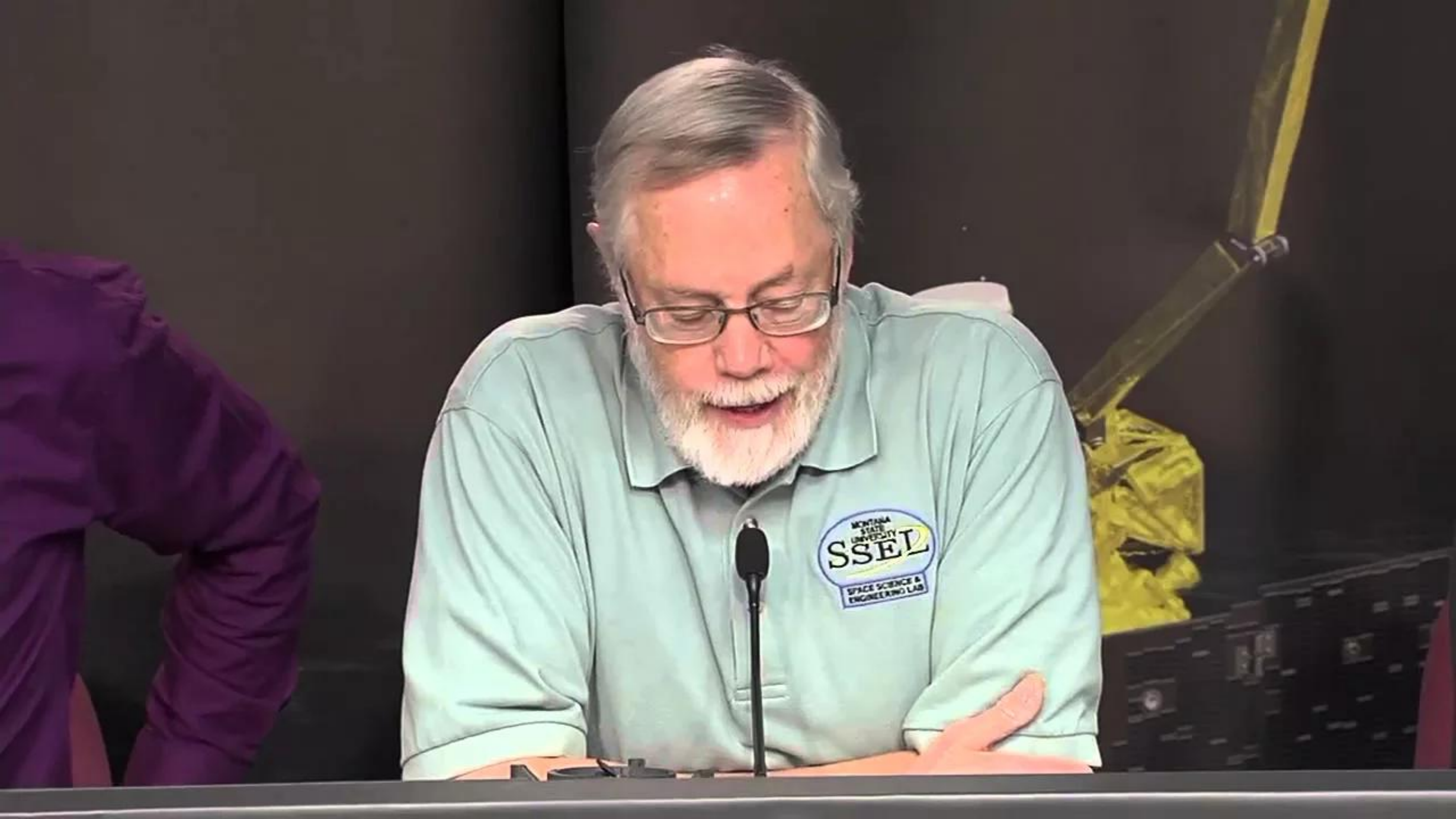
MONTANA STATE UNIVERSITY
SSEL
SPACE SCIENCE & ENGINEERING LAB

1
00:00:09,200 --> 00:00:06,740
hello again everyone welcome to our

2
00:00:11,390 --> 00:00:09,210
briefing on the ilanic cube sets also

3
00:00:15,230 --> 00:00:11,400
flying as auxiliary payloads on the

4
00:00:17,390 --> 00:00:15,240
Delta two on Thursday morning we will

5
00:00:19,729 --> 00:00:17,400
also take questions from the media at

6
00:00:22,130 --> 00:00:19,739
the conclusion of the presentations and

7
00:00:26,300 --> 00:00:22,140
then social media can also ask questions

8
00:00:28,069 --> 00:00:26,310
as well by using hashtag ask NASA and

9
00:00:30,019 --> 00:00:28,079
we'll start first with Scott

10
00:00:31,639 --> 00:00:30,029
Higginbotham who is the NASA Ilana

11
00:00:37,459 --> 00:00:31,649
mission manager from the Kennedy Space

12
00:00:40,069 --> 00:00:37,469
Center in Florida Dave clump are the

13
00:00:43,069 --> 00:00:40,079

Firebird two principal investigator and

14
00:00:44,869 --> 00:00:43,079
who was the director of the Space

15
00:00:46,910 --> 00:00:44,879
Science and Engineering Laboratory at

16
00:00:52,489 --> 00:00:46,920
Montana State University in Bozeman

17
00:00:54,500 --> 00:00:52,499
Montana then to John belardo the execute

18
00:00:57,020 --> 00:00:54,510
principle code principal investigator

19
00:01:01,450 --> 00:00:57,030
from the California Polytechnic State

20
00:01:04,280 --> 00:01:01,460
University in San Luis Obispo and

21
00:01:06,440 --> 00:01:04,290
finally to David writer the griffix

22
00:01:10,400 --> 00:01:06,450
principal investigator from the Jet

23
00:01:12,230 --> 00:01:10,410
Propulsion Laboratory in Pasadena so

24
00:01:15,320 --> 00:01:12,240
we'll start first with Scott

25
00:01:17,360 --> 00:01:15,330
Higginbotham the Ilana xmission less lon

26
00:01:19,490 --> 00:01:17,370
attend mission manager Scott thank you

27
00:01:20,980 --> 00:01:19,500
George for those that may not be

28
00:01:24,080 --> 00:01:20,990
familiar with what a cube set is

29
00:01:25,790 --> 00:01:24,090
basically it is a research nanosatellite

30
00:01:28,790 --> 00:01:25,800
that conforms to certain standard

31
00:01:31,970 --> 00:01:28,800
features in particular relative to size

32
00:01:34,700 --> 00:01:31,980
and shape and volume the smallest keep

33
00:01:37,790 --> 00:01:34,710
set that we fly is what we call one unit

34
00:01:41,180 --> 00:01:37,800
or one you and au is ten centimeters on

35
00:01:42,590 --> 00:01:41,190
a side so a 10 centimeter cube on this

36
00:01:45,140 --> 00:01:42,600
particular mission we have four

37
00:01:47,120 --> 00:01:45,150
satellites that we're launching two of

38
00:01:49,820 --> 00:01:47,130

them or what we call three you meaning

39
00:01:53,060 --> 00:01:49,830
that they are 30 x 10 x 10 roughly and

40
00:01:55,010 --> 00:01:53,070
the other two are one and a half you

41
00:01:58,820 --> 00:01:55,020
which means that they are about 15

42
00:02:00,950 --> 00:01:58,830
centimeters by 10 by 10 these four cube

43
00:02:03,290 --> 00:02:00,960
sets will be launched into space

44
00:02:05,450 --> 00:02:03,300
contained within some standard

45
00:02:06,980 --> 00:02:05,460
dispensers that we've procured the

46
00:02:09,380 --> 00:02:06,990
particular dispenser we're using on this

47
00:02:12,740 --> 00:02:09,390
mission is a pea pod which is a poly

48
00:02:13,860 --> 00:02:12,750
Pico satellite orbital deployer the pea

49
00:02:16,140 --> 00:02:13,870
pod is

50
00:02:17,970 --> 00:02:16,150
designed and built by the fine folks up

51
00:02:20,759 --> 00:02:17,980
at the California Polytechnic State

52
00:02:24,449 --> 00:02:20,769
University in San Luis Obispo or Cal

53
00:02:27,930 --> 00:02:24,459
Poly and this is a pea pod right here

54
00:02:29,910 --> 00:02:27,940
the pea pod is essentially a very

55
00:02:31,819 --> 00:02:29,920
sophisticated jack-in-the-box but you'll

56
00:02:35,220 --> 00:02:31,829
see there's no handle that you can crank

57
00:02:37,199 --> 00:02:35,230
it is a metal box that contains the cube

58
00:02:39,119 --> 00:02:37,209
set to keep the cube set from from

59
00:02:41,729 --> 00:02:39,129
harming anything and to keep it

60
00:02:44,610 --> 00:02:41,739
contained on a cent at the appropriate

61
00:02:46,979 --> 00:02:44,620
time on orbit the signal is sent from

62
00:02:49,229 --> 00:02:46,989
the launch vehicle to the pea pod there

63
00:02:53,009 --> 00:02:49,239

is a non-explosive actuator that goes

64
00:02:55,530 --> 00:02:53,019
right here and that that actuator then

65
00:02:58,500 --> 00:02:55,540
allows the door to open the door opens

66
00:03:00,149 --> 00:02:58,510
up its spring loaded and then those as

67
00:03:01,890 --> 00:03:00,159
you can see inside there is a pusher

68
00:03:04,289 --> 00:03:01,900
plate that's attached to a large spring

69
00:03:06,449 --> 00:03:04,299
that large spring provides the impulse

70
00:03:08,819 --> 00:03:06,459
to push the cubes out out or cube SATs

71
00:03:15,149 --> 00:03:08,829
out into the space environment at over

72
00:03:16,530 --> 00:03:15,159
one meter per second so the four keep

73
00:03:18,569 --> 00:03:16,540
sets that we're flying on this mission

74
00:03:20,250 --> 00:03:18,579
we're all selected through for flight

75
00:03:23,699 --> 00:03:20,260
through the NASA CubeSat launch

76
00:03:25,650 --> 00:03:23,709
initiative or CSL I csli provides

77
00:03:27,930 --> 00:03:25,660
opportunities for educational and

78
00:03:30,690 --> 00:03:27,940
nonprofit organizations and NASA centers

79
00:03:33,270 --> 00:03:30,700
to to get cube SATs launched into space

80
00:03:36,210 --> 00:03:33,280
either flying along as exhilarate a load

81
00:03:37,830 --> 00:03:36,220
on unmanned vehicles or being flown up

82
00:03:41,129 --> 00:03:37,840
and ejected from the International Space

83
00:03:43,259 --> 00:03:41,139
Station the cubesat launch initiative

84
00:03:45,629 --> 00:03:43,269
selection process is competitive and

85
00:03:48,089 --> 00:03:45,639
each proposer has to come forward and

86
00:03:49,650 --> 00:03:48,099
demonstrate the merit and feasibility of

87
00:03:52,020 --> 00:03:49,660
their satellite that they're proposing

88
00:03:54,059 --> 00:03:52,030

and also they have to demonstrate how

89
00:03:55,770 --> 00:03:54,069
that satellite meets one of NASA's

90
00:03:57,809 --> 00:03:55,780
strategic or more than one of NASA's

91
00:04:00,449 --> 00:03:57,819
strategic objectives relative to

92
00:04:04,140 --> 00:04:00,459
technology demonstration science and

93
00:04:05,640 --> 00:04:04,150
exploration or education and in the case

94
00:04:07,650 --> 00:04:05,650
of the cube sets you're going to be

95
00:04:10,400 --> 00:04:07,660
hearing about here shortly several of

96
00:04:14,309 --> 00:04:10,410
them meet objectives in different areas

97
00:04:16,560 --> 00:04:14,319
the since 2010 we have selected a

98
00:04:18,779 --> 00:04:16,570
hundred and fourteen cube sets for

99
00:04:21,330 --> 00:04:18,789
flight through csli of which 33 have

100
00:04:23,580 --> 00:04:21,340
been successfully placed into orbit to

101
00:04:27,780 --> 00:04:23,590
date and come Thursday there will be

102
00:04:29,730 --> 00:04:27,790
four more to add to that list olay Alana

103
00:04:31,380 --> 00:04:29,740
shins or educational launch of nano

104
00:04:34,230 --> 00:04:31,390
satellite missions or how we go about

105
00:04:36,000 --> 00:04:34,240
implementing the ultimate goal of csli

106
00:04:38,550 --> 00:04:36,010
and that is putting the hardware into

107
00:04:41,490 --> 00:04:38,560
space what we do at the launch services

108
00:04:43,500 --> 00:04:41,500
program is we look for rides going into

109
00:04:46,380 --> 00:04:43,510
orbit that are going at the right time

110
00:04:49,080 --> 00:04:46,390
at the right in the right direction and

111
00:04:50,670 --> 00:04:49,090
at the right price and if we can find a

112
00:04:52,320 --> 00:04:50,680
match there then what we will do is

113
00:04:54,300 --> 00:04:52,330

build a manifest to fly on that mission

114
00:04:56,250 --> 00:04:54,310
will then procure the launch service

115
00:04:57,660 --> 00:04:56,260
procure the dispenser and the

116
00:05:00,240 --> 00:04:57,670
integration services that go along with

117
00:05:02,280 --> 00:05:00,250
that and then will ultimately go value

118
00:05:05,100 --> 00:05:02,290
ate all that hardware to make sure that

119
00:05:08,430 --> 00:05:05,110
it's a suitable for flight our prime

120
00:05:10,650 --> 00:05:08,440
directive is that we can do no harm and

121
00:05:12,930 --> 00:05:10,660
so we have to spend a tremendous amount

122
00:05:15,660 --> 00:05:12,940
of time and energy proving that the cube

123
00:05:18,540 --> 00:05:15,670
sets and dispensers represent no risk to

124
00:05:20,400 --> 00:05:18,550
the baseline risk of the mission overall

125
00:05:22,080 --> 00:05:20,410
we can't harm the launch vehicle we

126
00:05:24,660 --> 00:05:22,090
can't harm the primary satellite we

127
00:05:28,290 --> 00:05:24,670
cannot harm the public and for this

128
00:05:29,880 --> 00:05:28,300
mission Ilana 10 again we have four cube

129
00:05:32,100 --> 00:05:29,890
sets that are flying up in three

130
00:05:34,290 --> 00:05:32,110
different p pods the pea pods are

131
00:05:35,700 --> 00:05:34,300
mounted on the second stage on the V

132
00:05:39,210 --> 00:05:35,710
struts of the second stage and are

133
00:05:41,160 --> 00:05:39,220
pointed down and in a way and there are

134
00:05:43,410 --> 00:05:41,170
signals that will be sent at the

135
00:05:45,270 --> 00:05:43,420
appropriate time in orbit for the doors

136
00:05:48,060 --> 00:05:45,280
to open and the pea pods to be ejected

137
00:05:49,920 --> 00:05:48,070
specifically our separation timeline is

138
00:05:51,900 --> 00:05:49,930

set up such that the first cube set

139
00:05:54,540 --> 00:05:51,910
actually first two cube sets the

140
00:05:56,820 --> 00:05:54,550
firebird cube sets will be ejected one

141
00:05:59,670 --> 00:05:56,830
hour and 45 minutes and seven seconds

142
00:06:02,040 --> 00:05:59,680
after launch the next pea pod will then

143
00:06:04,140 --> 00:06:02,050
be commanded to deploy a hundred seconds

144
00:06:06,180 --> 00:06:04,150
later and that'll be griffix and then a

145
00:06:08,580 --> 00:06:06,190
hundred seconds after that XO cube will

146
00:06:10,110 --> 00:06:08,590
be deployed once the cube sets are

147
00:06:11,670 --> 00:06:10,120
deployed they're on their own and their

148
00:06:13,830 --> 00:06:11,680
the responsibility of the sponsoring

149
00:06:15,540 --> 00:06:13,840
organization to control its not NASA

150
00:06:18,030 --> 00:06:15,550
it's the institutions that you'll be

151
00:06:19,890 --> 00:06:18,040
hearing from next the satellites will

152
00:06:21,510 --> 00:06:19,900
not start sending radio signals to the

153
00:06:24,570 --> 00:06:21,520
ground till about an hour at the

154
00:06:26,370 --> 00:06:24,580
earliest after they're deployed and so

155
00:06:28,020 --> 00:06:26,380
the earliest that we expect that we will

156
00:06:30,030 --> 00:06:28,030
start hearing from the cube SATs is

157
00:06:33,810 --> 00:06:30,040
later on in the afternoon on Thursday or

158
00:06:35,550 --> 00:06:33,820
into Thursday evening so in summary all

159
00:06:37,770 --> 00:06:35,560
of our hardware's on board and it's

160
00:06:40,350 --> 00:06:37,780
ready to go fly it's a thrill to be here

161
00:06:41,580 --> 00:06:40,360
and I do want to acknowledge two groups

162
00:06:44,160 --> 00:06:41,590
before I pass it

163
00:06:46,260 --> 00:06:44,170

over to Dave the first is that the fine

164
00:06:48,060 --> 00:06:46,270
team again at Cal Poly that that built

165
00:06:50,160 --> 00:06:48,070
the cube sets are built the peapods

166
00:06:53,010 --> 00:06:50,170
rather and did all of our integration

167
00:06:54,960 --> 00:06:53,020
work for us that team Alicia Johnstone

168
00:06:57,030 --> 00:06:54,970
Ryan Nugent and Justin Foley did an

169
00:06:58,860 --> 00:06:57,040
absolutely outstanding job and then

170
00:07:00,930 --> 00:06:58,870
lastly I want to acknowledge our mission

171
00:07:02,790 --> 00:07:00,940
integration team back within the launch

172
00:07:05,130 --> 00:07:02,800
services program led by Bill Atkinson

173
00:07:07,080 --> 00:07:05,140
who is here in the room with us they are

174
00:07:08,910 --> 00:07:07,090
responsible for doing all of the work to

175
00:07:10,550 --> 00:07:08,920
verify that all this hardware meets all

176
00:07:13,170 --> 00:07:10,560
of these stringent standards that NASA

177
00:07:15,870 --> 00:07:13,180
makes us apply to this hardware and they

178
00:07:18,030 --> 00:07:15,880
did it also an outstanding job so that

179
00:07:20,520 --> 00:07:18,040
George back to you all right thank you

180
00:07:23,040 --> 00:07:20,530
Scott and now to Dave Klump are the

181
00:07:27,240 --> 00:07:23,050
firebird two principal investigator from

182
00:07:29,760 --> 00:07:27,250
Montana State Dave thank you George I'm

183
00:07:32,430 --> 00:07:29,770
very pleased to be here to represent the

184
00:07:35,160 --> 00:07:32,440
Montana State University University of

185
00:07:37,500 --> 00:07:35,170
New Hampshire combined firebird to team

186
00:07:40,950 --> 00:07:37,510
on the occasion of our upcoming launch

187
00:07:44,370 --> 00:07:40,960
as an auxiliary payload with the S map

188
00:07:47,040 --> 00:07:44,380

mission I want to thank NASA's Earth

189
00:07:49,920 --> 00:07:47,050
Science Division for allowing our little

190
00:07:53,570 --> 00:07:49,930
guys to fly with their big earth science

191
00:07:58,380 --> 00:07:53,580
mission also want to thank the NASA

192
00:08:01,710 --> 00:07:58,390
launch services program Alana team for

193
00:08:04,650 --> 00:08:01,720
providing these opportunities that allow

194
00:08:08,070 --> 00:08:04,660
the students who've designed and built

195
00:08:10,080 --> 00:08:08,080
these satellites to actually see the

196
00:08:12,210 --> 00:08:10,090
fruits of their labor pay off by

197
00:08:14,880 --> 00:08:12,220
operating the spacecraft in the space

198
00:08:17,490 --> 00:08:14,890
environment you know it's it's it's one

199
00:08:20,400 --> 00:08:17,500
thing to do powerpoint presentations and

200
00:08:22,290 --> 00:08:20,410
studies in an undergraduate environment

201
00:08:25,620 --> 00:08:22,300
and it's something else to actually get

202
00:08:27,660 --> 00:08:25,630
out there put that learning that except

203
00:08:31,110 --> 00:08:27,670
that knowledge that you've gotten from

204
00:08:33,360 --> 00:08:31,120
the classroom to work and and actually

205
00:08:35,670 --> 00:08:33,370
build a piece of hardware and get it to

206
00:08:37,410 --> 00:08:35,680
its destination and operate it from the

207
00:08:39,240 --> 00:08:37,420
space environment that's just huge for

208
00:08:41,610 --> 00:08:39,250
the students and we wouldn't be able to

209
00:08:45,660 --> 00:08:41,620
do this without the support of the

210
00:08:47,670 --> 00:08:45,670
launch services program Alana team at

211
00:08:51,480 --> 00:08:47,680
Kennedy Space Center so thanks again

212
00:08:54,990 --> 00:08:51,490
Scott and please pass my thanks on to

213
00:08:57,870 --> 00:08:55,000

Big Daddy back there at Cape Canaveral

214
00:09:00,960 --> 00:08:57,880
in the large services program I think

215
00:09:04,110 --> 00:09:00,970
I'm referred to the gentleman who

216
00:09:09,660 --> 00:09:04,120
actually heads up and really really

217
00:09:12,090 --> 00:09:09,670
makes the Alana program what it is so if

218
00:09:13,620 --> 00:09:12,100
I can have the first graphic I want to

219
00:09:17,190 --> 00:09:13,630
talk a little bit about the scientific

220
00:09:22,320 --> 00:09:17,200
mission of Firebird it is a scientific

221
00:09:24,330 --> 00:09:22,330
investigation as I said primarily built

222
00:09:27,660 --> 00:09:24,340
by students at Montana State University

223
00:09:31,260 --> 00:09:27,670
and end at the University of New

224
00:09:33,660 --> 00:09:31,270
Hampshire Montana State really provided

225
00:09:36,150 --> 00:09:33,670
the spacecraft bus and did the

226
00:09:38,310 --> 00:09:36,160
integration and testing work while the

227
00:09:40,490 --> 00:09:38,320
scientific payload was designed and

228
00:09:43,350 --> 00:09:40,500
built at the University of New Hampshire

229
00:09:46,530 --> 00:09:43,360
the investigation is supported by the

230
00:09:48,450 --> 00:09:46,540
national science foundation and as

231
00:09:50,550 --> 00:09:48,460
you've heard today as being launched by

232
00:09:55,920 --> 00:09:50,560
NASA so we have a lot of government

233
00:09:59,970 --> 00:09:55,930
presence in our in our process let's get

234
00:10:03,320 --> 00:09:59,980
to the scientific purpose the purpose is

235
00:10:06,270 --> 00:10:03,330
to investigate a mysterious phenomenon

236
00:10:09,390 --> 00:10:06,280
unknown as I was a bit of a technical

237
00:10:13,380 --> 00:10:09,400
term here relativistic electron micro

238
00:10:16,650 --> 00:10:13,390

bursts I'll tell you a little more about

239
00:10:20,760 --> 00:10:16,660
that just briefly but why do we do this

240
00:10:22,829 --> 00:10:20,770
it's important because the Earth's Van

241
00:10:25,980 --> 00:10:22,839
Allen radiation belts which is the

242
00:10:29,160 --> 00:10:25,990
reservoir of the very intense radiation

243
00:10:31,880 --> 00:10:29,170
that can damage spacecraft and cause

244
00:10:34,890 --> 00:10:31,890
health problems with human beings that

245
00:10:37,530 --> 00:10:34,900
reservoir is a fairly stable environment

246
00:10:40,160 --> 00:10:37,540
some of the time but there's a

247
00:10:43,079 --> 00:10:40,170
mysterious process going on out there

248
00:10:46,200 --> 00:10:43,089
that jiggles the Earth's magnetic system

249
00:10:48,270 --> 00:10:46,210
in such a way that some of those very

250
00:10:51,270 --> 00:10:48,280
energetic they're called killer

251
00:10:53,220 --> 00:10:51,280
electrons for obvious reasons can be

252
00:10:56,730 --> 00:10:53,230
dumped into the Earth's upper atmosphere

253
00:10:58,860 --> 00:10:56,740
and precipitate out of the radiation

254
00:11:02,610 --> 00:10:58,870
belts causing perhaps one of the most

255
00:11:07,949 --> 00:11:02,620
significant losses from the Van Allen

256
00:11:08,639 --> 00:11:07,959
radiation belts we don't understand this

257
00:11:14,239 --> 00:11:08,649
process

258
00:11:17,759 --> 00:11:14,249
quantified and so the firebird mission

259
00:11:21,679 --> 00:11:17,769
if I could have that view graph back the

260
00:11:24,660 --> 00:11:21,689
firebird mission is is focused on

261
00:11:26,759 --> 00:11:24,670
understanding and the words of the

262
00:11:28,710 --> 00:11:26,769
acronym really tell it we're looking at

263
00:11:30,540 --> 00:11:28,720

the relativistic electron burst

264
00:11:33,090 --> 00:11:30,550
intensity how intense are these

265
00:11:35,249 --> 00:11:33,100
radiations as they rain down on the

266
00:11:37,650 --> 00:11:35,259
earth what is the range what is the

267
00:11:40,530 --> 00:11:37,660
spatial extent over which they they

268
00:11:44,609 --> 00:11:40,540
bombard the earth and how dynamic are

269
00:11:48,389 --> 00:11:44,619
they in order to do this we fly the two

270
00:11:52,619 --> 00:11:48,399
firebird satellites in a dog chasing a

271
00:11:54,530 --> 00:11:52,629
cat formation deep well above the

272
00:11:57,210 --> 00:11:54,540
earth's atmosphere but very low altitude

273
00:12:01,079 --> 00:11:57,220
compared to where the Van Allen probes

274
00:12:03,239 --> 00:12:01,089
are measuring the radiation out there in

275
00:12:05,939 --> 00:12:03,249
the space environment those fan Allen

276
00:12:09,629 --> 00:12:05,949
probes built by NASA and launched about

277
00:12:11,609 --> 00:12:09,639
two and a half years ago are embedded in

278
00:12:13,799 --> 00:12:11,619
this radiation belt environment and

279
00:12:15,600 --> 00:12:13,809
their understanding exactly the

280
00:12:20,179 --> 00:12:15,610
measuring all of the phenomenon that are

281
00:12:23,309 --> 00:12:20,189
any importance that's going on out there

282
00:12:26,790 --> 00:12:23,319
unfortunately they're blind to the very

283
00:12:29,160 --> 00:12:26,800
important very small spatial dynamic

284
00:12:30,600 --> 00:12:29,170
region they're blind to what's being

285
00:12:34,110 --> 00:12:30,610
dumped into the Earth's upper atmosphere

286
00:12:36,540 --> 00:12:34,120
and so with these two focused firebird

287
00:12:37,860 --> 00:12:36,550
satellites we look down at the upper

288
00:12:41,100 --> 00:12:37,870

atmosphere and see what's actually

289
00:12:43,739 --> 00:12:41,110
coming in and and the Van Allen probes

290
00:12:45,900 --> 00:12:43,749
are able to tell us ah here's what we

291
00:12:50,869 --> 00:12:45,910
saw out there at the same time you saw

292
00:13:02,369 --> 00:12:58,650
so let's go on to to the next slide it

293
00:13:04,259 --> 00:13:02,379
shows photograph so in order to

294
00:13:08,160 --> 00:13:04,269
accomplish this investigation it takes

295
00:13:14,929 --> 00:13:08,170
the two satellites as i described cat

296
00:13:20,009 --> 00:13:17,819
have been built by students at the

297
00:13:22,350 --> 00:13:20,019
university of at Montana State

298
00:13:24,300 --> 00:13:22,360
University and the payloads built by

299
00:13:29,130 --> 00:13:24,310
students at mom at the University of New

300
00:13:32,400 --> 00:13:29,140
Hampshire they're identical but they and

301
00:13:35,400 --> 00:13:32,410
their very diminutive as as Scott just

302
00:13:37,500 --> 00:13:35,410
described there about 10 centimeters on

303
00:13:39,930 --> 00:13:37,510
a side about 15 centimeters tall

304
00:13:43,110 --> 00:13:39,940
nevertheless they carry all of the

305
00:13:47,100 --> 00:13:43,120
fundamental hardware that the much

306
00:13:49,889 --> 00:13:47,110
larger brethren like s map carry they

307
00:13:52,410 --> 00:13:49,899
have as you can see in the image they

308
00:13:55,050 --> 00:13:52,420
have solar panels to charge the

309
00:13:58,340 --> 00:13:55,060
batteries that are that are providing

310
00:14:01,230 --> 00:13:58,350
power to the satellites during eclipse

311
00:14:03,990 --> 00:14:01,240
through a power system that very

312
00:14:05,550 --> 00:14:04,000
carefully controls and monitors the the

313
00:14:09,449 --> 00:14:05,560

power being distributed around the

314
00:14:12,449 --> 00:14:09,459
satellite they carry full downlink

315
00:14:14,970 --> 00:14:12,459
communications or RF transmitter on

316
00:14:17,190 --> 00:14:14,980
board antennas that are wrapped around

317
00:14:20,880 --> 00:14:17,200
the side walls of the spacecraft and

318
00:14:23,090 --> 00:14:20,890
deployed once we get into orbit these

319
00:14:27,300 --> 00:14:23,100
there's a transceiver a transmitter

320
00:14:30,600 --> 00:14:27,310
sorry a receiver on board to to receive

321
00:14:33,689 --> 00:14:30,610
and decode uplink signals and finally a

322
00:14:36,240 --> 00:14:33,699
GPS system to tell us where we are and

323
00:14:39,990 --> 00:14:36,250
to time the relative e the relative

324
00:14:42,780 --> 00:14:40,000
timing between the two satellites and of

325
00:14:49,790 --> 00:14:42,790
course not last but not least is the

326
00:14:55,400 --> 00:14:49,800
very important scientific payload so I

327
00:14:57,810 --> 00:14:55,410
want to close with a little video the

328
00:14:59,910 --> 00:14:57,820
school of film and photography at

329
00:15:03,180 --> 00:14:59,920
Montana State University produced the

330
00:15:05,310 --> 00:15:03,190
this little 30-second video regarding

331
00:15:08,340 --> 00:15:05,320
the program and the missions that were

332
00:15:11,250 --> 00:15:08,350
accomplishing with these cube SATs can

333
00:15:13,980 --> 00:15:11,260
we roll that video at Montana State

334
00:15:18,090 --> 00:15:13,990
University we build real satellites for

335
00:15:20,420 --> 00:15:18,100
NASA to most people the msu campus looks

336
00:15:26,350 --> 00:15:20,430
like this but to me

337
00:15:31,870 --> 00:15:28,720
our satellite has orbited the earth over

338
00:15:35,590 --> 00:15:31,880

5,000 times advancing technology

339
00:15:42,519 --> 00:15:35,600
throughout the world we work together we

340
00:15:46,380 --> 00:15:42,529
shape the future the university is so

341
00:15:48,940 --> 00:15:46,390
proud to be to be a part of this program

342
00:15:50,889 --> 00:15:48,950
augmenting our students formal education

343
00:15:53,440 --> 00:15:50,899
with such experiment experiential

344
00:15:57,550 --> 00:15:53,450
activities that this video was shown

345
00:16:00,370 --> 00:15:57,560
during the halftime break at the brawl

346
00:16:04,030 --> 00:16:00,380
of the wild as it's called that's the

347
00:16:06,400 --> 00:16:04,040
traditional once a year annual battle on

348
00:16:09,600 --> 00:16:06,410
the football field between Montana State

349
00:16:13,120 --> 00:16:09,610
University and the University of Montana

350
00:16:16,240 --> 00:16:13,130
it was shown on national TV during that

351
00:16:18,130 --> 00:16:16,250
during that game don't ask me how the

352
00:16:22,120 --> 00:16:18,140
game came out because I don't really

353
00:16:23,920 --> 00:16:22,130
follow football and I think I'll turn

354
00:16:27,880 --> 00:16:23,930
back to you George all right thanks Dave

355
00:16:30,340 --> 00:16:27,890
and now to John belardo the execute

356
00:16:32,470 --> 00:16:30,350
co-principal investigator for california

357
00:16:35,740 --> 00:16:32,480
polytechnic state university and san

358
00:16:37,569 --> 00:16:35,750
luis obispo John thank you George I'm

359
00:16:40,420 --> 00:16:37,579
pleased to be here representing the

360
00:16:42,009 --> 00:16:40,430
execute team despite the fact that all

361
00:16:44,590 --> 00:16:42,019
these satellites are small there's a

362
00:16:47,110 --> 00:16:44,600
huge team of folks that goes behind them

363
00:16:48,819 --> 00:16:47,120

don't make them what they are so I want

364
00:16:50,259 --> 00:16:48,829
to start out by thanking a number of the

365
00:16:52,180 --> 00:16:50,269
institutions that have been involved

366
00:16:54,790 --> 00:16:52,190
with execute to make it as successful as

367
00:16:56,650 --> 00:16:54,800
it has been thus far first and foremost

368
00:16:58,509 --> 00:16:56,660
scientific solutions was providing a lot

369
00:17:03,150 --> 00:16:58,519
of the the leadership on the project

370
00:17:05,020 --> 00:17:03,160
right in both technical and scientific

371
00:17:06,970 --> 00:17:05,030
we've also been working with the

372
00:17:09,059 --> 00:17:06,980
University of wisconsin-madison the

373
00:17:11,590 --> 00:17:09,069
University of Illinois urbana-champaign

374
00:17:13,179 --> 00:17:11,600
on the science side they have a number

375
00:17:15,340 --> 00:17:13,189
of scientists who have contributed to

376
00:17:17,890 --> 00:17:15,350
the science design of the experiment and

377
00:17:19,360 --> 00:17:17,900
are standing by to being analyzing the

378
00:17:22,150 --> 00:17:19,370
data as soon as the data starts coming

379
00:17:24,699 --> 00:17:22,160
down approximately a month or so after

380
00:17:26,230 --> 00:17:24,709
were deployed from the peapod we also

381
00:17:28,120 --> 00:17:26,240
worked with nasa goddard they were

382
00:17:31,240 --> 00:17:28,130
involved with making the science

383
00:17:33,250 --> 00:17:31,250
instrument that we have in the CubeSat

384
00:17:35,590 --> 00:17:33,260
itself and then finally the team at Cal

385
00:17:38,110 --> 00:17:35,600
Poly wasn't involved with designing the

386
00:17:39,910 --> 00:17:38,120
bus building the satellite and

387
00:17:42,820 --> 00:17:39,920
integrating the instrument from Goddard

388
00:17:45,460 --> 00:17:42,830

doing all the final testing the Cal Poly

389
00:17:46,890 --> 00:17:45,470
team is the team that I am responsible

390
00:17:50,050 --> 00:17:46,900
partially responsible for advising

391
00:17:51,460 --> 00:17:50,060
they're a team of students and as is the

392
00:17:53,140 --> 00:17:51,470
theme with these satellites they're

393
00:17:55,810 --> 00:17:53,150
largely student-built they provide a

394
00:17:57,880 --> 00:17:55,820
phenomenal educational opportunity to

395
00:18:00,460 --> 00:17:57,890
get real life experience for the

396
00:18:02,080 --> 00:18:00,470
students to complement their classroom

397
00:18:04,300 --> 00:18:02,090
education is a wonderful opportunity and

398
00:18:07,300 --> 00:18:04,310
a lot of things goes the Alana program

399
00:18:11,020 --> 00:18:07,310
to help facilitate that thank you thank

400
00:18:12,970 --> 00:18:11,030
you John and next to David writer the

401
00:18:14,770 --> 00:18:12,980
griffix principal investigator from the

402
00:18:19,180 --> 00:18:14,780
Jet Propulsion Laboratory in Pasadena

403
00:18:20,680 --> 00:18:19,190
California David yes good afternoon I'm

404
00:18:24,280 --> 00:18:20,690
going to tell you about griffix griffix

405
00:18:27,010 --> 00:18:24,290
stands for geo Cape rowing in flight in

406
00:18:28,360 --> 00:18:27,020
flight validation experiment so in some

407
00:18:29,710 --> 00:18:28,370
sense this is a little bit different

408
00:18:33,010 --> 00:18:29,720
than the other two in that we are at

409
00:18:34,840 --> 00:18:33,020
technology validation flight and I want

410
00:18:36,730 --> 00:18:34,850
to tell you a little bit about why we're

411
00:18:38,590 --> 00:18:36,740
worrying about validating technology and

412
00:18:40,990 --> 00:18:38,600
it's actually in the title of the it's

413
00:18:43,090 --> 00:18:41,000

in the acronym of our experiment but

414
00:18:44,980 --> 00:18:43,100
it's G ok geo Cape is a mission that's

415
00:18:47,530 --> 00:18:44,990
been envisioned by NASA for quite a

416
00:18:49,600 --> 00:18:47,540
while a lot of people have been working

417
00:18:51,700 --> 00:18:49,610
on it but when we first started thinking

418
00:18:54,160 --> 00:18:51,710
about geo Cape we realized fairly early

419
00:18:56,170 --> 00:18:54,170
on that there were some key components

420
00:18:58,660 --> 00:18:56,180
that we needed to develop in order to

421
00:19:01,180 --> 00:18:58,670
pull off the mission now what makes geo

422
00:19:03,340 --> 00:19:01,190
Cape unique at least in our thinking is

423
00:19:05,440 --> 00:19:03,350
that it will be located in a

424
00:19:08,050 --> 00:19:05,450
geostationary satellite which means that

425
00:19:11,050 --> 00:19:08,060
it's it's stationary with respect to the

426
00:19:13,420 --> 00:19:11,060
surface of the earth the idea being then

427
00:19:15,790 --> 00:19:13,430
that you can look over a big area of the

428
00:19:17,800 --> 00:19:15,800
earth many many times a day as opposed

429
00:19:19,480 --> 00:19:17,810
to low-earth orbiting missions such as s

430
00:19:22,600 --> 00:19:19,490
map where you can only see some places

431
00:19:24,660 --> 00:19:22,610
two or three times a week maybe the

432
00:19:27,220 --> 00:19:24,670
problem is is that we didn't have

433
00:19:30,330 --> 00:19:27,230
detectors that would take data fast

434
00:19:32,530 --> 00:19:30,340
enough to be able to allow us to do

435
00:19:33,760 --> 00:19:32,540
continental coverage over periods of

436
00:19:37,450 --> 00:19:33,770
several hours which is what our

437
00:19:39,190 --> 00:19:37,460
objective was and most importantly to be

438
00:19:40,840 --> 00:19:39,200

able to measure the composition of the

439
00:19:43,390 --> 00:19:40,850
atmosphere over those time and spatial

440
00:19:45,840 --> 00:19:43,400
scales so we needed to develop a

441
00:19:48,550 --> 00:19:45,850
detector that allows us to do that and

442
00:19:51,900 --> 00:19:48,560
that's what we are going to test on this

443
00:19:54,300 --> 00:19:51,910
griffix flight is the

444
00:19:56,550 --> 00:19:54,310
the readout integrated circuit which is

445
00:19:58,230 --> 00:19:56,560
what row expands for I have one here as

446
00:19:59,760 --> 00:19:58,240
an example it's a fairly tiny little

447
00:20:02,040 --> 00:19:59,770
piece of hardware but it's got a whole

448
00:20:05,130 --> 00:20:02,050
lot of parts in it this is essentially a

449
00:20:07,950 --> 00:20:05,140
detector array that's got 128 x 128

450
00:20:11,430 --> 00:20:07,960
pixels you multiply that out that's

451
00:20:13,980 --> 00:20:11,440
about 16,000 detectors but even better

452
00:20:16,460 --> 00:20:13,990
than that in order to be able to make it

453
00:20:19,230 --> 00:20:16,470
go as fast as we needed to go we end up

454
00:20:21,390 --> 00:20:19,240
building analog-to-digital converters

455
00:20:23,700 --> 00:20:21,400
into every pixel so essentially this is

456
00:20:27,330 --> 00:20:23,710
an all-digital focal plane detector

457
00:20:29,430 --> 00:20:27,340
array which is truly unique in the fact

458
00:20:31,440 --> 00:20:29,440
that it can digitize at very high rates

459
00:20:34,560 --> 00:20:31,450
this one runs at about 8 kilohertz which

460
00:20:36,000 --> 00:20:34,570
is really unprecedented well every time

461
00:20:37,410 --> 00:20:36,010
you go and make something like this you

462
00:20:39,000 --> 00:20:37,420
always worry that you forgot something

463
00:20:42,150 --> 00:20:39,010

and it won't work right when you get it

464
00:20:46,200 --> 00:20:42,160
on orbit so a cubesat is that really a

465
00:20:47,850 --> 00:20:46,210
rather ideal and efficient and quick way

466
00:20:49,680 --> 00:20:47,860
to go about demonstrating that you can

467
00:20:53,400 --> 00:20:49,690
actually make the same thing work on on

468
00:20:56,340 --> 00:20:53,410
in space and that's what we've done this

469
00:21:00,290 --> 00:20:56,350
is our griffix a model a plastic model

470
00:21:04,050 --> 00:21:00,300
of our griffix base craft it's a 3 you

471
00:21:05,520 --> 00:21:04,060
like we build a camera that is down here

472
00:21:07,230 --> 00:21:05,530
in the bottom half of this the outside

473
00:21:10,890 --> 00:21:07,240
is covered all with solar panels that

474
00:21:13,380 --> 00:21:10,900
provides the power for the satellite the

475
00:21:14,940 --> 00:21:13,390
rest of it is just I want to be careful

476
00:21:17,340 --> 00:21:14,950
i was going to say standard electronics

477
00:21:18,960 --> 00:21:17,350
nothing standard in here the data

478
00:21:21,390 --> 00:21:18,970
handling system the command and data

479
00:21:24,270 --> 00:21:21,400
system the radios the power subsystem

480
00:21:27,720 --> 00:21:24,280
and so combined we're going to be able

481
00:21:29,250 --> 00:21:27,730
to go and put a camera in orbit and take

482
00:21:31,470 --> 00:21:29,260
pictures of the earth and demonstrate

483
00:21:34,440 --> 00:21:31,480
that our readout integrated circuit and

484
00:21:37,500 --> 00:21:34,450
the works the way that we needed to work

485
00:21:39,780 --> 00:21:37,510
to be able to go do the gok mission I

486
00:21:42,300 --> 00:21:39,790
also want to make sure that I

487
00:21:44,460 --> 00:21:42,310
acknowledge the earth science technology

488
00:21:46,260 --> 00:21:44,470

office at NASA headquarters they've been

489
00:21:48,540 --> 00:21:46,270
very good about funding the development

490
00:21:50,910 --> 00:21:48,550
of technology for future missions for

491
00:21:53,790 --> 00:21:50,920
earth sciences and in this case they've

492
00:21:55,860 --> 00:21:53,800
been very generous with us along with

493
00:21:58,260 --> 00:21:55,870
that the educational part of it we also

494
00:22:00,180 --> 00:21:58,270
are partnered with a university which is

495
00:22:02,880 --> 00:22:00,190
the University of Michigan this Jamie

496
00:22:04,799 --> 00:22:02,890
Cutler's group who put several 3u

497
00:22:07,049 --> 00:22:04,809
cubesat sin to orbit and

498
00:22:09,119 --> 00:22:07,059
we depended on their experience and

499
00:22:10,409 --> 00:22:09,129
they've also had a great time with all

500
00:22:12,629 --> 00:22:10,419
their students trying to figure out how

501
00:22:14,730 --> 00:22:12,639
to make all this stuff work so at that

502
00:22:17,519 --> 00:22:14,740
I'll close and turn it back to George

503
00:22:19,830 --> 00:22:17,529
alright thanks Dave we're going to go

504
00:22:24,600 --> 00:22:19,840
back now to John belardo from Cal Poly

505
00:22:29,159 --> 00:22:24,610
who will discuss some about the science

506
00:22:31,919 --> 00:22:29,169
objectives on his mission John thank you

507
00:22:36,060 --> 00:22:31,929
George the science objectives science

508
00:22:38,600 --> 00:22:36,070
behind execute is to measure the density

509
00:22:40,619 --> 00:22:38,610
of particles in the upper atmosphere

510
00:22:44,460 --> 00:22:40,629
specifically particles that have atomic

511
00:22:46,019 --> 00:22:44,470
mass of less than 40 measuring the

512
00:22:47,399 --> 00:22:46,029
particles in place in the upper

513
00:22:49,019 --> 00:22:47,409

atmosphere is very important it's

514
00:22:51,149 --> 00:22:49,029
something that has not been done in

515
00:22:52,619 --> 00:22:51,159
approximately 30 years we've been

516
00:22:55,519 --> 00:22:52,629
largely relying on ground-based

517
00:22:58,230 --> 00:22:55,529
measurements which have inaccuracies and

518
00:23:00,419 --> 00:22:58,240
require calibration and the instruments

519
00:23:02,580 --> 00:23:00,429
to be able to take reasonably accurate

520
00:23:04,590 --> 00:23:02,590
readings through the atmosphere so we're

521
00:23:06,269 --> 00:23:04,600
excited to provide the opportunity to

522
00:23:09,029 --> 00:23:06,279
take measurements in place in the upper

523
00:23:10,710 --> 00:23:09,039
atmosphere you use them to recalibrate

524
00:23:12,810 --> 00:23:10,720
or refine the calibration of existing

525
00:23:15,690 --> 00:23:12,820
ground-based instruments use them to

526
00:23:17,789 --> 00:23:15,700
refine and validate models that predict

527
00:23:21,239 --> 00:23:17,799
what these density should be over time

528
00:23:23,669 --> 00:23:21,249
so that long after XO cube is no longer

529
00:23:26,039 --> 00:23:23,679
functioning or no longer in orbit we can

530
00:23:29,310 --> 00:23:26,049
still enjoy some of the benefits so that

531
00:23:31,109 --> 00:23:29,320
the science data that that's taken this

532
00:23:34,739 --> 00:23:31,119
is the engineering model for execute

533
00:23:35,940 --> 00:23:34,749
it's a 3u satellite looks like most of

534
00:23:37,859 --> 00:23:35,950
the other three use when it's deployed

535
00:23:40,739 --> 00:23:37,869
from the peapod one of the unique

536
00:23:42,840 --> 00:23:40,749
features that executes has is they have

537
00:23:45,450 --> 00:23:42,850
a deployable boom so a little while

538
00:23:47,009 --> 00:23:45,460

after deployment there will be booms on

539
00:23:49,259 --> 00:23:47,019
either side of the satellite this is

540
00:23:51,330 --> 00:23:49,269
just one the deploy that helps stabilize

541
00:23:53,190 --> 00:23:51,340
the satellite so that it's always

542
00:23:54,960 --> 00:23:53,200
pointing in the correct direction so the

543
00:23:56,930 --> 00:23:54,970
particles enter the mass spectrometer

544
00:23:59,190 --> 00:23:56,940
correctly that's one of the interesting

545
00:24:02,269 --> 00:23:59,200
features that the students at Cal Poly

546
00:24:04,470 --> 00:24:02,279
helped build into the the satellite

547
00:24:07,139 --> 00:24:04,480
thank you George back to you alright

548
00:24:09,539 --> 00:24:07,149
thanks John and we're ready now to take

549
00:24:12,090 --> 00:24:09,549
questions and remember social media can

550
00:24:14,789 --> 00:24:12,100
also ask questions by using hashtag ask

551
00:24:16,409 --> 00:24:14,799
NASA and we'll go first two questions

552
00:24:18,020 --> 00:24:16,419
here in the room and then take social

553
00:24:27,690 --> 00:24:18,030
media

554
00:24:29,549 --> 00:24:27,700
Justin my question to two parts for

555
00:24:32,070 --> 00:24:29,559
Scotty I was wondering if you could tell

556
00:24:35,340 --> 00:24:32,080
us what orbit the the satellites will be

557
00:24:37,169 --> 00:24:35,350
dropped off at I think Vernon mentioned

558
00:24:42,060 --> 00:24:37,179
that there's going to be a burn after

559
00:24:45,150 --> 00:24:42,070
smacks separation and also for for all

560
00:24:50,430 --> 00:24:45,160
of you how long do you expect the your

561
00:24:52,350 --> 00:24:50,440
your respective missions to last all

562
00:24:53,760 --> 00:24:52,360
right we'll start and I'm embarrassed I

563
00:24:55,620 --> 00:24:53,770

don't have that committed to memory I do

564
00:24:58,710 --> 00:24:55,630
have it in my computer so we'll get back

565
00:25:01,110 --> 00:24:58,720
with you on that we are separating I

566
00:25:03,480 --> 00:25:01,120
think it's like a half a degree of

567
00:25:05,220 --> 00:25:03,490
inclination from the SMAP orbit just

568
00:25:06,810 --> 00:25:05,230
that we get enough away that we don't

569
00:25:10,310 --> 00:25:06,820
have any conjunctions but we'll get you

570
00:25:13,110 --> 00:25:10,320
the details on the orbit I could comment

571
00:25:15,000 --> 00:25:13,120
I'll help Scott answer the question my

572
00:25:19,020 --> 00:25:15,010
memory serves me right and I'm not sure

573
00:25:21,450 --> 00:25:19,030
it does at my young age anymore but I

574
00:25:25,590 --> 00:25:21,460
believe that the initial parameters in

575
00:25:28,890 --> 00:25:25,600
terms of altitude and apogee is at about

576
00:25:31,950 --> 00:25:28,900
600 kilometers and parodies down at

577
00:25:35,010 --> 00:25:31,960
about 450 if I remember that right so

578
00:25:38,190 --> 00:25:35,020
it's a little bit elliptical and the

579
00:25:40,350 --> 00:25:38,200
parameters predict that will be in a

580
00:25:43,200 --> 00:25:40,360
truly sun-synchronous orbit now these

581
00:25:45,570 --> 00:25:43,210
are pre-launch predictions so that we

582
00:25:47,700 --> 00:25:45,580
pass over the satellites pass over each

583
00:25:51,419 --> 00:25:47,710
of our ground stations at exactly the

584
00:25:53,580 --> 00:25:51,429
same time twice a day every day at

585
00:25:58,770 --> 00:25:53,590
exactly the same time there's no phasing

586
00:26:00,510 --> 00:25:58,780
their Sun synchronous and and so we're

587
00:26:04,260 --> 00:26:00,520
very excited to be in that kind of an

588
00:26:08,190 --> 00:26:04,270

orbit lifetime that that orbit will give

589
00:26:10,620 --> 00:26:08,200
us a very long lifetime close to a

590
00:26:12,870 --> 00:26:10,630
decade or more for the satellites to

591
00:26:14,700 --> 00:26:12,880
actually be in space before they decay

592
00:26:17,070 --> 00:26:14,710
into the atmosphere and they will decay

593
00:26:21,110 --> 00:26:17,080
into the atmosphere they don't create

594
00:26:25,320 --> 00:26:21,120
space debris we clean them out naturally

595
00:26:27,390 --> 00:26:25,330
and operationally we would be

596
00:26:29,430 --> 00:26:27,400
disappointed if we don't get at least a

597
00:26:31,409 --> 00:26:29,440
year of operation out of the

598
00:26:34,649 --> 00:26:31,419
to firebird satellites we're we've

599
00:26:36,690 --> 00:26:34,659
designed them to operate for that period

600
00:26:38,669 --> 00:26:36,700
of time there's no there are no

601
00:26:43,560 --> 00:26:38,679
consumables there's no reason why they

602
00:26:49,259 --> 00:26:43,570
shouldn't last knock on wood comets from

603
00:26:52,740 --> 00:26:49,269
the others for execute the the hope

604
00:26:54,690 --> 00:26:52,750
lifetime for the operational side is six

605
00:26:58,680 --> 00:26:54,700
or twelve months but again there's

606
00:26:59,850 --> 00:26:58,690
nothing we if we could last a lot more

607
00:27:01,110 --> 00:26:59,860
than 12 months we continue to take

608
00:27:04,230 --> 00:27:01,120
measurements and continue to get data

609
00:27:07,619 --> 00:27:04,240
and that would be wonderful yes and I'll

610
00:27:09,299 --> 00:27:07,629
my answer is pretty much the same what

611
00:27:12,180 --> 00:27:09,309
gets in the way with them coming down is

612
00:27:14,190 --> 00:27:12,190
is just drag space dragon eventually

613
00:27:15,869 --> 00:27:14,200

they'll fall out of the sky and so

614
00:27:18,659 --> 00:27:15,879
they'll go for almost a decade and

615
00:27:19,740 --> 00:27:18,669
there's nothing in at least in griffix

616
00:27:24,090 --> 00:27:19,750
and I think it's true of the others that

617
00:27:27,060 --> 00:27:24,100
would cause it to quit working in

618
00:27:29,039 --> 00:27:27,070
something any other than yours so we

619
00:27:30,740 --> 00:27:29,049
take a few they r cube SATs they're

620
00:27:33,690 --> 00:27:30,750
built by students we do take a few

621
00:27:35,549 --> 00:27:33,700
shortcuts and the good thing about that

622
00:27:38,369 --> 00:27:35,559
is we get to try out an awful lot of

623
00:27:40,680 --> 00:27:38,379
electronic hardware that we probably

624
00:27:44,159 --> 00:27:40,690
wouldn't be allowed to do on a more

625
00:27:45,990 --> 00:27:44,169
expensive mission and so part of this in

626
00:27:47,249 --> 00:27:46,000
this case at least we're kind of anxious

627
00:27:49,919 --> 00:27:47,259
to find out how all the other

628
00:27:53,430 --> 00:27:49,929
electronics works work too so it's all a

629
00:27:57,330 --> 00:27:53,440
big experiment other questions here

630
00:28:01,560 --> 00:27:57,340
Janine are these this kind of Hannah

631
00:28:03,240 --> 00:28:01,570
hands-on lesson for the students I'll

632
00:28:04,970 --> 00:28:03,250
answer that because I work at a place

633
00:28:08,009 --> 00:28:04,980
where we actually hire a lot of these

634
00:28:10,980 --> 00:28:08,019
people that graduate and it makes a

635
00:28:13,740 --> 00:28:10,990
tremendous difference they come in with

636
00:28:14,730 --> 00:28:13,750
experience being around spacecraft I'm

637
00:28:17,039 --> 00:28:14,740
going to stay a little bit about the

638
00:28:18,299 --> 00:28:17,049

space environment they understand a

639
00:28:19,980 --> 00:28:18,309
little bit about what you have to go

640
00:28:21,570 --> 00:28:19,990
through to get things launched they

641
00:28:23,460 --> 00:28:21,580
understand a lot about what you need to

642
00:28:25,320 --> 00:28:23,470
do to test things so that they will work

643
00:28:29,820 --> 00:28:25,330
with some reliability when you do launch

644
00:28:34,200 --> 00:28:29,830
them so it's extremely valuable I'll

645
00:28:37,619 --> 00:28:34,210
just add comment on on the fact that the

646
00:28:39,359 --> 00:28:37,629
students are there practicing their

647
00:28:41,310 --> 00:28:39,369
careers they're practicing what they've

648
00:28:43,590 --> 00:28:41,320
learned in the classroom

649
00:28:46,620 --> 00:28:43,600
but their practice practicing it in a

650
00:28:49,019 --> 00:28:46,630
very interdisciplinary way when when the

651
00:28:50,639 --> 00:28:49,029
students come together to put one design

652
00:28:51,990 --> 00:28:50,649
and build one of these satellites and

653
00:28:55,169 --> 00:28:52,000
take it through tests and space

654
00:28:57,180 --> 00:28:55,179
qualification we have mechanical

655
00:28:59,249 --> 00:28:57,190
engineering students thermal engineers

656
00:29:01,889 --> 00:28:59,259
computer science students computer

657
00:29:04,289 --> 00:29:01,899
engineering electrical engineering and

658
00:29:05,879 --> 00:29:04,299
physics students all in the same room

659
00:29:07,649 --> 00:29:05,889
together and they're all bouncing

660
00:29:09,389 --> 00:29:07,659
they're their own little ideas off of

661
00:29:11,370 --> 00:29:09,399
each other what we should do it this way

662
00:29:13,830 --> 00:29:11,380
and the other guy says no you I can't

663
00:29:15,509 --> 00:29:13,840

support that much power on my thermal

664
00:29:17,369 --> 00:29:15,519
system and and so it's a real

665
00:29:19,860 --> 00:29:17,379
interdisciplinary interaction that makes

666
00:29:22,799 --> 00:29:19,870
them that hones their skills and makes

667
00:29:25,049 --> 00:29:22,809
them so valuable to to JPL and and the

668
00:29:29,519 --> 00:29:25,059
other employers in the aerospace

669
00:29:32,759 --> 00:29:29,529
industry alright we can take social

670
00:29:40,110 --> 00:29:32,769
media questions now have we got some

671
00:29:41,549 --> 00:29:40,120
that have come in all right wonderful

672
00:29:43,769 --> 00:29:41,559
this first question comes from twitter

673
00:29:45,869 --> 00:29:43,779
user harm who asks what are the

674
00:29:47,460 --> 00:29:45,879
advantages of cube SATs over normal

675
00:29:51,509 --> 00:29:47,470
satellites and how will these satellites

676
00:29:54,180 --> 00:29:51,519
benefit NASA oh let me take those second

677
00:29:57,869 --> 00:29:54,190
one first and how they dim and held a

678
00:30:00,990 --> 00:29:57,879
benefit NASA is one we have a mission to

679
00:30:03,060 --> 00:30:01,000
help improve the educational

680
00:30:04,799 --> 00:30:03,070
opportunities for students in the United

681
00:30:06,810 --> 00:30:04,809
States relative to science technology

682
00:30:09,600 --> 00:30:06,820
engineering and mathematics and as you

683
00:30:12,720 --> 00:30:09,610
heard this is an absolutely outstanding

684
00:30:15,360 --> 00:30:12,730
way for students to get real world

685
00:30:16,799 --> 00:30:15,370
experience on building flight hardware

686
00:30:18,899 --> 00:30:16,809
that they can take into their careers

687
00:30:21,360 --> 00:30:18,909
and hopefully keep them motivated to

688
00:30:24,570 --> 00:30:21,370

stay in the aerospace or other technical

689
00:30:26,279 --> 00:30:24,580
fields so then on top of that we get the

690
00:30:29,490 --> 00:30:26,289
opportunity to go demonstrate technology

691
00:30:31,529 --> 00:30:29,500
as griffix is going to do and as all

692
00:30:33,539 --> 00:30:31,539
three satellites are going to do we gain

693
00:30:36,509 --> 00:30:33,549
scientific knowledge which is also one

694
00:30:39,659 --> 00:30:36,519
of NASA's strategic objectives so so we

695
00:30:41,970 --> 00:30:39,669
get all the above and as far as benefits

696
00:30:44,789 --> 00:30:41,980
over larger satellites well I think you

697
00:30:48,180 --> 00:30:44,799
heard that too you can experiment the

698
00:30:50,669 --> 00:30:48,190
cost is such that we can try and fail

699
00:30:52,440 --> 00:30:50,679
and try again and fail or learn

700
00:30:54,419 --> 00:30:52,450
something every time incrementally and

701
00:30:55,080 --> 00:30:54,429
get better at something without making

702
00:30:56,490 --> 00:30:55,090
the huge

703
00:30:59,640 --> 00:30:56,500
investment that one would have to make

704
00:31:01,140 --> 00:30:59,650
if you were to buy a large satellite and

705
00:31:05,190 --> 00:31:01,150
invest in the launch service for that

706
00:31:07,500 --> 00:31:05,200
large satellite I just add a word if I

707
00:31:09,450 --> 00:31:07,510
could about about the technology

708
00:31:12,090 --> 00:31:09,460
development that can be done with these

709
00:31:16,290 --> 00:31:12,100
very small satellites I happen to bring

710
00:31:18,570 --> 00:31:16,300
along today the next satellite that it's

711
00:31:21,420 --> 00:31:18,580
it's it's a copy of the structure of the

712
00:31:25,350 --> 00:31:21,430
next satellite that Montana State will

713
00:31:28,710 --> 00:31:25,360

be building and if I up this is a

714
00:31:31,590 --> 00:31:28,720
completely 3d printed flight model

715
00:31:35,850 --> 00:31:31,600
flight satellite it's not a model it's

716
00:31:38,820 --> 00:31:35,860
not just a test demonstration this this

717
00:31:41,070 --> 00:31:38,830
3d printed structure will actually fly

718
00:31:44,700 --> 00:31:41,080
in the space environment it's not made

719
00:31:46,770 --> 00:31:44,710
of aluminum it's all plastic and that's

720
00:31:49,800 --> 00:31:46,780
the kind of technology that we can test

721
00:31:54,960 --> 00:31:49,810
in the space environment at a very low

722
00:31:58,830 --> 00:31:54,970
cost with cube sets inexpensive and

723
00:31:59,880 --> 00:31:58,840
faster I mean griffix which I think well

724
00:32:01,530 --> 00:31:59,890
we took a little longer than we

725
00:32:03,900 --> 00:32:01,540
anticipate it was less than three years

726
00:32:05,100 --> 00:32:03,910
from when we first thought about it too

727
00:32:07,200 --> 00:32:05,110
when we're actually going to launch it

728
00:32:11,400 --> 00:32:07,210
that's absolutely remarkable in the

729
00:32:14,250 --> 00:32:11,410
space business so next question comes

730
00:32:15,480 --> 00:32:14,260
from a Facebook user Warren who asks

731
00:32:18,090 --> 00:32:15,490
where the students at Montana State

732
00:32:19,680 --> 00:32:18,100
completely autonomous or were they asked

733
00:32:21,750 --> 00:32:19,690
to follow a specific template due to the

734
00:32:23,190 --> 00:32:21,760
size and safety restrictions or were

735
00:32:26,390 --> 00:32:23,200
they consulting with NASA engineers

736
00:32:30,660 --> 00:32:26,400
frequently and if so how frequently

737
00:32:33,420 --> 00:32:30,670
there is a very specific there's a very

738
00:32:36,390 --> 00:32:33,430

specific requirement on the size and

739
00:32:38,190 --> 00:32:36,400
mass of these cube sets you'll see that

740
00:32:41,510 --> 00:32:38,200
they all have very identical features

741
00:32:43,650 --> 00:32:41,520
from the outward appearances internally

742
00:32:46,170 --> 00:32:43,660
everything that goes into them is

743
00:32:49,430 --> 00:32:46,180
entirely up to the design team for each

744
00:32:52,290 --> 00:32:49,440
specific mission our students are are

745
00:32:54,720 --> 00:32:52,300
advised by a couple of full time and

746
00:32:57,630 --> 00:32:54,730
space flight engineers that work with

747
00:33:00,450 --> 00:32:57,640
the faculty myself and another faculty

748
00:33:03,300 --> 00:33:00,460
member to guide the students but they're

749
00:33:07,740 --> 00:33:03,310
left a lot on their own a big part of

750
00:33:08,710 --> 00:33:07,750
this this whole adventure is is trial by

751
00:33:11,440 --> 00:33:08,720
error

752
00:33:14,110 --> 00:33:11,450
trial by fire in other words we throw it

753
00:33:17,289 --> 00:33:14,120
at the students to to come to the table

754
00:33:19,000 --> 00:33:17,299
with it with a job well done and we help

755
00:33:21,820 --> 00:33:19,010
them along the way we meant to them we

756
00:33:24,100 --> 00:33:21,830
guide them we run regular meetings each

757
00:33:26,860 --> 00:33:24,110
week with the students but the ultimate

758
00:33:29,919 --> 00:33:26,870
design work and the fabrication is done

759
00:33:32,590 --> 00:33:29,929
by the students themselves and to add on

760
00:33:34,870 --> 00:33:32,600
to that from a government perspective we

761
00:33:37,149 --> 00:33:34,880
levy a fairly lengthy list of

762
00:33:38,890 --> 00:33:37,159
requirements on each satellite provider

763
00:33:41,950 --> 00:33:38,900

to ensure that the hardware they're

764
00:33:44,710 --> 00:33:41,960
providing is going to be safe to fly and

765
00:33:47,049 --> 00:33:44,720
so we work then with our integration

766
00:33:48,669 --> 00:33:47,059
contractor Cal Poly and with each of the

767
00:33:50,980 --> 00:33:48,679
teams to make sure that they have

768
00:33:53,770 --> 00:33:50,990
provided all the evidence necessary to

769
00:33:56,380 --> 00:33:53,780
prove to independent authorities that

770
00:33:58,240 --> 00:33:56,390
this hardware is safe to go fly that

771
00:34:00,730 --> 00:33:58,250
interaction takes place over the course

772
00:34:03,070 --> 00:34:00,740
of the campaign a little over a year in

773
00:34:04,990 --> 00:34:03,080
total and in the end we have all the

774
00:34:08,800 --> 00:34:05,000
evidence necessary to show that we are

775
00:34:10,839 --> 00:34:08,810
clear to fly excellent you just actually

776
00:34:12,490 --> 00:34:10,849
answered a Twitter user Joe's question

777
00:34:13,869 --> 00:34:12,500
about the basic required functions for

778
00:34:16,720 --> 00:34:13,879
cube SATs so thanks for taking care of

779
00:34:18,849 --> 00:34:16,730
that moving on this question comes from

780
00:34:20,649 --> 00:34:18,859
Twitter users Scott who asks what is the

781
00:34:22,419 --> 00:34:20,659
average total cost of a CubeSat

782
00:34:29,379 --> 00:34:22,429
including development launch and mission

783
00:34:30,820 --> 00:34:29,389
operations for 1 2 and 3 cube SATs well

784
00:34:33,070 --> 00:34:30,830
let's see I think from what I've heard

785
00:34:35,260 --> 00:34:33,080
from because there's multiple pieces of

786
00:34:38,440 --> 00:34:35,270
that and and I don't think none of us

787
00:34:40,329 --> 00:34:38,450
control all the pieces but we we go out

788
00:34:42,490 --> 00:34:40,339

and buy the integration services the

789
00:34:44,649 --> 00:34:42,500
dispensers the launch service meanwhile

790
00:34:46,359 --> 00:34:44,659
the satellite providers pay for building

791
00:34:48,250 --> 00:34:46,369
and testing the satellite and then we

792
00:34:49,780 --> 00:34:48,260
all pay for the paperwork that goes

793
00:34:52,030 --> 00:34:49,790
along with trying to prove that it's

794
00:34:54,399 --> 00:34:52,040
okay to fly I think it's probably safe

795
00:34:57,460 --> 00:34:54,409
to say that on average it's it's close

796
00:35:00,010 --> 00:34:57,470
to a million or two million dollars in

797
00:35:01,839 --> 00:35:00,020
the end in total for everything but I

798
00:35:04,180 --> 00:35:01,849
think it varies widely depending upon

799
00:35:05,680 --> 00:35:04,190
the sophistication of the scientific

800
00:35:08,380 --> 00:35:05,690
instrument that's flying on that

801
00:35:11,140 --> 00:35:08,390
satellite every cube set that we deal

802
00:35:12,940 --> 00:35:11,150
with is is different some have very

803
00:35:15,010 --> 00:35:12,950
sophisticated very expensive items

804
00:35:16,839 --> 00:35:15,020
inside and some are very simple and

805
00:35:19,030 --> 00:35:16,849
straightforward so there's a wide range

806
00:35:22,559 --> 00:35:19,040
but probably if I were to say on average

807
00:35:24,880 --> 00:35:22,569
it's one to two million dollars

808
00:35:27,130 --> 00:35:24,890
additional questions on social media

809
00:35:29,049 --> 00:35:27,140
indeed we have a few more here this one

810
00:35:33,809 --> 00:35:29,059
comes from twitter user Larry who asks

811
00:35:39,520 --> 00:35:36,640
they're working on it in fact some some

812
00:35:41,859 --> 00:35:39,530
do mine does not if it's all passive

813
00:35:43,539 --> 00:35:41,869

it's sort of fly it's got magnets in it

814
00:35:45,700 --> 00:35:43,549
and flies on the magnetic field lines of

815
00:35:46,900 --> 00:35:45,710
the earth but I know at JPL we're

816
00:35:50,260 --> 00:35:46,910
working on several where we actually

817
00:35:51,760 --> 00:35:50,270
have gas propulsion system that's

818
00:35:54,039 --> 00:35:51,770
particularly important if you start

819
00:35:56,710 --> 00:35:54,049
thinking about sending a CubeSat out of

820
00:35:58,930 --> 00:35:56,720
Earth's orbit because it takes some

821
00:36:02,230 --> 00:35:58,940
energy to get it on its way to where

822
00:36:05,400 --> 00:36:02,240
what's going so griffix doesn't I don't

823
00:36:08,200 --> 00:36:05,410
fix XO cube does have attitude control

824
00:36:09,250 --> 00:36:08,210
determination control absolutely and it

825
00:36:10,210 --> 00:36:09,260
depends on the satellite depends on the

826
00:36:11,710 --> 00:36:10,220
mission whether or not you need it

827
00:36:13,539 --> 00:36:11,720
obviously that's going to increase the

828
00:36:14,799 --> 00:36:13,549
complexity and drive some of the costs

829
00:36:18,190 --> 00:36:14,809
of the satellite if you need to include

830
00:36:20,049 --> 00:36:18,200
attitude control execute does not have

831
00:36:21,370 --> 00:36:20,059
full three access attitude control there

832
00:36:23,410 --> 00:36:21,380
are definitely satellites you see that

833
00:36:25,750 --> 00:36:23,420
have the full three reaction wheels and

834
00:36:29,289 --> 00:36:25,760
can have full three access control x 0

835
00:36:31,029 --> 00:36:29,299
cube and said as I showed you the boobs

836
00:36:32,620 --> 00:36:31,039
before that's part of the system right

837
00:36:35,079 --> 00:36:32,630
they have the gravity gradient booms one

838
00:36:36,460 --> 00:36:35,089

on either side and then there's a single

839
00:36:38,859 --> 00:36:36,470
wheel in the center which helps

840
00:36:40,930 --> 00:36:38,869
stabilize the axis in the other act and

841
00:36:42,970 --> 00:36:40,940
stabilize the satellite in the other

842
00:36:44,529 --> 00:36:42,980
axis so it uses gravity gradient delp

843
00:36:47,289 --> 00:36:44,539
stabilized two of the axes and then it

844
00:36:48,519 --> 00:36:47,299
uses the wheel to help with the third so

845
00:36:51,880 --> 00:36:48,529
it's a form of attitude Colonel's not as

846
00:36:53,410 --> 00:36:51,890
precise as a three wheel system but that

847
00:36:56,140 --> 00:36:53,420
wasn't necessary for this particular

848
00:36:58,089 --> 00:36:56,150
mission follow-up question to that comes

849
00:37:00,279 --> 00:36:58,099
from twitter user nil who asks how does

850
00:37:02,019 --> 00:37:00,289
the boom ensure that a cubesat will face

851
00:37:06,059 --> 00:37:02,029
towards Earth rather than rotate freely

852
00:37:09,130 --> 00:37:06,069
in space the gravity gradient effect

853
00:37:11,319 --> 00:37:09,140
works by gravity pulling slightly harder

854
00:37:13,359 --> 00:37:11,329
on the bottom boom versus the top boom

855
00:37:15,279 --> 00:37:13,369
and that tends to cause a satellite to

856
00:37:17,799 --> 00:37:15,289
stay oriented with one of the booms

857
00:37:20,769 --> 00:37:17,809
facing earth there are a couple of other

858
00:37:22,480 --> 00:37:20,779
coils here that we have to align the

859
00:37:24,549 --> 00:37:22,490
satellite roughly in that orientation

860
00:37:27,250 --> 00:37:24,559
before we deploy the booms so we can

861
00:37:29,500 --> 00:37:27,260
ensure that the satellite is correctly

862
00:37:32,650 --> 00:37:29,510
oriented vertically before we try to

863
00:37:35,559 --> 00:37:32,660

stabilize it in the third axis

864
00:37:37,240 --> 00:37:35,569
all right this next question comes from

865
00:37:38,770 --> 00:37:37,250
twitter user Matthew who asks could

866
00:37:41,140 --> 00:37:38,780
something like this be used for

867
00:37:43,240 --> 00:37:41,150
conducting similar missions that go

868
00:37:47,680 --> 00:37:43,250
along with things to the moon asteroids

869
00:37:49,690 --> 00:37:47,690
or even Mars yeah and in fact we're

870
00:37:51,970 --> 00:37:49,700
going to go do that we have some

871
00:37:54,609 --> 00:37:51,980
missions that that we're working on

872
00:37:57,520 --> 00:37:54,619
right now to send some cube sets along

873
00:38:00,670 --> 00:37:57,530
with larger spacecraft and Mars and then

874
00:38:03,430 --> 00:38:00,680
I'm actually working on a mission the

875
00:38:05,589 --> 00:38:03,440
first SLS mission that's coming up e-m1

876
00:38:07,329 --> 00:38:05,599
we're going to fly cube sets on that

877
00:38:10,029 --> 00:38:07,339
mission that are going to go to the moon

878
00:38:12,430 --> 00:38:10,039
to near-earth asteroids and out into

879
00:38:14,559 --> 00:38:12,440
deeper space to do other interesting

880
00:38:16,510 --> 00:38:14,569
things so absolutely NASA is interested

881
00:38:20,200 --> 00:38:16,520
in seeing that happen and we're going to

882
00:38:22,809 --> 00:38:20,210
make it happen I just add right now

883
00:38:24,279 --> 00:38:22,819
there's a as an opportunity to the

884
00:38:28,930 --> 00:38:24,289
scientific and university community

885
00:38:32,380 --> 00:38:28,940
broadly from NASA's planetary sciences

886
00:38:35,799 --> 00:38:32,390
division and right now as we speak there

887
00:38:37,539 --> 00:38:35,809
are dozens of teams out there working on

888
00:38:41,470 --> 00:38:37,549

their proposals that are due on March

889
00:38:44,529 --> 00:38:41,480
thirteenth to fly on this em1 mission or

890
00:38:48,670 --> 00:38:44,539
a similar mission to do planetary

891
00:38:50,049 --> 00:38:48,680
science very much so it's a great sec to

892
00:38:52,029 --> 00:38:50,059
this question here from Twitter user

893
00:38:53,349 --> 00:38:52,039
Elaine who asks how do you choose which

894
00:39:01,599 --> 00:38:53,359
universities to partner with for

895
00:39:04,140 --> 00:39:01,609
projects like these I there's there's a

896
00:39:06,400 --> 00:39:04,150
long-established sort of collegial

897
00:39:10,059 --> 00:39:06,410
relationships I would say we we

898
00:39:11,859 --> 00:39:10,069
typically know who's good at one

899
00:39:15,720 --> 00:39:11,869
particular subsystem or one particular

900
00:39:19,210 --> 00:39:15,730
area typically as was described earlier

901
00:39:21,519 --> 00:39:19,220
we do compete for funding for all these

902
00:39:25,870 --> 00:39:21,529
missions so we want to put the best team

903
00:39:27,849 --> 00:39:25,880
forward that we can we get together we

904
00:39:30,099 --> 00:39:27,859
choose a particular science

905
00:39:31,930 --> 00:39:30,109
investigation and that drives the

906
00:39:34,450 --> 00:39:31,940
instrumentation and the hardware that

907
00:39:37,269 --> 00:39:34,460
will be developed so the teaming you

908
00:39:41,319 --> 00:39:37,279
know it's a lot about who you know kind

909
00:39:43,690 --> 00:39:41,329
of but but but it's it's not for it's

910
00:39:46,630 --> 00:39:43,700
the forming the team is not a very

911
00:39:49,160 --> 00:39:46,640
formal process it happens

912
00:39:52,010 --> 00:39:49,170
it happens at meetings it happens

913
00:39:54,470 --> 00:39:52,020

through email and eventually a team

914
00:39:55,970 --> 00:39:54,480
comes together and things start to click

915
00:39:58,460 --> 00:39:55,980
but we pretty much know each other

916
00:40:00,200 --> 00:39:58,470
before we start right we'll take one

917
00:40:02,210 --> 00:40:00,210
more social media question before we

918
00:40:04,130 --> 00:40:02,220
wrap up last question comes from Twitter

919
00:40:05,750 --> 00:40:04,140
user amber who asks what type of data

920
00:40:10,150 --> 00:40:05,760
and what format do these cube SATs

921
00:40:16,610 --> 00:40:14,000
I'll start that one the data in the

922
00:40:19,280 --> 00:40:16,620
format that the data in is in is very

923
00:40:20,930 --> 00:40:19,290
specific to the mission right so the

924
00:40:22,850 --> 00:40:20,940
data format that we get out of the mass

925
00:40:25,010 --> 00:40:22,860
spectrometer on XO cube is going to look

926
00:40:27,230 --> 00:40:25,020
different than the data format on other

927
00:40:29,780 --> 00:40:27,240
missions now in terms of down linking it

928
00:40:32,630 --> 00:40:29,790
to earth we do use a largely

929
00:40:36,050 --> 00:40:32,640
standardized format for communicating

930
00:40:37,760 --> 00:40:36,060
the data over the radio namely using a x

931
00:40:38,810 --> 00:40:37,770
25 which is part of the amateur radio

932
00:40:41,120 --> 00:40:38,820
community and we do this for

933
00:40:43,100 --> 00:40:41,130
interoperability so that the ground

934
00:40:45,050 --> 00:40:43,110
station that we have at Cal Poly can

935
00:40:46,220 --> 00:40:45,060
participate in tracking griffix and

936
00:40:48,290 --> 00:40:46,230
helping get the data from griffix

937
00:40:50,870 --> 00:40:48,300
tracking firebird helping getting the

938
00:40:53,780 --> 00:40:50,880

data from firebird so as a community we

939
00:40:55,610 --> 00:40:53,790
try to work together to downlink the

940
00:40:58,640 --> 00:40:55,620
data and that level of interoperability

941
00:41:00,050 --> 00:40:58,650
is exist does exist when the satellites

942
00:41:02,540 --> 00:41:00,060
when it comes to the actual science data

943
00:41:04,570 --> 00:41:02,550
and the format of the data itself that

944
00:41:09,680 --> 00:41:04,580
varies largely from mission to Mission

945
00:41:13,880 --> 00:41:09,690
I'll just underscore that the the radio

946
00:41:15,830 --> 00:41:13,890
system on which that's that's the DS

947
00:41:19,160 --> 00:41:15,840
that many of these cube SATs are

948
00:41:23,240 --> 00:41:19,170
transmitting from is readily heard by

949
00:41:26,890 --> 00:41:23,250
and translated by amateur radio folks

950
00:41:29,630 --> 00:41:26,900
and there's a community of amateur radio

951
00:41:32,540 --> 00:41:29,640
enthusiasts around the world and a

952
00:41:35,390 --> 00:41:32,550
subset of that community is very active

953
00:41:40,030 --> 00:41:35,400
in tracking satellites as they're

954
00:41:42,800 --> 00:41:40,040
launched so we expect a colleague from

955
00:41:45,950 --> 00:41:42,810
Germany to be the very first person to

956
00:41:48,950 --> 00:41:45,960
hear our cube set if the orbit predict

957
00:41:51,670 --> 00:41:48,960
is right will turn on just as we cross

958
00:41:57,319 --> 00:41:51,680
the Mediterranean heading north and

959
00:42:00,199 --> 00:41:57,329
Germany will be right within the the the

960
00:42:03,049 --> 00:42:00,209
the data band through which the

961
00:42:06,170 --> 00:42:03,059
satellite can be be heard so so these

962
00:42:08,959 --> 00:42:06,180
amateur radio guys amsac community

963
00:42:10,670 --> 00:42:08,969

really is really helpful for this entire

964
00:42:12,620 --> 00:42:10,680
university community and we're really

965
00:42:15,680 --> 00:42:12,630
pleased that those guys and gals are out

966
00:42:18,680 --> 00:42:15,690
there helping us out all right any

967
00:42:20,359 --> 00:42:18,690
further questions here in the room all

968
00:42:22,819 --> 00:42:20,369
right in that event that's going to

969
00:42:24,589 --> 00:42:22,829
conclude this briefing and a programming

970
00:42:27,289 --> 00:42:24,599
note about our launch coverage on NASA

971
00:42:30,259 --> 00:42:27,299
television which will start at four a.m.