GTRI Space Strategic Initiative: MicroNimbus CubeSat

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Georgia Tech Astrobiology

1
00:00:00,820 --> 00:00:08,680
[Music]

2
00:00:14,060 --> 00:00:11,509
so we're gonna change gears I'm not a

3
00:00:16,970 --> 00:00:14,070
biochemist I'm actually an electrical

4
00:00:18,590 --> 00:00:16,980
engineer and I wanted to give a brief

5
00:00:21,109 --> 00:00:18,600
overview to everyone here about some of

6
00:00:22,970 --> 00:00:21,119
this remote sensing and other space

7
00:00:25,400 --> 00:00:22,980
applications that were working at GTRI

8
00:00:30,980 --> 00:00:25,410
collaboration with pubic schools at door

9
00:00:33,319 --> 00:00:30,990
tech so this is outline so first I'll

10
00:00:36,080 --> 00:00:33,329
provide a beep background about Georgia

11
00:00:37,880 --> 00:00:36,090
Georgia Tech in their space history the

12
00:00:39,350 --> 00:00:37,890
bulk of my talks and a focus on this

13
00:00:42,650 --> 00:00:39,360

micro name is IRA which is a remote

14
00:00:45,860 --> 00:00:42,660
sensing CubeSat for measuring the

15
00:00:47,389 --> 00:00:45,870
temperature in the atmosphere and then

16
00:00:49,369 --> 00:00:47,399
I'll wrap up with some other

17
00:00:53,090 --> 00:00:49,379
applications that we've done and take

18
00:00:55,279 --> 00:00:53,100
any questions that you may have so some

19
00:00:57,670 --> 00:00:55,289
of the history of GTRI so back in the

20
00:01:00,500 --> 00:00:57,680
80s we worked with the long-duration

21
00:01:02,510 --> 00:01:00,510
exposure facility which was about a bus

22
00:01:04,310 --> 00:01:02,520
sized satellite in space and was meant

23
00:01:06,050 --> 00:01:04,320
to have some experiments to see the

24
00:01:08,090 --> 00:01:06,060
effects of low Earth orbit in particular

25
00:01:10,760 --> 00:01:08,100
radiation on those experiments similar

26
00:01:12,469 --> 00:01:10,770
biological some of them electrical in

27
00:01:13,910 --> 00:01:12,479
the 90s we worked with the International

28
00:01:16,100 --> 00:01:13,920
Space Station and work on their airlock

29
00:01:25,219 --> 00:01:16,110
antenna and you can see right here you

30
00:01:26,929 --> 00:01:25,229
see a knot and sat the attendant

31
00:01:28,130 --> 00:01:26,939
actually is built into the handle here

32
00:01:30,319 --> 00:01:28,140
and so what they use actually

33
00:01:31,249 --> 00:01:30,329
communicate with their fellow astronauts

34
00:01:33,740 --> 00:01:31,259
and the space station when they're

35
00:01:35,539 --> 00:01:33,750
coming through the airlock as I

36
00:01:37,190 --> 00:01:35,549
mentioned the focus of my talk will be

37
00:01:40,149 --> 00:01:37,200
on these current projects were working

38
00:01:42,140 --> 00:01:40,159

at primarily that micro numbers CubeSat

39
00:01:43,760 --> 00:01:42,150
before we go into the actual engineering

40
00:01:46,010 --> 00:01:43,770
behind Micra numbers I'll give you an

41
00:01:47,450 --> 00:01:46,020
outline of what we were talking about

42
00:01:55,250 --> 00:01:47,460
we're looking at a remote sensing

43
00:02:01,320 --> 00:01:59,070
okay so what we're doing is we're

44
00:02:03,420 --> 00:02:01,330
focusing on the 60 gigahertz RF spectrum

45
00:02:06,710 --> 00:02:03,430
and what we see here in the right hand

46
00:02:08,640 --> 00:02:06,720
side is attenuation or absorption of

47
00:02:11,730 --> 00:02:08,650
electromagnetic radiation against

48
00:02:14,400 --> 00:02:11,740
frequency for oxygen and normally oxygen

49
00:02:16,380 --> 00:02:14,410
has very fine lines in this absorption

50
00:02:18,180 --> 00:02:16,390
spectrum but at lower altitudes we

51
00:02:19,770 --> 00:02:18,190
actually see a polar broadening due to

52
00:02:21,900 --> 00:02:19,780
high pressures in the lower atmosphere

53
00:02:23,640 --> 00:02:21,910
but as you go higher up you actually

54
00:02:25,020 --> 00:02:23,650
start to resolve these different

55
00:02:26,850 --> 00:02:25,030
transition frequencies and what we can

56
00:02:29,420 --> 00:02:26,860
do is because of that we can actually

57
00:02:31,710 --> 00:02:29,430
focus in frequency and bandwidth of our

58
00:02:33,840 --> 00:02:31,720
system and we can actually tune to one

59
00:02:35,880 --> 00:02:33,850
of these transition frequencies and we

60
00:02:37,380 --> 00:02:35,890
can probe along it and by doing that you

61
00:02:40,250 --> 00:02:37,390
can actually focus in a certain area in

62
00:02:44,850 --> 00:02:40,260
the atmosphere and engage is temperature

63
00:02:48,270 --> 00:02:44,860

so by doing that we focused thisis from

64
00:02:50,280 --> 00:02:48,280
MIT by William Lenoir and he provided

65
00:02:53,400 --> 00:02:50,290
that if you chose certain frequencies

66
00:02:54,990 --> 00:02:53,410
and bandwidths across that spectrum you

67
00:02:57,540 --> 00:02:55,000
could resolve these weighting functions

68
00:02:59,130 --> 00:02:57,550
or windows and basically if you choose

69
00:03:01,080 --> 00:02:59,140
these are frequencies and bandwidth so

70
00:03:03,150 --> 00:03:01,090
you're isolating your measurement to

71
00:03:04,620 --> 00:03:03,160
this like an isothermal slab in the

72
00:03:06,930 --> 00:03:04,630
atmosphere so you can actually focus and

73
00:03:08,880 --> 00:03:06,940
measure the temperature of that slab of

74
00:03:09,960 --> 00:03:08,890
the atmosphere am i changing that you

75
00:03:12,449 --> 00:03:09,970
can actually walk across these

76
00:03:17,670 --> 00:03:12,459
frequencies and we've actually optimized

77
00:03:19,170 --> 00:03:17,680
that to account for our equipment and we

78
00:03:20,520 --> 00:03:19,180
see we have seven window functions so if

79
00:03:21,840 --> 00:03:20,530
I were flying over the low Earth orbit

80
00:03:23,910 --> 00:03:21,850
we could actually scan across these

81
00:03:25,650 --> 00:03:23,920
different frequencies and measure from

82
00:03:27,600 --> 00:03:25,660
about 10 kilometers up to 70 kilometers

83
00:03:30,270 --> 00:03:27,610
and get a very large depth profile of

84
00:03:33,720 --> 00:03:30,280
the atmosphere for weather radars and

85
00:03:35,040 --> 00:03:33,730
other applications so I don't know how

86
00:03:37,590 --> 00:03:35,050
many electrical engineers are here so I

87
00:03:41,190 --> 00:03:37,600
won't go too deep into this but one of

88
00:03:44,510 --> 00:03:41,200

the big novel aspects of this system was

89
00:03:46,470 --> 00:03:44,520
that we took a like a board level or

90
00:03:47,670 --> 00:03:46,480
already I'm going to use commercial

91
00:03:49,050 --> 00:03:47,680
off-the-shelf parts and we actually

92
00:03:52,860 --> 00:03:49,060
integrate everything into a single chip

93
00:03:54,180 --> 00:03:52,870
so we see here is a receiver that would

94
00:03:55,710 --> 00:03:54,190
use in a Radiometer where we have an

95
00:03:58,860 --> 00:03:55,720
antenna that's pointing down at the

96
00:04:00,479 --> 00:03:58,870
earth we have gone ship calibration

97
00:04:01,770 --> 00:04:00,489
which usually is a fixed load at a

98
00:04:04,410 --> 00:04:01,780
certain temperature that we can switch

99
00:04:05,720 --> 00:04:04,420
to and calibrate our receiver chant our

100
00:04:08,160 --> 00:04:05,730
receiver channels and then we have

101
00:04:09,870 --> 00:04:08,170
amplification and down conversion

102
00:04:12,000 --> 00:04:09,880
and that lets us select a certain

103
00:04:13,260 --> 00:04:12,010
frequency and then we pass it on to a

104
00:04:15,930 --> 00:04:13,270
filter bank that can select our

105
00:04:18,060 --> 00:04:15,940
different bandwidths to do this we

106
00:04:20,069 --> 00:04:18,070
collaborated with my former advisor at

107
00:04:21,420 --> 00:04:20,079
GT electrical Computer Engineering

108
00:04:23,909 --> 00:04:21,430
school of electrical computer

109
00:04:25,020 --> 00:04:23,919
engineering dr. John kressler who are

110
00:04:28,020 --> 00:04:25,030
leaders in the silicon germanium

111
00:04:30,150 --> 00:04:28,030
research effort said can design these

112
00:04:31,440 --> 00:04:30,160
type of applications on a single chip we

113
00:04:33,150 --> 00:04:31,450

chose silicon germanium because it

114
00:04:34,920 --> 00:04:33,160
provides some performance compared to 35

115
00:04:36,390 --> 00:04:34,930
it's cheaper you can integrate digital

116
00:04:38,909 --> 00:04:36,400
you can bring everything down to a

117
00:04:40,320 --> 00:04:38,919
single chip it has excellent one of a

118
00:04:41,909 --> 00:04:40,330
rough noise which would if you don't

119
00:04:43,890 --> 00:04:41,919
know what that means is that it provided

120
00:04:45,690 --> 00:04:43,900
a good long-term stability in these

121
00:04:47,280 --> 00:04:45,700
systems and its radiation hard

122
00:04:48,510 --> 00:04:47,290
especially particularly for low Earth

123
00:04:52,409 --> 00:04:48,520
orbit and even up to the Jovian

124
00:04:56,100 --> 00:04:52,419
atmosphere so this is what it integrated

125
00:04:57,810 --> 00:04:56,110
radiometer looks like that won't go down

126
00:04:59,820 --> 00:04:57,820
too deep of biggest things I want to

127
00:05:02,580 --> 00:04:59,830
talk about is that it's very small

128
00:05:04,440 --> 00:05:02,590
you bring that whole that whole receiver

129
00:05:06,300 --> 00:05:04,450
channel down to a single chip it's about

130
00:05:09,090 --> 00:05:06,310
one millimeter by two millimeters and

131
00:05:10,950 --> 00:05:09,100
you can see here the power draw it was

132
00:05:13,140 --> 00:05:10,960
only about 81 milliwatts these is this

133
00:05:15,000 --> 00:05:13,150
is a perfect system for CubeSat scoop

134
00:05:16,590 --> 00:05:15,010
size are very limited power distribution

135
00:05:19,800 --> 00:05:16,600
systems and they have very little

136
00:05:22,700 --> 00:05:19,810
limited power battery banks so we really

137
00:05:25,710 --> 00:05:22,710
need to reduce the power requirements

138
00:05:28,590 --> 00:05:25,720

this slide here shows some of the

139
00:05:32,430 --> 00:05:28,600
metrics all I'd want to convey is that

140
00:05:33,920 --> 00:05:32,440
this is comparable to the state of the

141
00:05:36,120 --> 00:05:33,930
art in terms of some of the other

142
00:05:40,890 --> 00:05:36,130
systems coming out of MIT Lincoln lab

143
00:05:42,779 --> 00:05:40,900
NASA or DPL and we allows us to resolve

144
00:05:44,969 --> 00:05:42,789
those temperatures down as we need to

145
00:05:46,650 --> 00:05:44,979
and we're actually working to reduce

146
00:05:48,779 --> 00:05:46,660
this noise figure this this is a

147
00:05:50,610 --> 00:05:48,789
limiting factor and how fine we can get

148
00:05:52,050 --> 00:05:50,620
down to a temperature measurement or

149
00:05:57,029 --> 00:05:52,060
brint trying to bring that down to our

150
00:05:59,520 --> 00:05:57,039
new final system now if we the previous

151
00:06:01,409 --> 00:05:59,530
slide showed some of that the dye

152
00:06:03,180 --> 00:06:01,419
micrograph of that receiver what we're

153
00:06:05,670 --> 00:06:03,190
seeing now is the full integration so

154
00:06:07,350 --> 00:06:05,680
now we have everything we need to look

155
00:06:10,290 --> 00:06:07,360
at 60 gigahertz measure the atmosphere

156
00:06:11,760 --> 00:06:10,300
bring it down to our i/o frequencies

157
00:06:13,680 --> 00:06:11,770
that we can actually digitize it and

158
00:06:15,240 --> 00:06:13,690
bring and beam it down to earth and now

159
00:06:18,390 --> 00:06:15,250
we're including everything we need to

160
00:06:20,760 --> 00:06:18,400
generate the local oscillator frequency

161
00:06:24,330 --> 00:06:20,770
what we need to ACTU downconvert

162
00:06:25,529 --> 00:06:24,340
and everything fits in about 2.5 by

163
00:06:31,170 --> 00:06:25,539

three millimeters squared so it's very

164
00:06:33,719 --> 00:06:31,180
very small so in terms of the actual

165
00:06:35,249 --> 00:06:33,729
payload we're working with professor

166
00:06:37,860 --> 00:06:35,259
Glenn Lightsey from the aerospace

167
00:06:38,879 --> 00:06:37,870
engineering department and I to help go

168
00:06:41,010 --> 00:06:38,889
through this I actually brought a

169
00:06:43,129 --> 00:06:41,020
one-to-one scale model of Micra numbers

170
00:06:45,900 --> 00:06:43,139
so if you don't know what cube SATs are

171
00:06:49,200 --> 00:06:45,910
they have a standard standardization so

172
00:06:51,960 --> 00:06:49,210
a 1u is a 10 centimeter by 10 centimeter

173
00:06:54,029 --> 00:06:51,970
by 10 centimeter volume and has a weight

174
00:06:56,820 --> 00:06:54,039
requirement as well but about 1.3 three

175
00:06:59,370 --> 00:06:56,830
kilograms or about 3 pounds and this is

176
00:07:02,700 --> 00:06:59,380
a 3u spacecraft so it's 10 by 10 by 30

177
00:07:04,260 --> 00:07:02,710
centimeters you can see here we could

178
00:07:07,020 --> 00:07:04,270
break into three sections the lower

179
00:07:08,730 --> 00:07:07,030
section hole to be on this side is our

180
00:07:10,100 --> 00:07:08,740
payload and that's what we're actually

181
00:07:12,689 --> 00:07:10,110
have a Radiometer and all the

182
00:07:15,240 --> 00:07:12,699
electronics we have we need you'll

183
00:07:18,270 --> 00:07:15,250
notice here we see a cone that's

184
00:07:19,710 --> 00:07:18,280
actually a horn antenna which is right

185
00:07:22,050 --> 00:07:19,720
here this is the actual size of what it

186
00:07:23,520 --> 00:07:22,060
would look like this alone had a lot of

187
00:07:24,749 --> 00:07:23,530
engineering behind it cuz normally to

188
00:07:26,999 --> 00:07:24,759

get the performance we need the beam

189
00:07:29,939 --> 00:07:27,009
wits we need to scan through resolving

190
00:07:31,909 --> 00:07:29,949
down to about 50 kilometers swath on the

191
00:07:33,749 --> 00:07:31,919
earth surface from low-earth orbit

192
00:07:35,580 --> 00:07:33,759
normally the three times longer than

193
00:07:38,430 --> 00:07:35,590
this which wouldn't fit and CubeSat so

194
00:07:40,320 --> 00:07:38,440
we re-engineered some got to fit and

195
00:07:43,560 --> 00:07:40,330
have the weight requirements to not push

196
00:07:45,360 --> 00:07:43,570
over what we need if we move over we'll

197
00:07:49,320 --> 00:07:45,370
see the other two modules which is what

198
00:07:51,749 --> 00:07:49,330
dr. Glenn Lightsey has led first of

199
00:07:54,149 --> 00:07:51,759
which was the attitude determination and

200
00:07:56,040 --> 00:07:54,159
control so I'll be this upper module and

201
00:07:58,790 --> 00:07:56,050
that has our Sun sensors for kind of

202
00:08:01,620 --> 00:07:58,800
getting us our bearing and all of our

203
00:08:03,600 --> 00:08:01,630
torque rods and reaction wheels we need

204
00:08:07,680 --> 00:08:03,610
to detail and control the satellite as

205
00:08:09,689 --> 00:08:07,690
its orbiting the earth we also have a

206
00:08:11,730 --> 00:08:09,699
service module which will be the center

207
00:08:14,459 --> 00:08:11,740
of the center region and that has our

208
00:08:16,439 --> 00:08:14,469
electric power system our GPS unit our

209
00:08:17,520 --> 00:08:16,449
command and data handling unit so all

210
00:08:23,129 --> 00:08:17,530
three of these are integrated together

211
00:08:25,200 --> 00:08:23,139
the form to build this and now this kind

212
00:08:27,809 --> 00:08:25,210
this gives you a view of how this would

213
00:08:29,610 --> 00:08:27,819

work so we we launch up we actually go

214
00:08:31,290 --> 00:08:29,620
to the ISS they actually have a CubeSat

215
00:08:32,730 --> 00:08:31,300
launcher on the ISS and they can just

216
00:08:34,380 --> 00:08:32,740
send these out and they're low-earth

217
00:08:37,140 --> 00:08:34,390
orbit when we come out

218
00:08:41,130 --> 00:08:37,150
we D tumble we get in a stable orbit and

219
00:08:43,860 --> 00:08:41,140
then once we are we power up and we're

220
00:08:46,470 --> 00:08:43,870
in our nominal operating regime we start

221
00:08:48,180 --> 00:08:46,480
scanning the Earth's surface we have to

222
00:08:50,220 --> 00:08:48,190
do all our measurements in about seven

223
00:08:52,080 --> 00:08:50,230
seconds because after seven seconds you

224
00:08:52,980 --> 00:08:52,090
pass over fifty seven kilometers or 60

225
00:08:53,580 --> 00:08:52,990
kilometer so we have to do all our

226
00:08:56,220 --> 00:08:53,590
measurements

227
00:08:59,070 --> 00:08:56,230
very quickly digitize it and then as we

228
00:09:00,840 --> 00:08:59,080
move across will scan again as we

229
00:09:02,850 --> 00:09:00,850
approach and we get in Lana's site of

230
00:09:05,040 --> 00:09:02,860
Georgia we actually have a ground

231
00:09:06,630 --> 00:09:05,050
station which I'll cover shortly and

232
00:09:09,570 --> 00:09:06,640
we'll start communicating and getting

233
00:09:12,170 --> 00:09:09,580
our telemetry corrections and also beam

234
00:09:14,160 --> 00:09:12,180
down our data so that we can actually

235
00:09:17,850 --> 00:09:14,170
look at it and share that with

236
00:09:20,310 --> 00:09:17,860
scientists as needed so that covers my

237
00:09:23,280 --> 00:09:20,320
Crenn inves i wanted to touch base on a

238
00:09:26,250 --> 00:09:23,290

few other space related work that we've

239
00:09:27,360 --> 00:09:26,260
done so I'm part of space systems

240
00:09:29,490 --> 00:09:27,370
program office which is under the

241
00:09:31,260 --> 00:09:29,500
advanced concepts lab and they have

242
00:09:34,050 --> 00:09:31,270
experts there in electromagnetics

243
00:09:35,940 --> 00:09:34,060
particularly with tennis and one of the

244
00:09:37,170 --> 00:09:35,950
big things that they've done is develop

245
00:09:39,240 --> 00:09:37,180
these fragments or radiator technology

246
00:09:41,760 --> 00:09:39,250
and what that is they have these custom

247
00:09:44,580 --> 00:09:41,770
in-house algorithms that can take in and

248
00:09:48,360 --> 00:09:44,590
work with scientists or engineers and we

249
00:09:51,090 --> 00:09:48,370
can design this this a ten element for a

250
00:09:53,310 --> 00:09:51,100
very precise performance be it bandwidth

251
00:09:56,490 --> 00:09:53,320
or frequency or maybe you want to cancel

252
00:09:57,900 --> 00:09:56,500
some interference we can design very

253
00:09:59,310 --> 00:09:57,910
large panels and we can integrate that

254
00:10:00,570 --> 00:09:59,320
with all the power divider and

255
00:10:02,220 --> 00:10:00,580
everything else behind that feeds into

256
00:10:04,530 --> 00:10:02,230
that antenna and then that could feed in

257
00:10:06,150 --> 00:10:04,540
right to our satellite you can put it

258
00:10:08,130 --> 00:10:06,160
out on side it's it's easy to space

259
00:10:11,610 --> 00:10:08,140
qualify these antennas so it's really

260
00:10:14,310 --> 00:10:11,620
easy to bring this into space related

261
00:10:15,750 --> 00:10:14,320
applications and for example one of the

262
00:10:17,910 --> 00:10:15,760
projects that we're working on is called

263
00:10:19,440 --> 00:10:17,920

Skyfall and this is not a cube set this

264
00:10:20,850 --> 00:10:19,450
is actually a small set about a hundred

265
00:10:22,890 --> 00:10:20,860
fifty kilograms if I remember correctly

266
00:10:26,520 --> 00:10:22,900
and what we designed is this large

267
00:10:28,920 --> 00:10:26,530
phased array antenna has about ten at

268
00:10:30,480 --> 00:10:28,930
the eight panels and what you can do is

269
00:10:32,760 --> 00:10:30,490
you can build lots of these at 10

270
00:10:34,290 --> 00:10:32,770
aperture as I mentioned and you can scan

271
00:10:36,930 --> 00:10:34,300
the beam because let's try on a CLE

272
00:10:38,430 --> 00:10:36,940
point the beam it's orbiting and this

273
00:10:41,840 --> 00:10:38,440
application had a 1 meter resolution

274
00:10:44,730 --> 00:10:41,850
under 500 climate orbiter is very fine

275
00:10:47,010 --> 00:10:44,740
so now that covers some of the projects

276
00:10:48,370 --> 00:10:47,020
that we've done jour tech and GTRI

277
00:10:50,350 --> 00:10:48,380
specifically is investing

278
00:10:51,580 --> 00:10:50,360
and some facilities to work for our

279
00:10:53,410 --> 00:10:51,590
projects but also eventually working

280
00:10:56,320 --> 00:10:53,420
with any scientists or future projects

281
00:10:58,480 --> 00:10:56,330
one of which was repurposing this

282
00:11:00,010 --> 00:10:58,490
cleanroom it's actually a baker building

283
00:11:02,680 --> 00:11:00,020
which is on Donnelly Street kind of just

284
00:11:04,450 --> 00:11:02,690
a five-minute walk away or it's a class

285
00:11:06,760 --> 00:11:04,460
100 clean room and we're repurposing it

286
00:11:08,020 --> 00:11:06,770
as a space flight assembly area so we

287
00:11:10,690 --> 00:11:08,030
could actually build payloads

288
00:11:13,390 --> 00:11:10,700

in a clean environment qualify them and

289
00:11:14,950 --> 00:11:13,400
send them out and one of the really cool

290
00:11:16,510 --> 00:11:14,960
things we've installed is this ground

291
00:11:17,860 --> 00:11:16,520
station as I mentioned before it's Micra

292
00:11:19,260 --> 00:11:17,870
Nimbus it's orbit around the earth and

293
00:11:21,940 --> 00:11:19,270
measuring we need to beam that data down

294
00:11:23,650 --> 00:11:21,950
so we installed its ground station is in

295
00:11:26,380 --> 00:11:23,660
Cobb County it's actually I think gonna

296
00:11:30,490 --> 00:11:26,390
be near Iron Monger I think actually the

297
00:11:31,810 --> 00:11:30,500
facility there yeah and with that we

298
00:11:34,150 --> 00:11:31,820
have will be able to communicate through

299
00:11:35,320 --> 00:11:34,160
satellite and you know get our data and

300
00:11:37,330 --> 00:11:35,330
share with scientists but also we're

301
00:11:39,610 --> 00:11:37,340
open we're working to with other

302
00:11:43,060 --> 00:11:39,620
engineers and other scientists to use

303
00:11:45,100 --> 00:11:43,070
the facility for other programs so I

304
00:11:47,470 --> 00:11:45,110
hope that provided you with a good

305
00:11:50,200 --> 00:11:47,480
outline of what we do again it's kind of

306
00:11:52,060 --> 00:11:50,210
engineering side we really love building

307
00:11:53,680 --> 00:11:52,070
these systems but we need to talk to

308
00:11:56,620 --> 00:11:53,690
scientists like you because you're the

309
00:11:59,050 --> 00:11:56,630
ones driving these missions so with that

310
00:12:01,910 --> 00:11:59,060
that completes my talk and I'll take any

311
00:12:13,180 --> 00:12:06,150
[Applause]

312
00:12:17,530 --> 00:12:13,190
question of June or two yeah that's

313
00:12:18,550 --> 00:12:17,540

really cool um so are you I think I got

314
00:12:19,540 --> 00:12:18,560
that you're doing single point

315
00:12:23,440 --> 00:12:19,550
measurements it's not scanning

316
00:12:26,410 --> 00:12:23,450
measurements for micro Nimbus

317
00:12:28,150 --> 00:12:26,420
it's a has an eight degree beam with

318
00:12:29,650 --> 00:12:28,160
it's fixed but for some of the

319
00:12:31,060 --> 00:12:29,660
applications we have a phased array but

320
00:12:32,260 --> 00:12:31,070
you said you said you know you have to

321
00:12:35,590 --> 00:12:32,270
do your measurement all at once and it

322
00:12:37,270 --> 00:12:35,600
takes 50 seconds moving across it's

323
00:12:39,370 --> 00:12:37,280
pointed at nadir right so he's just

324
00:12:42,280 --> 00:12:39,380
doing a single point yeah and if you're

325
00:12:43,900 --> 00:12:42,290
not scanning I wore skinny you are scan

326
00:12:44,890 --> 00:12:43,910
yeah well you're taking seven seconds

327
00:12:46,450 --> 00:12:44,900
you're taking the measurements digitize

328
00:12:47,830 --> 00:12:46,460
it it has it passes into the next swath

329
00:12:49,600 --> 00:12:47,840
you take another measurement you know

330
00:12:51,880 --> 00:12:49,610
until until your memories fills and then

331
00:12:53,590 --> 00:12:51,890
you'll dump that and then go again okay

332
00:12:55,330 --> 00:12:53,600
and the idea is to make this cheap

333
00:12:57,040 --> 00:12:55,340
enough that you could launch a

334
00:13:00,190 --> 00:12:57,050
constellation of these right then call

335
00:13:02,740 --> 00:13:00,200
it have a real-time 3d map of the earth

336
00:13:05,020 --> 00:13:02,750
set that's the actual this is what it

337
00:13:06,970 --> 00:13:05,030
actually look the size look like the 3d

338
00:13:08,740 --> 00:13:06,980

printing does not do great on the

339
00:13:10,810 --> 00:13:08,750
panel's they would have to be flat and

340
00:13:12,490 --> 00:13:10,820
they won't be warped like this and you

341
00:13:15,250 --> 00:13:12,500
might have noticed these whip atenas

342
00:13:21,820 --> 00:13:15,260
those are at UHF and that's for

343
00:13:24,130 --> 00:13:21,830
telemetry yeah I guess my question was

344
00:13:38,800 --> 00:13:24,140
censored I was thinking the temporality

345
00:13:39,910 --> 00:13:38,810
of the measurements but I was just

346
00:13:41,500 --> 00:13:39,920
wondering if you had any mass

347
00:13:43,870 --> 00:13:41,510
constraints on your design or if it

348
00:13:45,310 --> 00:13:43,880
factored into any of the selection of

349
00:13:47,590 --> 00:13:45,320
your components because I know for

350
00:13:53,610 --> 00:13:47,600
designing CubeSat NASA usually has some

351
00:13:56,890 --> 00:13:53,620
restrictions on mass size yeah

352
00:14:00,040 --> 00:13:56,900
it's like wait wait okay yeah that is a

353
00:14:02,260 --> 00:14:00,050
big thing so in terms of the actual keep

354
00:14:04,330 --> 00:14:02,270
set itself on a department you know try

355
00:14:06,190 --> 00:14:04,340
to go with weights possible since we're

356
00:14:07,600 --> 00:14:06,200
low Earth orbit shielding is on a bit

357
00:14:10,060 --> 00:14:07,610
constraint my background actually is in

358
00:14:12,070 --> 00:14:10,070
radiation effects in electronics so we

359
00:14:15,130 --> 00:14:12,080
can go light on that in terms of the

360
00:14:16,420 --> 00:14:15,140
antenna by shrieking it we were able to

361
00:14:18,699 --> 00:14:16,430
save away because it's actually heavy

362
00:14:20,230 --> 00:14:18,709
it's actually copper solid copper

363
00:14:22,240 --> 00:14:20,240

but that makes sense for a for example

364
00:14:25,120 --> 00:14:22,250
I'm designing we're still finalizing

365
00:14:26,860 --> 00:14:25,130
some of the board level components for

366
00:14:28,480 --> 00:14:26,870
doing the digitization and we have to be

367
00:14:30,880 --> 00:14:28,490
careful about how many layers as boards

368
00:14:33,550 --> 00:14:30,890
are every any mass matters but as long

369
00:14:35,230 --> 00:14:33,560
as but we always add like a 20% margin

370
00:14:37,060 --> 00:14:35,240
of error so that worst case if you go