --> 00:04:34,080
breaking them

122
00:04:39,510 --> 00:04:36,320
we do have some concepts for large solar

123
00:04:41,749 --> 00:04:39,520
rays that can be retracted and extended

124
00:04:43,590 --> 00:04:41,759
so we need to trade off the risk of that

125
00:04:45,189 --> 00:04:43,600
versus

126
00:04:48,710 --> 00:04:45,199
you know the

127
00:04:49,510 --> 00:04:48,720
lower loads on a retracted array

128
00:04:51,749 --> 00:04:49,520
and

129
00:04:55,189 --> 00:04:51,759
finally i thought

130
00:05:00,870 --> 00:04:58,150
point and we really need to look at this

131
00:05:03,510 --> 00:05:00,880
other mission scenario where we pluck a

132
00:05:05,830 --> 00:05:03,520
boulder off the surface and most of our

133
00:05:07,909 --> 00:05:05,840
capture system concepts are

134
00:05:09,189 --> 00:05:07,919
for capturing the whole asteroid but we

135
00:05:11,830 --> 00:05:09,199
don't really have

136
00:05:13,590 --> 00:05:11,840
a lot of good ideas yet on how to

137
00:05:14,710 --> 00:05:13,600
pluck a rock off the surface other than

138
00:05:15,830 --> 00:05:14,720

the one that

139
00:05:17,670 --> 00:05:15,840
ryan showed

140
00:05:23,029 --> 00:05:17,680
so

141
00:05:24,790 --> 00:05:23,039
ideas i think those are those are good

142
00:05:27,670 --> 00:05:24,800
inputs because um

143
00:05:29,990 --> 00:05:27,680
one of the challenges i think the agency

144
00:05:32,230 --> 00:05:30,000
uh sees is we've we've done a certain

145
00:05:33,510 --> 00:05:32,240
amount of analysis on our own but we'd

146
00:05:35,670 --> 00:05:33,520
also

147
00:05:36,790 --> 00:05:35,680
this whole workshop has been intended to

148
00:05:39,430 --> 00:05:36,800
solicit

149
00:05:42,150 --> 00:05:39,440
ideas and concepts from industry and

150
00:05:43,909 --> 00:05:42,160
academia and the general public so every

151
00:05:45,990 --> 00:05:43,919
every idea that you're bringing forward

152
00:05:47,990 --> 00:05:46,000
i'm i'm writing it down and gonna try

153
00:05:51,270 --> 00:05:48,000
and synthesize it together and i've

154
00:05:53,029 --> 00:05:51,280
worked with chris closely uh before on a

155
00:05:55,430 --> 00:05:53,039
number of ideas and concepts so we're

156
00:05:56,550 --> 00:05:55,440
trying to capture everything that we can

157
00:05:59,830 --> 00:05:56,560
to bring

158
00:06:01,670 --> 00:05:59,840
more informed um analysis and decision

159
00:06:03,430 --> 00:06:01,680
making by the by the agency so we

160
00:06:05,430 --> 00:06:03,440
appreciate everyone everything you all

161
00:06:07,189 --> 00:06:05,440
are bringing forward next comment i'd

162
00:06:09,110 --> 00:06:07,199
like to speak to the number of the

163
00:06:11,350 --> 00:06:09,120

comments that were just made one about

164
00:06:13,510 --> 00:06:11,360
retracting solar arrays

165
00:06:15,670 --> 00:06:13,520
uh already in in industry one of the

166
00:06:18,309 --> 00:06:15,680
things we sometimes do if there's a

167
00:06:20,870 --> 00:06:18,319
leonid swarm or meteorites approaching

168
00:06:23,350 --> 00:06:20,880
we feather the arrays to

169
00:06:25,110 --> 00:06:23,360
prevent present a minimum surface area

170
00:06:27,270 --> 00:06:25,120
towards the on towards the radiant to

171
00:06:29,110 --> 00:06:27,280
the meteor stream so there is a little

172
00:06:31,189 --> 00:06:29,120
bit of heritage in that direction

173
00:06:33,590 --> 00:06:31,199
already but the next thing one might

174
00:06:36,070 --> 00:06:33,600
think about is to have a sort of hinge

175
00:06:38,230 --> 00:06:36,080
mount underneath where the sata is and

176
00:06:39,029 --> 00:06:38,240
just hinge the solar array out of the

177
00:06:41,270 --> 00:06:39,039
way

178
00:06:43,670 --> 00:06:41,280
and then the solar the sata might not be

179
00:06:45,830 --> 00:06:43,680
able to be operable and it would rotate

180
00:06:48,150 --> 00:06:45,840
to a desired position and then be hinged

181
00:06:50,070 --> 00:06:48,160
out of the way and you wouldn't operate

182
00:06:52,629 --> 00:06:50,080
the sata anymore until you hinged it

183
00:06:53,589 --> 00:06:52,639
back that would be one way to approach

184
00:06:54,469 --> 00:06:53,599
that

185
00:07:00,870 --> 00:06:54,479
the

186
00:07:02,390 --> 00:07:00,880
i perceive a desire not to cause any

187
00:07:03,430 --> 00:07:02,400
structural deformation

188
00:07:06,230 --> 00:07:03,440

or

189
00:07:08,629 --> 00:07:06,240
change physical change to the

190
00:07:09,909 --> 00:07:08,639
asteroid that we're trying to capture

191
00:07:11,510 --> 00:07:09,919
but

192
00:07:13,430 --> 00:07:11,520
this is sort of a mirror image of the

193
00:07:16,390 --> 00:07:13,440
notion of pick up a rock what you might

194
00:07:17,830 --> 00:07:16,400
say is we've got this irregular

195
00:07:19,589 --> 00:07:17,840
object we're going to we're trying to

196
00:07:22,070 --> 00:07:19,599
capture here and it's got undesirable

197
00:07:24,950 --> 00:07:22,080
spin on it maybe what we need to do is

198
00:07:27,510 --> 00:07:24,960
to give it a shave

199
00:07:28,230 --> 00:07:27,520
as a somebody who wears a beard i can i

200
00:07:31,430 --> 00:07:28,240
can

201
00:07:34,150 --> 00:07:31,440
see this point um give it a shave before

202
00:07:36,469 --> 00:07:34,160
you uh before you bring it home

203
00:07:39,110 --> 00:07:36,479
it needs a little cleanup and we'd like

204
00:07:41,350 --> 00:07:39,120
to bring it home pristine but the way we

205
00:07:43,510 --> 00:07:41,360
found it but we'll take good pictures of

206
00:07:45,749 --> 00:07:43,520
it and and uh then we're gonna we're

207
00:07:49,110 --> 00:07:45,759
gonna cut this irregular piece off maybe

208
00:07:52,230 --> 00:07:49,120
with a robot arm hitting it and maybe by

209
00:07:54,150 --> 00:07:52,240
doing that we also change its its mass

210
00:07:55,670 --> 00:07:54,160
properties that's one of the things in

211
00:07:56,950 --> 00:07:55,680
commercial spacecraft we concern

212
00:07:59,189 --> 00:07:56,960
ourselves with a lot of the mass

213
00:08:01,909 --> 00:07:59,199

properties of the object if you

214
00:08:04,230 --> 00:08:01,919
gave it a shave it would then be

215
00:08:07,270 --> 00:08:04,240
all set up maybe for a

216
00:08:09,510 --> 00:08:07,280
more benign d spin

217
00:08:10,950 --> 00:08:09,520
all right thank you

218
00:08:13,029 --> 00:08:10,960
marshall

219
00:08:13,749 --> 00:08:13,039
so and following up on what he said i

220
00:08:16,070 --> 00:08:13,759
think

221
00:08:19,110 --> 00:08:16,080
one thing that this group might sort of

222
00:08:21,830 --> 00:08:19,120
convey back upstream is

223
00:08:24,790 --> 00:08:21,840
that the object will in fact be changed

224
00:08:26,309 --> 00:08:24,800
how it would be changed is unclear

225
00:08:27,990 --> 00:08:26,319
you know you can say well we'll try not

226
00:08:29,749 --> 00:08:28,000
to modify it or whatever we don't really

227
00:08:31,589 --> 00:08:29,759
know we might touch it and it falls into

228
00:08:33,110 --> 00:08:31,599
pieces you don't know

229
00:08:35,269 --> 00:08:33,120
and so

230
00:08:37,750 --> 00:08:35,279
a question relay upstream is is there

231
00:08:40,070 --> 00:08:37,760
anything that we need to measure before

232
00:08:40,870 --> 00:08:40,080
we touch it

233
00:08:42,709 --> 00:08:40,880
you know

234
00:08:44,389 --> 00:08:42,719
he just mentioned taking pictures well

235
00:08:46,470 --> 00:08:44,399
is that is that one of the goals do you

236
00:08:47,350 --> 00:08:46,480
have to take pictures from all sides

237
00:08:49,670 --> 00:08:47,360
you know

238
00:08:51,269 --> 00:08:49,680

and so on i mean

239
00:08:52,790 --> 00:08:51,279
i i think really the thing that this

240
00:08:54,949 --> 00:08:52,800
group could do is just sort of raise

241
00:08:56,310 --> 00:08:54,959
that flag and just say hey you know

242
00:08:58,310 --> 00:08:56,320
things are going to be changed and don't

243
00:08:59,350 --> 00:08:58,320
come to us afterwards and say oh but now

244
00:09:00,949 --> 00:08:59,360
we can't

245
00:09:02,470 --> 00:09:00,959
right you know

246
00:09:04,470 --> 00:09:02,480
now we can't determine this because

247
00:09:06,550 --> 00:09:04,480
you've mucked with the surface so one of

248
00:09:08,550 --> 00:09:06,560
the things we've done in some of the

249
00:09:10,470 --> 00:09:08,560
studies over the spring and summer is

250
00:09:12,470 --> 00:09:10,480
try to engage the

251
00:09:13,750 --> 00:09:12,480
planetary science community to

252
00:09:16,150 --> 00:09:13,760
understand what

253
00:09:18,630 --> 00:09:16,160
characteristics they want to be able to

254
00:09:19,990 --> 00:09:18,640
explore and understand so your input is

255
00:09:21,670 --> 00:09:20,000
right in line with some of the things

256
00:09:23,430 --> 00:09:21,680
they've been talking about yeah i mean

257
00:09:24,870 --> 00:09:23,440
not even in a sort of bigger picture you

258
00:09:26,550 --> 00:09:24,880
might even consider going to the lunar

259
00:09:28,470 --> 00:09:26,560
planetary science conference it's coming

260
00:09:30,470 --> 00:09:28,480
up or whatever and giving a presentation

261
00:09:31,990 --> 00:09:30,480
on that and saying you know what what

262
00:09:34,070 --> 00:09:32,000
should we be thinking about what's

263
00:09:35,110 --> 00:09:34,080

what's important here very good thank

264
00:09:37,670 --> 00:09:35,120
you

265
00:09:39,990 --> 00:09:37,680
next commenter

266
00:09:42,070 --> 00:09:40,000
yeah so my comment is uh to chris's

267
00:09:44,550 --> 00:09:42,080
point about uh

268
00:09:46,630 --> 00:09:44,560
this alternative uh mission concept to

269
00:09:49,110 --> 00:09:46,640
grab a boulder off the surface and it

270
00:09:51,030 --> 00:09:49,120
and it relates to the concept that brian

271
00:09:52,710 --> 00:09:51,040
muir had presented as well

272
00:09:55,110 --> 00:09:52,720
i think it would be at a high level

273
00:09:56,710 --> 00:09:55,120
useful to think about these concepts

274
00:09:57,829 --> 00:09:56,720
that were presented today for that

275
00:09:59,030 --> 00:09:57,839
alternate

276
00:10:01,269 --> 00:09:59,040
um

277
00:10:03,670 --> 00:10:01,279
approach but i would put out a strong

278
00:10:05,590 --> 00:10:03,680
word of caution that the constraints are

279
00:10:08,389 --> 00:10:05,600
very different if you're capturing an

280
00:10:10,310 --> 00:10:08,399
object that's in free space

281
00:10:11,750 --> 00:10:10,320
you have a lot of flexibility whereas if

282
00:10:14,310 --> 00:10:11,760
you're capturing an object that's

283
00:10:15,750 --> 00:10:14,320
fixtured to something else

284
00:10:17,910 --> 00:10:15,760
you're going to want a different kind of

285
00:10:19,750 --> 00:10:17,920
system specifically you can't have

286
00:10:22,230 --> 00:10:19,760
isotropic compliance because that

287
00:10:23,990 --> 00:10:22,240
boulder is going to be

288
00:10:25,350 --> 00:10:24,000

potentially much more massive than your

289
00:10:28,470 --> 00:10:25,360
spacecraft so if you're slightly

290
00:10:30,710 --> 00:10:28,480
misaligned or if the boulder is bulging

291
00:10:32,470 --> 00:10:30,720
on one side you're going to make contact

292
00:10:34,550 --> 00:10:32,480
with that first that's going to impart

293
00:10:36,790 --> 00:10:34,560
loads to your spacecraft

294
00:10:38,389 --> 00:10:36,800
that are going to cause you to tip over

295
00:10:40,550 --> 00:10:38,399
so you know the work dan is doing is

296
00:10:43,110 --> 00:10:40,560
going to tell us how well that boulder

297
00:10:44,710 --> 00:10:43,120
may be fixtured to the surface

298
00:10:47,350 --> 00:10:44,720
but if you look at you know the field of

299
00:10:49,190 --> 00:10:47,360
robotic manipulation uh they'll tell you

300
00:10:51,750 --> 00:10:49,200
it's a it's a very different problem to

301
00:10:54,069 --> 00:10:51,760
pick up a ball on a table than it is to

302
00:10:56,870 --> 00:10:54,079
grab a ball shaped doorknob that's

303
00:10:58,949 --> 00:10:56,880
fixtured to something um so you need to

304
00:11:00,790 --> 00:10:58,959
consider that when we look at extending

305
00:11:04,550 --> 00:11:00,800
the concepts

306
00:11:10,310 --> 00:11:06,069
next comment do we have anything more

307
00:11:13,190 --> 00:11:11,829
you've asked a lot of questions today

308
00:11:16,230 --> 00:11:13,200
you look like you're primed to ask a

309
00:11:18,389 --> 00:11:16,240
question or make a comment it was

310
00:11:19,910 --> 00:11:18,399
as far as the tethers the tethers go

311
00:11:23,110 --> 00:11:19,920
would it be possible to use the

312
00:11:24,069 --> 00:11:23,120
spacecraft itself as the yoyo and you

313
00:11:26,069 --> 00:11:24,079

know

314
00:11:26,949 --> 00:11:26,079
pull it away and keep it tethered and

315
00:11:28,389 --> 00:11:26,959
then

316
00:11:30,230 --> 00:11:28,399
not only would you not have to worry

317
00:11:32,069 --> 00:11:30,240
about anything getting entangled in in

318
00:11:34,069 --> 00:11:32,079
solar arrays or things but you'd also

319
00:11:35,430 --> 00:11:34,079
increase your lever arm which i would

320
00:11:37,590 --> 00:11:35,440
think would make

321
00:11:40,550 --> 00:11:37,600
would allow you to use less

322
00:11:42,470 --> 00:11:40,560
uh propellant in trying to de-spin

323
00:11:45,670 --> 00:11:42,480
and brian do you have anything to say

324
00:11:50,069 --> 00:11:47,910
uh we did not explicitly consider that

325
00:11:52,230 --> 00:11:50,079
but um certainly that could be done and

326
00:11:54,870 --> 00:11:52,240
you probably would reduce your uh

327
00:11:58,629 --> 00:11:54,880
propellant significantly by doing that

328
00:12:00,230 --> 00:11:58,639
um but once we were down in the 200 kilo

329
00:12:02,870 --> 00:12:00,240
considering that we're carrying 10 tons

330
00:12:04,870 --> 00:12:02,880
of xenon uh we felt that you know that

331
00:12:08,629 --> 00:12:04,880
just the added complexity

332
00:12:11,110 --> 00:12:08,639
um would you know would not be a good

333
00:12:13,110 --> 00:12:11,120
yeah it's it's a it's a lesser version

334
00:12:15,590 --> 00:12:13,120
of the of the separable spacecraft

335
00:12:17,269 --> 00:12:15,600
argument basically that means that the

336
00:12:19,190 --> 00:12:17,279
the whole s

337
00:12:22,310 --> 00:12:19,200
um

338
00:12:24,550 --> 00:12:22,320

uh system that captures the whole

339
00:12:25,750 --> 00:12:24,560
capture mechanism

340
00:12:26,629 --> 00:12:25,760
has to be

341
00:12:29,350 --> 00:12:26,639
uh

342
00:12:32,069 --> 00:12:29,360
releasable which we already have

343
00:12:34,150 --> 00:12:32,079
because if if we decide you know later

344
00:12:35,990 --> 00:12:34,160
when the astronauts are deploying it if

345
00:12:37,190 --> 00:12:36,000
we decide we want to use the system for

346
00:12:38,389 --> 00:12:37,200
something else

347
00:12:41,030 --> 00:12:38,399
we already have

348
00:12:43,350 --> 00:12:41,040
set nuts and so on that can they can pop

349
00:12:44,790 --> 00:12:43,360
off the whole capture system but then

350
00:12:46,870 --> 00:12:44,800
you have a requirement that you'll be

351
00:12:49,350 --> 00:12:46,880
able to reel it back in on the tether

352
00:12:51,509 --> 00:12:49,360
and reconnect re-dock with it and so

353
00:12:52,870 --> 00:12:51,519
that's a whole new set of requirements

354
00:12:55,190 --> 00:12:52,880
and hardware

355
00:12:57,990 --> 00:12:55,200
that we felt was just going to add you

356
00:13:00,310 --> 00:12:58,000
know the the 200 kilos of rcs propellant

357
00:13:01,190 --> 00:13:00,320
seemed like you know it was small enough

358
00:13:08,629 --> 00:13:01,200
to

359
00:13:10,870 --> 00:13:08,639
re-dock with this capture mechanism

360
00:13:12,710 --> 00:13:10,880
all right mr enriquez

361
00:13:14,710 --> 00:13:12,720
yeah i just wanted to uh bring up the

362
00:13:15,829 --> 00:13:14,720
point uh we really didn't discuss in

363
00:13:17,030 --> 00:13:15,839

detail

364
00:13:19,670 --> 00:13:17,040
if you could move a little closer to the

365
00:13:21,590 --> 00:13:19,680
mic sure we didn't discuss in detail the

366
00:13:24,069 --> 00:13:21,600
transition between

367
00:13:26,389 --> 00:13:24,079
uh what what we consider the soft

368
00:13:28,310 --> 00:13:26,399
capture phase or when we're trying to

369
00:13:30,150 --> 00:13:28,320
attach ourselves to the asteroid and

370
00:13:32,230 --> 00:13:30,160
what we call the final hard capture

371
00:13:34,790 --> 00:13:32,240
phase i believe that that's one of the

372
00:13:36,870 --> 00:13:34,800
areas that we need to be look

373
00:13:38,150 --> 00:13:36,880
needs to be looked into more

374
00:13:40,870 --> 00:13:38,160
in detail

375
00:13:42,870 --> 00:13:40,880
since we know that that transition is

376
00:13:44,069 --> 00:13:42,880
going to give rise to loads that can be

377
00:13:46,069 --> 00:13:44,079
imported

378
00:13:48,389 --> 00:13:46,079
either to the capture

379
00:13:50,230 --> 00:13:48,399
system or to the spacecraft

380
00:13:51,990 --> 00:13:50,240
and so that area

381
00:13:53,110 --> 00:13:52,000
which always uh

382
00:13:55,590 --> 00:13:53,120
gave us

383
00:13:57,350 --> 00:13:55,600
in our design of attachment systems for

384
00:13:58,870 --> 00:13:57,360
the space station uh

385
00:13:59,990 --> 00:13:58,880
was the challenge

386
00:14:01,590 --> 00:14:00,000
and so

387
00:14:04,389 --> 00:14:01,600
we still have the challenge here

388
00:14:06,069 --> 00:14:04,399

particularly now that the asteroid is

389
00:14:08,470 --> 00:14:06,079
rotating so

390
00:14:10,069 --> 00:14:08,480
i wanted to bring that up as an area

391
00:14:11,509 --> 00:14:10,079
that really needs to be looked into more

392
00:14:15,110 --> 00:14:11,519
closely

393
00:14:19,910 --> 00:14:17,590
any other thoughts or questions we we

394
00:14:21,350 --> 00:14:19,920
got plenty of time but i know that some

395
00:14:22,629 --> 00:14:21,360
people may want to go to lunch so we

396
00:14:25,590 --> 00:14:22,639
don't want to

397
00:14:28,949 --> 00:14:25,600
unduly restrain you

398
00:14:31,110 --> 00:14:28,959
i wanted to say again that we've

399
00:14:33,590 --> 00:14:31,120
the agency again is has

400
00:14:36,150 --> 00:14:33,600
been seeking outside input uh this is

401
00:14:38,629 --> 00:14:36,160
one mechanism but there are other ways

402
00:14:40,389 --> 00:14:38,639
that the agency explores or there are

403
00:14:43,030 --> 00:14:40,399
different advisory bodies and then

404
00:14:44,629 --> 00:14:43,040
consultations with uh with partners all

405
00:14:46,150 --> 00:14:44,639
around so

406
00:14:47,590 --> 00:14:46,160
don't feel like this is the only

407
00:14:49,990 --> 00:14:47,600
opportunity

408
00:14:50,949 --> 00:14:50,000
to provide some inputs to nasa and i

409
00:14:53,269 --> 00:14:50,959
think

410
00:14:56,629 --> 00:14:53,279
through the website and some of the

411
00:14:58,710 --> 00:14:56,639
other mechanisms we've definitely got

412
00:15:00,150 --> 00:14:58,720
opportunities there and then the agency

413
00:15:01,269 --> 00:15:00,160

is going to continue to do its

414
00:15:04,790 --> 00:15:01,279
formulation

415
00:15:06,629 --> 00:15:04,800
work and explore not just this

416
00:15:10,230 --> 00:15:06,639
area of capture systems but all of the

417
00:15:12,230 --> 00:15:10,240
dimensions of the of the mission as was

418
00:15:13,670 --> 00:15:12,240
stated and defined in the rfi and then

419
00:15:16,389 --> 00:15:13,680
of course brian muir heads talked about

420
00:15:18,470 --> 00:15:16,399
the alternate mission concept which

421
00:15:20,790 --> 00:15:18,480
wasn't we didn't solicit any solicit

422
00:15:23,590 --> 00:15:20,800
inputs via the rfi so there's other

423
00:15:25,750 --> 00:15:23,600
activities that may uh guide and

424
00:15:27,430 --> 00:15:25,760
influence the work that we're doing here

425
00:15:29,269 --> 00:15:27,440
today

426
00:15:30,870 --> 00:15:29,279
anything more from the online

427
00:15:32,629 --> 00:15:30,880
pedro

428
00:15:35,350 --> 00:15:32,639
questions now on twitter

429
00:15:36,870 --> 00:15:35,360
and there's a question for

430
00:15:38,150 --> 00:15:36,880
let's see

431
00:15:38,949 --> 00:15:38,160
herald

432
00:15:41,110 --> 00:15:38,959
on

433
00:15:43,590 --> 00:15:41,120
can the asteroid regolith be used to

434
00:15:45,829 --> 00:15:43,600
augment the end mast for very large

435
00:15:47,350 --> 00:15:45,839
asteroids basically gather mass like a

436
00:15:49,430 --> 00:15:47,360
starfish

437
00:15:52,310 --> 00:15:49,440
a similar question on

438
00:15:54,629 --> 00:15:52,320

for jeff could cubesat eat some regular

439
00:15:56,550 --> 00:15:54,639
regolith and store in a small ballast

440
00:15:59,030 --> 00:15:56,560
bag prior to deploying the tether

441
00:16:01,350 --> 00:15:59,040
basically augmenting your end mass okay

442
00:16:03,110 --> 00:16:01,360
howard if you could go first

443
00:16:06,069 --> 00:16:03,120
oh i just had a comment that there's a

444
00:16:07,509 --> 00:16:06,079
huge need for an ep tug in the earth

445
00:16:09,910 --> 00:16:07,519
earth moon system

446
00:16:11,910 --> 00:16:09,920
uh beyond nasa and so it's very possible

447
00:16:12,790 --> 00:16:11,920
to get other mission partners who could

448
00:16:15,269 --> 00:16:12,800
uh

449
00:16:17,269 --> 00:16:15,279
contribute funding for that capability

450
00:16:19,430 --> 00:16:17,279
there is an issue of mission control so

451
00:16:21,509 --> 00:16:19,440
it has to be you know carefully crafted

452
00:16:23,670 --> 00:16:21,519
so that this mission isn't impacted but

453
00:16:25,189 --> 00:16:23,680
uh this would have a lot of utility to

454
00:16:27,430 --> 00:16:25,199
those other areas

455
00:16:29,269 --> 00:16:27,440
okay so the question that someone online

456
00:16:31,350 --> 00:16:29,279
had a question for you and that that's

457
00:16:33,430 --> 00:16:31,360
yes sorry so thinking about my question

458
00:16:35,269 --> 00:16:33,440
that's fine say the part about for

459
00:16:39,030 --> 00:16:35,279
howard again sorry about that real quick

460
00:16:41,189 --> 00:16:39,040
pedro uh sure okay so it says uh would

461
00:16:43,590 --> 00:16:41,199
tether capture hold on can astro

462
00:16:47,110 --> 00:16:43,600
regulate be used to augment the end math

463
00:16:47,990 --> 00:16:47,120

for very large very large asteroids

464
00:16:48,949 --> 00:16:48,000
so

465
00:16:50,790 --> 00:16:48,959
let's see

466
00:16:54,069 --> 00:16:50,800
others at jpl might want to comment on

467
00:16:54,949 --> 00:16:54,079
that they're the isru kind of gurus but

468
00:16:57,509 --> 00:16:54,959
um

469
00:17:00,069 --> 00:16:57,519
that would be a whole development beyond

470
00:17:02,310 --> 00:17:00,079
this so eventually that's a goal i

471
00:17:04,230 --> 00:17:02,320
believe of this mission is to understand

472
00:17:06,789 --> 00:17:04,240
the asteroids enough that that could be

473
00:17:09,189 --> 00:17:06,799
done to put that level of risk into this

474
00:17:10,789 --> 00:17:09,199
mission would be um

475
00:17:12,870 --> 00:17:10,799
would probably

476
00:17:14,710 --> 00:17:12,880
put too much on this one mission okay

477
00:17:15,669 --> 00:17:14,720
and then we had a question i think for

478
00:17:18,390 --> 00:17:15,679
jeff

479
00:17:20,309 --> 00:17:18,400
the part on the tether

480
00:17:22,630 --> 00:17:20,319
these two questions are related it says

481
00:17:25,189 --> 00:17:22,640
could cubesat eat some regolith and

482
00:17:27,189 --> 00:17:25,199
store in a small ballast bag prior to

483
00:17:30,150 --> 00:17:27,199
deploying the tether

484
00:17:32,789 --> 00:17:30,160
technically it could um the

485
00:17:34,470 --> 00:17:32,799
d spin i think is the square of the

486
00:17:37,110 --> 00:17:34,480
tether length and the tether weighs

487
00:17:38,789 --> 00:17:37,120
nothing it's basically dental floss so

488
00:17:40,230 --> 00:17:38,799

from a complexity standpoint i don't

489
00:17:41,909 --> 00:17:40,240
think it would be worth it because you

490
00:17:44,830 --> 00:17:41,919
could just add another couple kilometers

491
00:17:46,870 --> 00:17:44,840
of tether if you wanted to at almost no

492
00:17:48,710 --> 00:17:46,880
penalty okay

493
00:17:50,789 --> 00:17:48,720
it looks like we've got a do you have a

494
00:17:55,750 --> 00:17:50,799
comment

495
00:17:59,669 --> 00:17:57,830
yeah i think the uh fella before i

496
00:18:01,909 --> 00:17:59,679
answered it pretty pretty well i mean uh

497
00:18:04,310 --> 00:18:01,919
for the tethers if i mean we're looking

498
00:18:06,789 --> 00:18:04,320
at having a spacecraft you know capture

499
00:18:08,310 --> 00:18:06,799
uh you know the asteroid that would be

500
00:18:09,669 --> 00:18:08,320
mass that you could i mean it's already

501
00:18:10,789 --> 00:18:09,679
connected you know so the added

502
00:18:14,470 --> 00:18:10,799
complexity like the other fella

503
00:18:17,510 --> 00:18:14,480
mentioned is is a lot more difficult

504
00:18:22,950 --> 00:18:20,470
so um if i can maybe do a little recap

505
00:18:25,029 --> 00:18:22,960
just to kind of play back uh some of the

506
00:18:26,950 --> 00:18:25,039
general conversation we've had

507
00:18:28,470 --> 00:18:26,960
in this um

508
00:18:30,789 --> 00:18:28,480
commenting session

509
00:18:33,510 --> 00:18:30,799
um we've got uh

510
00:18:35,990 --> 00:18:33,520
feedback from uh

511
00:18:38,549 --> 00:18:36,000
on trying to understand you know how

512
00:18:40,870 --> 00:18:38,559
much uh impact does the capture have on

513
00:18:43,350 --> 00:18:40,880

the asteroid you know what

514
00:18:45,990 --> 00:18:43,360
provisions should we look at exploring

515
00:18:47,669 --> 00:18:46,000
to address that

516
00:18:49,350 --> 00:18:47,679
we know that there is a variety of

517
00:18:51,590 --> 00:18:49,360
different objects

518
00:18:54,150 --> 00:18:51,600
out there for consideration some of the

519
00:18:57,110 --> 00:18:54,160
early analysis has been on

520
00:18:59,270 --> 00:18:57,120
neos that are not binaries uh and but

521
00:19:01,350 --> 00:18:59,280
there's a whole other session that i

522
00:19:03,029 --> 00:19:01,360
think took place on the first day of the

523
00:19:03,750 --> 00:19:03,039
workshop back in september that looked

524
00:19:08,070 --> 00:19:03,760
at

525
00:19:09,669 --> 00:19:08,080
of the key elements of this entire

526
00:19:12,150 --> 00:19:09,679
initiative is to try and understand and

527
00:19:13,669 --> 00:19:12,160
characterize the asteroid targets that

528
00:19:15,669 --> 00:19:13,679
are being considered so i'm hoping that

529
00:19:17,750 --> 00:19:15,679
that would yield the information that we

530
00:19:19,909 --> 00:19:17,760
would need to address the question about

531
00:19:22,150 --> 00:19:19,919
the potential for a binary that we

532
00:19:23,909 --> 00:19:22,160
didn't didn't realize

533
00:19:26,710 --> 00:19:23,919
i think there's been a lot of discussion

534
00:19:29,270 --> 00:19:26,720
overall about uh how do you

535
00:19:32,470 --> 00:19:29,280
work with a rubble pile or a dirt clod

536
00:19:34,150 --> 00:19:32,480
asteroid so any capture system uh that's

537
00:19:36,070 --> 00:19:34,160
being envisioned is gonna have to have

538
00:19:38,070 --> 00:19:36,080

enough flexibility or robustness to

539
00:19:39,270 --> 00:19:38,080
handle you know range of potential

540
00:19:40,390 --> 00:19:39,280
materials

541
00:19:41,990 --> 00:19:40,400
um

542
00:19:45,830 --> 00:19:42,000
unders

543
00:19:48,789 --> 00:19:45,840
asteroid again i think is going to be a

544
00:19:49,669 --> 00:19:48,799
big part of the observation campaign

545
00:19:51,510 --> 00:19:49,679
um

546
00:19:53,990 --> 00:19:51,520
chris moore brought forward the idea

547
00:19:55,990 --> 00:19:54,000
that we do need to explore

548
00:19:57,669 --> 00:19:56,000
some of these areas in greater depth and

549
00:19:59,110 --> 00:19:57,679
i think we've certainly got a great

550
00:20:01,110 --> 00:19:59,120
starting point

551
00:20:01,830 --> 00:20:01,120
for pursuing that so i'm happy to add

552
00:20:06,390 --> 00:20:01,840
that

553
00:20:07,270 --> 00:20:06,400
be making tomorrow to at least propose

554
00:20:11,430 --> 00:20:07,280
that

555
00:20:16,070 --> 00:20:13,430
i think

556
00:20:17,830 --> 00:20:16,080
those are the those are the main things

557
00:20:20,230 --> 00:20:17,840
obviously we talked more about the yoyo

558
00:20:21,190 --> 00:20:20,240
effect and the tethers scott you had a

559
00:20:23,510 --> 00:20:21,200
comment

560
00:20:25,029 --> 00:20:23,520
about tethers and the changing mass

561
00:20:27,750 --> 00:20:25,039
properties that we would expect in a

562
00:20:30,149 --> 00:20:27,760
rubble pile so say we cast the net or

563
00:20:33,430 --> 00:20:30,159

the bag around it and then start to do

564
00:20:35,590 --> 00:20:33,440
the uh the tethered d spend uh despin

565
00:20:37,029 --> 00:20:35,600
i would presume that the forces in the

566
00:20:39,110 --> 00:20:37,039
bag are going to start changing the

567
00:20:42,470 --> 00:20:39,120
shape of that rubble pile how can the

568
00:20:44,630 --> 00:20:42,480
tether system accommodate for that

569
00:20:51,190 --> 00:20:44,640
who cares after the tether guy okay yeah

570
00:20:55,430 --> 00:20:53,029
i i just like to emphasize for the group

571
00:20:58,070 --> 00:20:55,440
that the forces in all of this are very

572
00:21:00,070 --> 00:20:58,080
small um you know a few a few newtons

573
00:21:01,990 --> 00:21:00,080
you know a one pound of force is enough

574
00:21:03,190 --> 00:21:02,000
to do everything you need to do on this

575
00:21:04,710 --> 00:21:03,200
mission

576
00:21:06,789 --> 00:21:04,720
you don't need

577
00:21:08,870 --> 00:21:06,799
significant forces in

578
00:21:11,430 --> 00:21:08,880
in the terms that most aerospace

579
00:21:13,190 --> 00:21:11,440
engineers you think of large forces so

580
00:21:15,350 --> 00:21:13,200
so we hear people talk about oh you know

581
00:21:16,870 --> 00:21:15,360
it needs to be strong it's what doesn't

582
00:21:18,870 --> 00:21:16,880
really need to be very strong when you

583
00:21:20,149 --> 00:21:18,880
work out the forces you know most of you

584
00:21:21,909 --> 00:21:20,159
probably already done a lot of the back

585
00:21:23,590 --> 00:21:21,919
of the envelope sophomore physics on

586
00:21:26,390 --> 00:21:23,600
this and and if you just you know with

587
00:21:28,149 --> 00:21:26,400
just a little bits of force you can d

588
00:21:31,750 --> 00:21:28,159

spin these things over hours which is

589
00:21:32,789 --> 00:21:31,760
good enough to to solve the problem so

590
00:21:34,390 --> 00:21:32,799
um

591
00:21:35,830 --> 00:21:34,400
more more

592
00:21:37,270 --> 00:21:35,840
key is the

593
00:21:40,230 --> 00:21:37,280
is the point that i tried to make and

594
00:21:42,950 --> 00:21:40,240
that dan shears made um that

595
00:21:45,190 --> 00:21:42,960
that this material could be

596
00:21:48,310 --> 00:21:45,200
way under one psi

597
00:21:50,870 --> 00:21:48,320
compressive and sheer strength and

598
00:21:53,029 --> 00:21:50,880
as a result you know that's why we ended

599
00:21:55,830 --> 00:21:53,039
up with these capture bags

600
00:21:58,950 --> 00:21:55,840
that are inflated to much less than one

601
00:22:00,789 --> 00:21:58,960
psi something comparable to or less than

602
00:22:02,310 --> 00:22:00,799
the the sheer and compressive strength

603
00:22:06,950 --> 00:22:02,320
of the

604
00:22:09,990 --> 00:22:06,960
compress it of course you add strength

605
00:22:11,350 --> 00:22:10,000
so when you confine the thing from all

606
00:22:13,750 --> 00:22:11,360
sides

607
00:22:16,630 --> 00:22:13,760
it'll tend to be more cohesive than it

608
00:22:19,029 --> 00:22:16,640
would just in free space

609
00:22:21,669 --> 00:22:19,039
and but as long as we

610
00:22:24,950 --> 00:22:21,679
see as we inflate the bags we watch the

611
00:22:27,669 --> 00:22:24,960
imu of the spacecraft and if the imu

612
00:22:29,270 --> 00:22:27,679
says the spacecraft is not doing what we

613
00:22:31,669 --> 00:22:29,280

thought it would do for example if the

614
00:22:33,990 --> 00:22:31,679
center of mass is slightly off from

615
00:22:36,310 --> 00:22:34,000
where we thought the center of mass was

616
00:22:38,230 --> 00:22:36,320
we adjust the inflation pressures so

617
00:22:39,750 --> 00:22:38,240
that we don't

618
00:22:41,510 --> 00:22:39,760
number one we don't want to trigger

619
00:22:43,909 --> 00:22:41,520
adverse you know excessive forces on the

620
00:22:45,830 --> 00:22:43,919
spacecraft solar arrays um but number

621
00:22:48,870 --> 00:22:45,840
two we don't you know we want to take

622
00:22:50,789 --> 00:22:48,880
that into account in the future dynamic

623
00:22:52,390 --> 00:22:50,799
you know prediction of where we're going

624
00:22:53,909 --> 00:22:52,400
to be where we're going to fire rcs

625
00:22:56,310 --> 00:22:53,919
thrusters to start de-tumbling and

626
00:22:58,390 --> 00:22:56,320
de-spinning things like that but we have

627
00:23:01,430 --> 00:22:58,400
22 newton thrusters which actually turn

628
00:23:03,990 --> 00:23:01,440
out to be you know large you know

629
00:23:06,950 --> 00:23:04,000
for what we really need to apply

630
00:23:08,789 --> 00:23:06,960
um in terms of the d-spin forces so

631
00:23:10,630 --> 00:23:08,799
we're going to try not to modify the

632
00:23:12,310 --> 00:23:10,640
shape of the

633
00:23:14,870 --> 00:23:12,320
of the asteroid

634
00:23:17,430 --> 00:23:14,880
and the yoyo would be probably have even

635
00:23:20,230 --> 00:23:17,440
less force than you know than the 22

636
00:23:22,630 --> 00:23:20,240
newton rcs thrusters so the once you

637
00:23:24,310 --> 00:23:22,640
start to deploy the yoyo

638
00:23:26,950 --> 00:23:24,320

if you went it did it that way you would

639
00:23:29,669 --> 00:23:26,960
do it slowly so that again over a period

640
00:23:31,029 --> 00:23:29,679
of hours or days you know a day or a

641
00:23:33,270 --> 00:23:31,039
couple of days

642
00:23:35,190 --> 00:23:33,280
you could de-spin the thing easily and

643
00:23:37,990 --> 00:23:35,200
and with just you know one pound of

644
00:23:38,000 --> 00:23:42,310
thanks brian really appreciate that

645
00:23:47,029 --> 00:23:44,230
all right well we're

646
00:23:49,269 --> 00:23:47,039
i think we've done a great job here this

647
00:23:51,590 --> 00:23:49,279
morning of trying to canvas

648
00:23:52,549 --> 00:23:51,600
all of all of you all i think there's a

649
00:23:54,470 --> 00:23:52,559
lot of

650
00:23:56,470 --> 00:23:54,480
areas in which i think different folks

651
00:23:58,470 --> 00:23:56,480
have have brought their in their

652
00:24:00,310 --> 00:23:58,480
expertise and their perspectives

653
00:24:01,750 --> 00:24:00,320
certainly the industry

654
00:24:03,669 --> 00:24:01,760
partners have been

655
00:24:05,029 --> 00:24:03,679
very good in sharing with their flight

656
00:24:06,870 --> 00:24:05,039
experience has been and how they've

657
00:24:07,990 --> 00:24:06,880
applied their technologies to other

658
00:24:09,510 --> 00:24:08,000
domains

659
00:24:12,230 --> 00:24:09,520
we've had some representatives from

660
00:24:14,870 --> 00:24:12,240
academic community sharing with their

661
00:24:16,950 --> 00:24:14,880
experience and then nasa personnel from

662
00:24:18,950 --> 00:24:16,960
the study teams also shared their

663
00:24:21,430 --> 00:24:18,960

experience i think we've got a good

664
00:24:23,750 --> 00:24:21,440
broad cross-section of

665
00:24:26,390 --> 00:24:23,760
folks taking a look at this problem we

666
00:24:28,870 --> 00:24:26,400
really appreciate all of the responses

667
00:24:30,630 --> 00:24:28,880
to the rfi and particularly you all who

668
00:24:33,029 --> 00:24:30,640
are able to join us here

669
00:24:35,269 --> 00:24:33,039
today what i would invite you to do is

670
00:24:37,350 --> 00:24:35,279
to participate in some of the sessions

671
00:24:39,669 --> 00:24:37,360
this afternoon there's a crew crude

672
00:24:41,669 --> 00:24:39,679
system session i think is it going to be

673
00:24:43,909 --> 00:24:41,679
in this room pedro

674
00:24:45,750 --> 00:24:43,919
okay so look at your program to figure

675
00:24:47,750 --> 00:24:45,760
out i think we've got three sessions

676
00:24:49,750 --> 00:24:47,760
this afternoon two to three sessions

677
00:24:51,990 --> 00:24:49,760
some here and maybe one in the lecture

678
00:24:54,310 --> 00:24:52,000
hall and then tomorrow

679
00:24:56,230 --> 00:24:54,320
between 10 and noon they're slated to

680
00:24:57,750 --> 00:24:56,240
have a summary or out brief of each of

681
00:24:58,789 --> 00:24:57,760
the sessions so i'll be doing the out

682
00:25:00,789 --> 00:24:58,799
brief

683
00:25:02,710 --> 00:25:00,799
from this session and

684
00:25:05,029 --> 00:25:02,720
if you want to get some additional

685
00:25:06,510 --> 00:25:05,039
thoughts to me between now and then

686
00:25:09,029 --> 00:25:06,520
i'm

687
00:25:10,390 --> 00:25:09,039
andre.j.sylvester nasa.gov

688
00:25:12,630 --> 00:25:10,400

if you want to send me a quick email

689
00:25:14,710 --> 00:25:12,640
note i'd be happy to at least respond to

690
00:25:17,430 --> 00:25:14,720
you but again i'd like to thank everyone

691
00:25:19,430 --> 00:25:17,440
for their participation uh enjoy maybe a

692
00:25:21,590 --> 00:25:19,440
little bit longer lunch break i think we

693
00:25:22,470 --> 00:25:21,600
the whole activity starts up again at 1

694
00:25:24,310 --> 00:25:22,480
30

695
00:25:26,230 --> 00:25:24,320
this afternoon and because of the bus

696
00:25:28,630 --> 00:25:26,240
system we've got i would say give

697
00:25:30,390 --> 00:25:28,640
yourself some extra time in getting

698
00:25:32,070 --> 00:25:30,400
getting back here allow for the transit

699
00:25:33,669 --> 00:25:32,080
time of the of the bus