NASA'S SOUNDING ROCKETS

Cutting edge science
15 minutes at a time

1
00:00:37,240 --> 00:00:35,860
we don't want to waste our rocket

2
00:00:38,919 --> 00:00:37,250
the thing is three years to make the

3
00:00:41,349 --> 00:00:38,929
rocket on the 15 minutes to use it I

4
00:00:43,270 --> 00:00:41,359
don't waste my shot here when we started

5
00:00:44,709 --> 00:00:43,280
seeing this really good data this clock

6
00:00:46,899 --> 00:00:44,719
started counting down and that's when

7
00:00:48,850 --> 00:00:46,909
everyone realized this is gonna happen

8
00:00:50,229 --> 00:00:48,860
you're filled with trepidation oh my

9
00:00:54,849 --> 00:00:50,239
gosh look at this thing that I'd evolved

10
00:00:56,920 --> 00:00:54,859
is it gonna work after all this it is

11
00:01:00,039 --> 00:00:56,930
really really challenging and

12
00:01:03,430 --> 00:01:00,049
nerve-racking at that point at t-minus

13
00:01:14,430 --> 00:01:03,440

one minute all of us ran out

14
00:01:17,440 --> 00:01:14,440
[Music]

15
00:01:18,730 --> 00:01:17,450
hey everyone today we're live at NASA's

16
00:01:20,590 --> 00:01:18,740
Goddard Space Flight Center in Greenbelt

17
00:01:22,690 --> 00:01:20,600
Maryland and we're here with a team of

18
00:01:24,850 --> 00:01:22,700
experts to talk about sounding rockets

19
00:01:26,500 --> 00:01:24,860
sounding rockets were NASA's first space

20
00:01:28,210 --> 00:01:26,510
vehicles but they remain one of the

21
00:01:30,700 --> 00:01:28,220
agency's most important tools for

22
00:01:32,680 --> 00:01:30,710
cutting-edge science today the footage

23
00:01:34,090 --> 00:01:32,690
you just saw was from a recent sounding

24
00:01:35,590 --> 00:01:34,100
rocket mission that launched last year

25
00:01:37,690 --> 00:01:35,600
from an island in the middle of the

26
00:01:39,580 --> 00:01:37,700
Arctic Ocean but it was just the first

27
00:01:42,190 --> 00:01:39,590
mission of a larger series called the

28
00:01:44,200 --> 00:01:42,200
grand challenge initiative cusp in fact

29
00:01:45,969 --> 00:01:44,210
people are there right now back on the

30
00:01:48,640 --> 00:01:45,979
island preparing for launches that are

31
00:01:50,350 --> 00:01:48,650
coming up in just a week today we'll be

32
00:01:52,359 --> 00:01:50,360
joined by scientists from bat mission

33
00:01:54,580 --> 00:01:52,369
and other experts from NASA's sounding

34
00:01:55,530 --> 00:01:54,590
rockets program here's the show that we

35
00:01:58,120 --> 00:01:55,540
have for you today

36
00:01:59,380 --> 00:01:58,130
first we'll talk all about what sounding

37
00:02:00,969 --> 00:01:59,390
Rockets are and the groundbreaking

38
00:02:03,370 --> 00:02:00,979

research that they've contributed to

39
00:02:05,530 --> 00:02:03,380
science next we'll talk about what makes

40
00:02:07,270 --> 00:02:05,540
sounding Rockets unique and why they can

41
00:02:09,850 --> 00:02:07,280
do science that no other launch vehicle

42
00:02:11,680 --> 00:02:09,860
can will cover how sounding Rockets are

43
00:02:14,080 --> 00:02:11,690
advancing space science and technology

44
00:02:15,910 --> 00:02:14,090
and we'll take you inside NASA's Wallops

45
00:02:16,500 --> 00:02:15,920
Flight Facility the place where it all

46
00:02:18,490 --> 00:02:16,510
happens

47
00:02:20,140 --> 00:02:18,500
finally it will go behind the scenes

48
00:02:21,670 --> 00:02:20,150
with an Arctic sounding rocket mission

49
00:02:23,650 --> 00:02:21,680
and learn what it's like to launch one

50
00:02:26,050 --> 00:02:23,660
if you have any questions throughout the

51
00:02:27,640 --> 00:02:26,060
show use the hashtag ask NASA in the

52
00:02:31,510 --> 00:02:27,650
comments and we'll answer some of them

53
00:02:39,540 --> 00:02:35,830
[Music]

54
00:02:42,270 --> 00:02:39,550
[Applause]

55
00:02:45,340 --> 00:02:42,280
[Music]

56
00:02:46,930 --> 00:02:45,350
I'm now joined by Rob faff the project

57
00:02:50,020 --> 00:02:46,940
scientist for NASA's sounding rockets

58
00:02:52,360 --> 00:02:50,030
program and a couple parts of sounding

59
00:02:54,580 --> 00:02:52,370
rockets Rob tell us a little bit more

60
00:02:55,810 --> 00:02:54,590
about what Sonny Rockets are and how

61
00:02:56,530 --> 00:02:55,820
they differ from other kinds of

62
00:02:58,510 --> 00:02:56,540
spacecraft

63
00:03:00,730 --> 00:02:58,520

sure well sounding Rockets are

64
00:03:03,000 --> 00:03:00,740
spacecraft they launched into space by

65
00:03:05,200 --> 00:03:03,010
NASA to carry out scientific

66
00:03:07,720 --> 00:03:05,210
investigations and also to test new

67
00:03:09,520 --> 00:03:07,730
instruments they differ from satellites

68
00:03:11,620 --> 00:03:09,530
and that satellites go into space and

69
00:03:12,940 --> 00:03:11,630
orbit the earth and they can last for

70
00:03:15,760 --> 00:03:12,950
many many years

71
00:03:17,740 --> 00:03:15,770
usually in one region of one altitude

72
00:03:20,590 --> 00:03:17,750
region the sound markets on the other

73
00:03:22,270 --> 00:03:20,600
hand a follow pack go up into space and

74
00:03:24,820 --> 00:03:22,280
come down we call them suborbital

75
00:03:27,580 --> 00:03:24,830
platforms so we follow parabolic

76
00:03:29,440 --> 00:03:27,590
trajectories and is a more limited time

77
00:03:33,460 --> 00:03:29,450
only 10 or 15 minutes but it's very

78
00:03:36,430 --> 00:03:33,470
focused investigations I should also I

79
00:03:37,990 --> 00:03:36,440
could say this NASA has has said as had

80
00:03:40,720 --> 00:03:38,000
sounding Rockets really since the onset

81
00:03:42,610 --> 00:03:40,730
of the agency over 16 years ago they've

82
00:03:44,650 --> 00:03:42,620
served the service very well in

83
00:03:47,350 --> 00:03:44,660
scientific community supporting such

84
00:03:50,199 --> 00:03:47,360
disciplines as astronomy solar physics

85
00:03:52,360 --> 00:03:50,209
and also geo space geo spaces that

86
00:03:54,790 --> 00:03:52,370
region around the earth that includes

87
00:03:57,010 --> 00:03:54,800
the ionosphere the upper atmosphere it's

88
00:03:59,650 --> 00:03:57,020

where for example the aurora is formed

89
00:04:02,170 --> 00:03:59,660
and that region is ideal for study with

90
00:04:05,170 --> 00:04:02,180
sounding rockets we also look at

91
00:04:06,760 --> 00:04:05,180
planetary reentry systems and in special

92
00:04:09,550 --> 00:04:06,770
projects such as that have served by the

93
00:04:11,320 --> 00:04:09,560
sounding rocket program I just want to

94
00:04:14,470 --> 00:04:11,330
say people are always asking me what

95
00:04:16,539 --> 00:04:14,480
does sounding y sounding right sounding

96
00:04:18,220 --> 00:04:16,549
is actually an old nautical term which

97
00:04:20,020 --> 00:04:18,230
means to take measurements of the depth

98
00:04:22,180 --> 00:04:20,030
of the ocean below you take soundings

99
00:04:23,860 --> 00:04:22,190
and so essentially a sounding rocket is

100
00:04:27,040 --> 00:04:23,870
simply a rocket that takes measurements

101
00:04:29,230 --> 00:04:27,050
got it and we have a couple parts of the

102
00:04:30,940 --> 00:04:29,240
sounding rocket here in the studio this

103
00:04:32,650 --> 00:04:30,950
one looks like it's a little worse for

104
00:04:35,290 --> 00:04:32,660
the wear tell me more about what this

105
00:04:37,570 --> 00:04:35,300
guy is okay this is a nose cone it

106
00:04:39,070 --> 00:04:37,580
served us very well on a rocket that was

107
00:04:42,040 --> 00:04:39,080
launched from white sands missile range

108
00:04:43,990 --> 00:04:42,050
and that rocket was recovered and the

109
00:04:46,150 --> 00:04:44,000
the nose cone was also recovered as you

110
00:04:47,860 --> 00:04:46,160
can see it got a few uh a few dents we

111
00:04:49,420 --> 00:04:47,870
would never fly this again but

112
00:04:52,120 --> 00:04:49,430
nevertheless this is what a nose cone

113
00:04:53,650 --> 00:04:52,130

looks like the rocket over the sound the

114
00:04:55,780 --> 00:04:53,660
payload over here on my left

115
00:04:57,610 --> 00:04:55,790
has a again the nose cone on top this is

116
00:05:00,400 --> 00:04:57,620
one of our smaller payloads and then

117
00:05:02,770 --> 00:05:00,410
this week this segment here includes the

118
00:05:04,240 --> 00:05:02,780
instruments and the telemetry system and

119
00:05:06,160 --> 00:05:04,250
batteries and that sort of thing so this

120
00:05:07,930 --> 00:05:06,170
would then go on top of a motor which of

121
00:05:10,150 --> 00:05:07,940
course isn't here with us in the studio

122
00:05:12,070 --> 00:05:10,160
so sounding Rockets launch above the

123
00:05:13,060 --> 00:05:12,080
atmosphere but why do it why is it

124
00:05:15,550 --> 00:05:13,070
important to get above the atmosphere

125
00:05:17,680 --> 00:05:15,560
well it's extremely important

126
00:05:19,090 --> 00:05:17,690
particularly in the fields of astronomy

127
00:05:20,620 --> 00:05:19,100
and solar physics because you want to

128
00:05:22,630 --> 00:05:20,630
look at wavelengths which are absorbed

129
00:05:24,670 --> 00:05:22,640
by the atmosphere so you have to if you

130
00:05:26,530 --> 00:05:24,680
want to look at ultraviolet radiation

131
00:05:28,750 --> 00:05:26,540
for example you need to be above the

132
00:05:30,190 --> 00:05:28,760
atmosphere that to look at those and you

133
00:05:32,320 --> 00:05:30,200
mentioned that they they follow an

134
00:05:34,540 --> 00:05:32,330
elliptical trajectory so they they fall

135
00:05:36,190 --> 00:05:34,550
back down and how much time do they

136
00:05:38,700 --> 00:05:36,200
actually get to do against actually it's

137
00:05:41,830 --> 00:05:38,710
a parabolic trajectory

138
00:05:44,950 --> 00:05:41,840

depends on the apogee you could get 5 10

139
00:05:46,480 --> 00:05:44,960
and maybe 15 minutes or technical that

140
00:05:47,980 --> 00:05:46,490
doesn't sound like much time but

141
00:05:50,440 --> 00:05:47,990
sounding Rockets can actually accomplish

142
00:05:51,730 --> 00:05:50,450
a lot in just a few minutes here's a

143
00:05:53,350 --> 00:05:51,740
brief video about the history of

144
00:05:54,760 --> 00:05:53,360
sounding rocket research including some

145
00:05:58,330 --> 00:05:54,770
of the groundbreaking achievements that

146
00:06:01,510 --> 00:05:58,340
they've made we've been flying

147
00:06:04,420 --> 00:06:01,520
instruments on balloons for decades and

148
00:06:06,760 --> 00:06:04,430
the more we flew the more we learned

149
00:06:08,920 --> 00:06:06,770
about the atmosphere but we couldn't go

150
00:06:11,590 --> 00:06:08,930
that high and so we knew there was an

151
00:06:13,990 --> 00:06:11,600
awful lot more to discover scientists

152
00:06:16,600 --> 00:06:14,000
started to develop rockets in the 1930s

153
00:06:19,150 --> 00:06:16,610
but a big incentive to explore the upper

154
00:06:21,820 --> 00:06:19,160
atmosphere was during World War 2 when

155
00:06:24,250 --> 00:06:21,830
the u.s. captured Germany's v2 rockets a

156
00:06:26,830 --> 00:06:24,260
long-range missile that could fly to

157
00:06:28,390 --> 00:06:26,840
these upper regions seeing that the

158
00:06:31,120 --> 00:06:28,400
Germans had created this sophisticated

159
00:06:32,890 --> 00:06:31,130
rocket scientists from the US Navy were

160
00:06:35,170 --> 00:06:32,900
motivated to learn how to build their

161
00:06:37,180 --> 00:06:35,180
own a number of the early sounding

162
00:06:39,610 --> 00:06:37,190
rocket technologies and the experiments

163
00:06:42,040 --> 00:06:39,620

that they're designed to do are largely

164
00:06:44,950 --> 00:06:42,050
for military applications they want to

165
00:06:46,960 --> 00:06:44,960
know the nature of that medium through

166
00:06:49,450 --> 00:06:46,970
which missiles would eventually travel

167
00:06:52,840 --> 00:06:49,460
so the sounding rocket really became the

168
00:06:54,760 --> 00:06:52,850
vehicle of choice after years of proving

169
00:06:58,810 --> 00:06:54,770
the scientific worth of sounding rockets

170
00:07:00,250 --> 00:06:58,820
in 1958 NASA's sounding rockets program

171
00:07:02,770 --> 00:07:00,260
was born

172
00:07:04,990 --> 00:07:02,780
these small but versatile rockets have

173
00:07:07,450 --> 00:07:05,000
founded entirely new fields of science

174
00:07:10,180 --> 00:07:07,460
ultraviolet x-ray and gamma-ray

175
00:07:12,790 --> 00:07:10,190
astronomy which inevitably led to more

176
00:07:14,350 --> 00:07:12,800
discoveries a sounding rocket made the

177
00:07:17,440 --> 00:07:14,360
first detection of molecular hydrogen

178
00:07:19,540 --> 00:07:17,450
his face sounding Rockets confirmed the

179
00:07:21,850 --> 00:07:19,550
theory that the Aurora will caused by

180
00:07:24,190 --> 00:07:21,860
beams of electrons colliding with our

181
00:07:26,500 --> 00:07:24,200
atmosphere they've launched over

182
00:07:31,810 --> 00:07:26,510
lightning storms to study rare phenomena

183
00:07:34,000 --> 00:07:31,820
such as chess and sprites in 1987 when a

184
00:07:36,760 --> 00:07:34,010
supernova suddenly appeared in the sky

185
00:07:39,910 --> 00:07:36,770
Sarla rockets were among the first to

186
00:07:41,190 --> 00:07:39,920
study it Sani Rockets captured samples

187
00:07:43,810 --> 00:07:41,200
from the hole in the ozone layer

188
00:07:46,630 --> 00:07:43,820

critical to understanding how the hole

189
00:07:49,830 --> 00:07:46,640
formed today they continued to push the

190
00:07:52,820 --> 00:07:49,840
boundaries of what we can see and learn

191
00:07:55,350 --> 00:07:52,830
[Music]

192
00:07:57,390 --> 00:07:55,360
we're now joined by two other sounding

193
00:07:59,310 --> 00:07:57,400
rocket experts Kathy Hesh is the

194
00:08:01,110 --> 00:07:59,320
technology manager for the national

195
00:08:03,810 --> 00:08:01,120
national sounding rockets program and

196
00:08:05,400 --> 00:08:03,820
Doug Rowland he's the lead scientist for

197
00:08:07,830 --> 00:08:05,410
the Arctic sounding rocket mission that

198
00:08:09,480 --> 00:08:07,840
you saw at the top of the show now all

199
00:08:11,460 --> 00:08:09,490
of you have launched sandy rocket

200
00:08:13,500 --> 00:08:11,470
missions before out of all the different

201
00:08:15,240 --> 00:08:13,510
kinds of spacecraft you can use why do

202
00:08:17,490 --> 00:08:15,250
you keep coming back to Sony rockets for

203
00:08:19,410 --> 00:08:17,500
your research well for my own research

204
00:08:22,860 --> 00:08:19,420
is really to look at us at that region

205
00:08:24,870 --> 00:08:22,870
of space which is actually about between

206
00:08:26,670 --> 00:08:24,880
it's too high for measurements with

207
00:08:28,500 --> 00:08:26,680
balloons and too low for satellites so

208
00:08:31,200 --> 00:08:28,510
that's why we use Rockets also you want

209
00:08:32,700 --> 00:08:31,210
to get the vertical profiles my personal

210
00:08:34,350 --> 00:08:32,710
research is with the interface between

211
00:08:36,930 --> 00:08:34,360
the ionosphere and the upper atmosphere

212
00:08:39,540 --> 00:08:36,940
which occurs at around 100 kilometers or

213
00:08:41,610 --> 00:08:39,550

60 miles up some of the most important

214
00:08:43,440 --> 00:08:41,620
processes in geo space happen there is

215
00:08:46,080 --> 00:08:43,450
really one of the most happening is

216
00:08:48,090 --> 00:08:46,090
places in all of geo space and you can

217
00:08:49,590 --> 00:08:48,100
only measure it with sounding Rockets so

218
00:08:52,320 --> 00:08:49,600
of course we're gonna use rockets to do

219
00:08:54,090 --> 00:08:52,330
that research right and and as you go up

220
00:08:56,880 --> 00:08:54,100
and come back down you're also able to

221
00:09:00,960 --> 00:08:56,890
see measurements that vary along the

222
00:09:02,820 --> 00:09:00,970
vertical right but and and we in the

223
00:09:04,530 --> 00:09:02,830
last video that the viewers just saw we

224
00:09:07,050 --> 00:09:04,540
also talked a little bit about the ozone

225
00:09:07,980 --> 00:09:07,060
layer yes okay right exactly that first

226
00:09:09,900 --> 00:09:07,990
of all I just want to emphasize that

227
00:09:11,670 --> 00:09:09,910
rockets give you the vertical profiles

228
00:09:13,380 --> 00:09:11,680
just as you said up leg and down like

229
00:09:15,150 --> 00:09:13,390
which you can't get on the sounding with

230
00:09:17,460 --> 00:09:15,160
on a satellite at least with direct

231
00:09:19,980 --> 00:09:17,470
measurement but in view of the ozone

232
00:09:21,570 --> 00:09:19,990
common sounding rockets also enable us

233
00:09:23,640 --> 00:09:21,580
to take samples of the upper atmosphere

234
00:09:26,340 --> 00:09:23,650
either in the ozone or maybe noctilucent

235
00:09:27,930 --> 00:09:26,350
clouds recover those samples bring them

236
00:09:30,750 --> 00:09:27,940
back to the laboratory for detailed

237
00:09:32,580 --> 00:09:30,760
study Doug I know that you've launched

238
00:09:34,110 --> 00:09:32,590

through the Northern Lights and you're

239
00:09:36,000 --> 00:09:34,120
not the only sounding rocket researcher

240
00:09:37,710 --> 00:09:36,010
to do that what is it about sounding

241
00:09:40,020 --> 00:09:37,720
rockets that makes them so useful or

242
00:09:42,030 --> 00:09:40,030
suitable for auroral research well miles

243
00:09:43,560 --> 00:09:42,040
you mentioned where we go where the

244
00:09:45,870 --> 00:09:43,570
science is you know that's one thing we

245
00:09:47,790 --> 00:09:45,880
do in northern lights you don't see

246
00:09:50,670 --> 00:09:47,800
those in Washington DC but you go to

247
00:09:52,500 --> 00:09:50,680
Alaska or Norway or Canada and you can

248
00:09:54,300 --> 00:09:52,510
see brilliant displays the things about

249
00:09:56,130 --> 00:09:54,310
those rural displays is they're very

250
00:09:58,230 --> 00:09:56,140
kind of sudden they change the dance

251
00:09:59,220 --> 00:09:58,240
around and when they do that you've got

252
00:10:01,560 --> 00:09:59,230
to be in the right spot at the right

253
00:10:03,540 --> 00:10:01,570
time or you're gonna miss it and so what

254
00:10:05,460 --> 00:10:03,550
we do is we set up our rockets we wait

255
00:10:06,720 --> 00:10:05,470
for the roar it's almost like you

256
00:10:07,830 --> 00:10:06,730
you're gonna hunting blind or something

257
00:10:10,320 --> 00:10:07,840
trying to wait for that Aurora to come

258
00:10:11,940 --> 00:10:10,330
out than you then you go and I think the

259
00:10:13,290 --> 00:10:11,950
sunrise provide an opportunity for you

260
00:10:16,710 --> 00:10:13,300
to kind of do that targeted research

261
00:10:18,090 --> 00:10:16,720
right and going along with that it's you

262
00:10:21,480 --> 00:10:18,100
could go to all these different places

263
00:10:23,130 --> 00:10:21,490

right I mean you're going to Norway in

264
00:10:25,530 --> 00:10:23,140
an earlier version twenty early

265
00:10:27,060 --> 00:10:25,540
emissions say more about that well we go

266
00:10:29,090 --> 00:10:27,070
to Norway we went to Norway with our

267
00:10:31,350 --> 00:10:29,100
mission because that was a particular

268
00:10:32,760 --> 00:10:31,360
magnetic field configuration a

269
00:10:34,680 --> 00:10:32,770
particular region of the earth we wanted

270
00:10:36,480 --> 00:10:34,690
to study but we've been launching at

271
00:10:38,250 --> 00:10:36,490
Wallops Flight Facility in Virginia one

272
00:10:39,630 --> 00:10:38,260
of the thunderstorms we've launched from

273
00:10:41,970 --> 00:10:39,640
White Sands Missile Range people who

274
00:10:43,980 --> 00:10:41,980
study different astronomical

275
00:10:45,960 --> 00:10:43,990
observations we've gone to Peru or

276
00:10:47,370 --> 00:10:45,970
Marshall Islands it just we were in the

277
00:10:50,130 --> 00:10:47,380
world kind of wherever the science as we

278
00:10:51,600 --> 00:10:50,140
go now Kathy you've been involved in

279
00:10:52,890 --> 00:10:51,610
tons of different sounding rocket

280
00:10:55,800 --> 00:10:52,900
missions that have come through white

281
00:10:57,780 --> 00:10:55,810
through Wallops Flight Facility tell us

282
00:10:59,040 --> 00:10:57,790
more what you've noticed about sounding

283
00:11:01,650 --> 00:10:59,050
rocket missions that makes them unique

284
00:11:04,650 --> 00:11:01,660
sahni rocket missions really inspire o

285
00:11:07,020 --> 00:11:04,660
inspire innovation and ambition among

286
00:11:10,260 --> 00:11:07,030
the science community they are one of

287
00:11:11,970 --> 00:11:10,270
the most low costs and quick platforms

288
00:11:13,320 --> 00:11:11,980

that you can use to get into space and

289
00:11:14,700 --> 00:11:13,330
it's really interesting to see how all

290
00:11:16,950 --> 00:11:14,710
the different science disciplines

291
00:11:18,560 --> 00:11:16,960
utilize sounding rockets to do this

292
00:11:21,720 --> 00:11:18,570
cutting-edge science that they do

293
00:11:24,410 --> 00:11:21,730
they're about 40 to 50 sounding rocket

294
00:11:26,820 --> 00:11:24,420
missions in progress at any given time

295
00:11:28,650 --> 00:11:26,830
annually we launched about 18 missions a

296
00:11:31,410 --> 00:11:28,660
year from launch sites all over the

297
00:11:33,360 --> 00:11:31,420
world and a typical mission life cycle

298
00:11:35,910 --> 00:11:33,370
is about on the order of two years for a

299
00:11:38,310 --> 00:11:35,920
new mission for missions where payloads

300
00:11:40,440 --> 00:11:38,320
already exist and we can refine they can

301
00:11:42,150 --> 00:11:40,450
be done in as little as six to twelve

302
00:11:44,160 --> 00:11:42,160
months so a relatively short timeframe

303
00:11:46,140 --> 00:11:44,170
as I mentioned before sanding Rockets

304
00:11:47,520 --> 00:11:46,150
are also extremely cost effective the

305
00:11:49,140 --> 00:11:47,530
average cost for a sounding rocket

306
00:11:50,670 --> 00:11:49,150
mission is on the order of about two

307
00:11:52,890 --> 00:11:50,680
million dollars and there are kind of

308
00:11:56,520 --> 00:11:52,900
three main things that keep us low cost

309
00:11:58,350 --> 00:11:56,530
we utilize commercial I'm sorry military

310
00:12:00,240 --> 00:11:58,360
surplus rocket motors those are motors

311
00:12:02,640 --> 00:12:00,250
that the military no longer needs or

312
00:12:06,030 --> 00:12:02,650
once we use commercial off-the-shelf

313
00:12:08,550 --> 00:12:06,040

components and we recover about half of

314
00:12:10,410 --> 00:12:08,560
the payloads that we fly so we'll launch

315
00:12:13,140 --> 00:12:10,420
them we'll go pick them up on a

316
00:12:15,030 --> 00:12:13,150
helicopter or on a boat refurbish the

317
00:12:16,800 --> 00:12:15,040
instruments and the support systems and

318
00:12:18,630 --> 00:12:16,810
reef line again and some of our pelas

319
00:12:21,360 --> 00:12:18,640
have flown three four or five times look

320
00:12:22,740 --> 00:12:21,370
different targets of opportunity that's

321
00:12:24,690 --> 00:12:22,750
a really important point actually the

322
00:12:26,400 --> 00:12:24,700
the low-cost and the quick turnaround of

323
00:12:28,020 --> 00:12:26,410
sounding rocket missions is one of the

324
00:12:30,120 --> 00:12:28,030
things that makes them to place where

325
00:12:32,520 --> 00:12:30,130
the latest ideas and newest technology

326
00:12:34,350 --> 00:12:32,530
are often first tested out a great

327
00:12:36,270 --> 00:12:34,360
recent example comes from the recent

328
00:12:39,230 --> 00:12:36,280
hi-c mission which stands for

329
00:12:42,000 --> 00:12:39,240
high-resolution coronal imager telescope

330
00:12:44,130 --> 00:12:42,010
NASA researchers mounted this telescope

331
00:12:45,930 --> 00:12:44,140
on a sounding rocket launched up into

332
00:12:47,250 --> 00:12:45,940
space and looked at the Sun and when

333
00:12:48,900 --> 00:12:47,260
they did they saw something that had

334
00:12:52,860 --> 00:12:48,910
never been seen before let's take a

335
00:12:54,780 --> 00:12:52,870
quick video view about that now so one

336
00:12:56,910 --> 00:12:54,790
of the questions in solar physics is is

337
00:12:59,550 --> 00:12:56,920
how is the kroehner the atmosphere the

338
00:13:01,650 --> 00:12:59,560

Sun she did you want to know if it's

339
00:13:03,900 --> 00:13:01,660
caused by the braids in the magnetic

340
00:13:05,520 --> 00:13:03,910
field or is it simply caused by waves

341
00:13:07,650 --> 00:13:05,530
the problem is that you look at the

342
00:13:09,330 --> 00:13:07,660
Sun's corona and images it doesn't look

343
00:13:11,580 --> 00:13:09,340
particularly braided it looks kind of

344
00:13:13,230 --> 00:13:11,590
you know combed almost the structures

345
00:13:14,730 --> 00:13:13,240
that you see don't click they crisscross

346
00:13:17,850 --> 00:13:14,740
or startle around each other anything

347
00:13:18,900 --> 00:13:17,860
maybe the braids are just below the

348
00:13:20,910 --> 00:13:18,910
resolution of our current

349
00:13:22,650 --> 00:13:20,920
instrumentation so we both hi see this

350
00:13:24,360 --> 00:13:22,660
high-resolution imagery and one of our

351
00:13:25,700 --> 00:13:24,370
goals was whether because you breathing

352
00:13:28,369 --> 00:13:25,710
or not

353
00:13:30,689 --> 00:13:28,379
[Music]

354
00:13:33,509 --> 00:13:30,699
so we're all in the car on the way back

355
00:13:35,280 --> 00:13:33,519
from white sands back to Las Cruces I'm

356
00:13:36,809 --> 00:13:35,290
in the passenger seat the pee is in the

357
00:13:39,420 --> 00:13:36,819
in the driver's seat Jonathan Sartain

358
00:13:40,800 --> 00:13:39,430
and I'm a little laptop and I'm looking

359
00:13:43,710 --> 00:13:40,810
at the data for the first time and we

360
00:13:45,869 --> 00:13:43,720
see a brain and on the drive Jonathan

361
00:13:47,309 --> 00:13:45,879
pulls over we call everybody else well

362
00:13:49,139 --> 00:13:47,319
if we see you Friday we see Frank were

363
00:13:50,819 --> 00:13:49,149

so excited and then Jonathan's like why

364
00:13:52,590 --> 00:13:50,829
am i driving you need to surprise so I

365
00:13:53,819 --> 00:13:52,600
can look at the data but that was our

366
00:13:55,019 --> 00:13:53,829
first time that we'd zoom in any

367
00:14:00,150 --> 00:13:55,029
frightening and we actually got a nature

368
00:14:01,799 --> 00:14:00,160
paper from that result sounding rocket

369
00:14:03,629 --> 00:14:01,809
missions can be developed in really

370
00:14:05,400 --> 00:14:03,639
quick time periods as we mentioned

371
00:14:07,350 --> 00:14:05,410
earlier sometimes that's a shortest six

372
00:14:10,139 --> 00:14:07,360
months and this really makes them an

373
00:14:11,999 --> 00:14:10,149
ideal platform for capturing brief

374
00:14:14,610 --> 00:14:12,009
events and also testing out some of the

375
00:14:15,989 --> 00:14:14,620
latest and newest technology Cathy and

376
00:14:18,840 --> 00:14:15,999
Stephen you guys can speak more directly

377
00:14:20,730 --> 00:14:18,850
to this Stephen ear and astrophysicist

378
00:14:22,619 --> 00:14:20,740
at Johns Hopkins University and you've

379
00:14:24,540 --> 00:14:22,629
been using sounding rockets for your

380
00:14:26,610 --> 00:14:24,550
research for a long time

381
00:14:28,439 --> 00:14:26,620
I understand one common feature of your

382
00:14:31,379 --> 00:14:28,449
missions is you're usually testing out

383
00:14:33,509 --> 00:14:31,389
some new tech that is is being developed

384
00:14:36,090 --> 00:14:33,519
for bigger missions many years in the

385
00:14:38,100 --> 00:14:36,100
future and you've even done crazy things

386
00:14:40,139 --> 00:14:38,110
like chase after comets could you say

387
00:14:43,319 --> 00:14:40,149
more about that sure miles

388
00:14:46,259 --> 00:14:43,329

targets of opportunity or a unique niche

389
00:14:48,389 --> 00:14:46,269
for signing rockets they allow us to

390
00:14:50,519 --> 00:14:48,399
mount a mission on a very short

391
00:14:53,040 --> 00:14:50,529
timescale see it's short of six months

392
00:14:57,119 --> 00:14:53,050
or so and follow-up a unique

393
00:15:00,480 --> 00:14:57,129
astronomical event I've been doing UV

394
00:15:02,369 --> 00:15:00,490
astronomy from sámi Rockets for a number

395
00:15:05,610 --> 00:15:02,379
of years going after comets in

396
00:15:07,429 --> 00:15:05,620
particular typically when you go after a

397
00:15:09,150 --> 00:15:07,439
comment you're using a spectroscopic

398
00:15:11,220 --> 00:15:09,160
application where you're looking through

399
00:15:14,519 --> 00:15:11,230
a very narrow little window to take

400
00:15:16,280 --> 00:15:14,529
narrow pictures of the comet in many

401
00:15:19,889 --> 00:15:16,290
different wavelengths

402
00:15:22,860 --> 00:15:19,899
right now on for instance we did that in

403
00:15:26,309 --> 00:15:22,870
1997 with comet hale-bopp it was a very

404
00:15:27,989 --> 00:15:26,319
successful mission later on we've

405
00:15:31,290 --> 00:15:27,999
decided that it would be good to be able

406
00:15:32,939 --> 00:15:31,300
to sample larger regions of around the

407
00:15:34,980 --> 00:15:32,949
comet not just be restricted to the

408
00:15:37,259 --> 00:15:34,990
narrow little window so we've developed

409
00:15:39,180 --> 00:15:37,269
a new technique based on technologies

410
00:15:41,970 --> 00:15:39,190
that were developed for the Jame

411
00:15:43,890 --> 00:15:41,980
to Webb Space Telescope and which is a

412
00:15:46,770 --> 00:15:43,900
day for red telescope that we're moving

413
00:15:49,230 --> 00:15:46,780

them into the ultraviolet and there we

414
00:15:51,480 --> 00:15:49,240
have instead of one long narrow window

415
00:15:53,970 --> 00:15:51,490
we have many little tiny baby windows

416
00:15:55,500 --> 00:15:53,980
that we can then sample larger regions

417
00:15:57,690 --> 00:15:55,510
of the sky and gather more information

418
00:16:00,000 --> 00:15:57,700
during the course of the observation

419
00:16:02,460 --> 00:16:00,010
that we take how do you tested this out

420
00:16:04,380 --> 00:16:02,470
on a flight yet yeah we recently got

421
00:16:06,660 --> 00:16:04,390
back from White Sands Missile Range in

422
00:16:09,090 --> 00:16:06,670
New Mexico where we have a successful

423
00:16:10,860 --> 00:16:09,100
flight of micro shutter array the

424
00:16:12,210 --> 00:16:10,870
next-generation micro shutter array it's

425
00:16:14,330 --> 00:16:12,220
a little bit different from what's being

426
00:16:16,890 --> 00:16:14,340
flown on the James Webb Space Telescope

427
00:16:19,140 --> 00:16:16,900
and it's very new and exciting to be

428
00:16:24,810 --> 00:16:19,150
able to do this we looked at a galaxy

429
00:16:27,330 --> 00:16:24,820
called m33 and we looked at the star

430
00:16:29,940 --> 00:16:27,340
clusters in the galaxy and we wanted to

431
00:16:32,990 --> 00:16:29,950
see how the gas that was blown out of

432
00:16:36,210 --> 00:16:33,000
these very hot new star clusters as a

433
00:16:38,970 --> 00:16:36,220
merging from the disk of the galaxy and

434
00:16:41,160 --> 00:16:38,980
and populating the circumvallate medium

435
00:16:42,900 --> 00:16:41,170
surrounding the galaxy often this stuff

436
00:16:45,600 --> 00:16:42,910
will not have enough velocity so that

437
00:16:50,070 --> 00:16:45,610
rains back down on the disk and it forms

438
00:16:51,270 --> 00:16:50,080

clouds of dust and ultimately adds to an

439
00:16:53,820 --> 00:16:51,280
enrichment of

440
00:16:56,550 --> 00:16:53,830
the clouds that then can form other

441
00:16:58,410 --> 00:16:56,560
stars usually lower mass stars and out

442
00:17:00,540 --> 00:16:58,420
of these you get solar systems and

443
00:17:03,480 --> 00:17:00,550
stellar systems that ultimately form

444
00:17:06,030 --> 00:17:03,490
planets out of the dust and so the dust

445
00:17:08,429 --> 00:17:06,040
sort of becomes us Wow

446
00:17:09,960 --> 00:17:08,439
so what was important about the the new

447
00:17:13,290 --> 00:17:09,970
technology were using that allowed you

448
00:17:15,900 --> 00:17:13,300
to see that like what was the key thing

449
00:17:18,630 --> 00:17:15,910
about is that it is not just restricted

450
00:17:21,090 --> 00:17:18,640
to one little narrow window but it's

451
00:17:23,490 --> 00:17:21,100
lots of little tiny windows that we can

452
00:17:26,760 --> 00:17:23,500
then sample larger and larger regions

453
00:17:28,680 --> 00:17:26,770
and increase the region that we see this

454
00:17:30,780 --> 00:17:28,690
is a capability that's been enjoyed from

455
00:17:32,550 --> 00:17:30,790
the ground for a long time but the

456
00:17:34,860 --> 00:17:32,560
technologies that we're now developing

457
00:17:39,060 --> 00:17:34,870
here allow us to then bring this to

458
00:17:41,190 --> 00:17:39,070
space and is the basis of many mission

459
00:17:43,550 --> 00:17:41,200
studies for new ultra Maya

460
00:17:46,200 --> 00:17:43,560
instrumentation that is projected to be

461
00:17:48,060 --> 00:17:46,210
developed in the next twenty eight ten

462
00:17:50,190 --> 00:17:48,070
and twenty year times Wow so it's like

463
00:17:52,760 --> 00:17:50,200

way in the future but the stuff is the

464
00:17:54,260 --> 00:17:52,770
stuff we're doing the new stuff the

465
00:17:56,240 --> 00:17:54,270
big missions we'll just have to touch up

466
00:17:58,310 --> 00:17:56,250
later on Wow

467
00:17:59,630 --> 00:17:58,320
Kathy I understand you've been involved

468
00:18:01,670 --> 00:17:59,640
with some missions that are actually

469
00:18:04,190 --> 00:18:01,680
testing out technology that will help us

470
00:18:06,470 --> 00:18:04,200
get to Mars right that's right you might

471
00:18:08,240 --> 00:18:06,480
have heard of the art of NASA's Artemis

472
00:18:09,770 --> 00:18:08,250
mission where we plan to send spacecraft

473
00:18:12,590 --> 00:18:09,780
and humans to the moon and then

474
00:18:15,290 --> 00:18:12,600
eventually onto Mars well before we send

475
00:18:18,080 --> 00:18:15,300
humans to Mars we're going to get doing

476
00:18:20,390 --> 00:18:18,090
robotic missions that are going to be

477
00:18:22,190 --> 00:18:20,400
collecting scientific data that then

478
00:18:24,860 --> 00:18:22,200
tells us a little bit more about the

479
00:18:28,310 --> 00:18:24,870
planet and what's what's going on there

480
00:18:31,250 --> 00:18:28,320
so as you know landing on Mars is not an

481
00:18:33,470 --> 00:18:31,260
easy thing to do the atmosphere on Mars

482
00:18:36,620 --> 00:18:33,480
is significantly less dense than it is

483
00:18:40,220 --> 00:18:36,630
on earth and so landing a payload the

484
00:18:42,470 --> 00:18:40,230
size of a car or a small SUV coming in

485
00:18:45,110 --> 00:18:42,480
from supersonic velocity is incredibly

486
00:18:47,930 --> 00:18:45,120
difficult to do so we recently worked

487
00:18:50,060 --> 00:18:47,940
with sunny Rockets with NASA's Jet

488
00:18:52,520 --> 00:18:50,070

Propulsion Laboratory on their aspire

489
00:18:53,950 --> 00:18:52,530
program and what they're interested in

490
00:18:55,940 --> 00:18:53,960
doing is studying the fundamental

491
00:18:59,000 --> 00:18:55,950
inflation characteristics of a

492
00:19:00,560 --> 00:18:59,010
supersonic parachute so we flew three

493
00:19:03,830 --> 00:19:00,570
sounding rocket missions over the course

494
00:19:06,350 --> 00:19:03,840
of two years and they were able to use

495
00:19:08,000 --> 00:19:06,360
very high definition video to study this

496
00:19:10,850 --> 00:19:08,010
inflation characteristics of the

497
00:19:12,770 --> 00:19:10,860
supersonic parachute and they're able to

498
00:19:14,810 --> 00:19:12,780
take what they learn from the sani

499
00:19:18,670 --> 00:19:14,820
rocket flights and then design a

500
00:19:20,600 --> 00:19:18,680
parachute for the Mars sample return

501
00:19:23,300 --> 00:19:20,610
system that they're going to be

502
00:19:25,040 --> 00:19:23,310
developing for the Mars 2020 mission Wow

503
00:19:26,630 --> 00:19:25,050
we're getting a bunch of questions on

504
00:19:29,300 --> 00:19:26,640
social media so I'm going to take some

505
00:19:31,700 --> 00:19:29,310
of those now oh now on Facebook wants to

506
00:19:34,940 --> 00:19:31,710
know how fast your sounding rockets go

507
00:19:37,850 --> 00:19:34,950
maybe so the mission we've seen earlier

508
00:19:40,190 --> 00:19:37,860
Doug's Norway mission that rocket got

509
00:19:42,710 --> 00:19:40,200
about two eight thousand miles per hour

510
00:19:44,090 --> 00:19:42,720
so that differs from say with the

511
00:19:45,380 --> 00:19:44,100
International Space Station or the

512
00:19:47,210 --> 00:19:45,390
orbital Rockets

513
00:19:49,700 --> 00:19:47,220

those typically have to go to speeds of

514
00:19:52,010 --> 00:19:49,710
about 17,500 miles per hour to stay in

515
00:19:54,590 --> 00:19:52,020
orbit so we're at least half the speed

516
00:19:56,570 --> 00:19:54,600
of an orbital mission right but that

517
00:19:58,730 --> 00:19:56,580
probably gives you some level of hang

518
00:20:00,350 --> 00:19:58,740
time when you're flying that's right

519
00:20:02,090 --> 00:20:00,360
yeah we want to send all our velocity

520
00:20:03,770 --> 00:20:02,100
straight up as high as we can so we can

521
00:20:04,930 --> 00:20:03,780
get our Rockets as high as they can and

522
00:20:07,840 --> 00:20:04,940
get as much

523
00:20:10,090 --> 00:20:07,850
in the space environment as possible

524
00:20:11,800 --> 00:20:10,100
Marci on Facebook is asking can the

525
00:20:14,400 --> 00:20:11,810
sounding rockets be tracked after the

526
00:20:17,620 --> 00:20:14,410
launch and in the place that they land

527
00:20:21,490 --> 00:20:17,630
sure yeah tell me Rockets are often

528
00:20:22,450 --> 00:20:21,500
track with via radar or GPS and you

529
00:20:23,860 --> 00:20:22,460
mentioned there were some other

530
00:20:27,660 --> 00:20:23,870
techniques that were being developed to

531
00:20:30,520 --> 00:20:27,670
do that as well cool

532
00:20:32,320 --> 00:20:30,530
Steven from Facebook is asking how far

533
00:20:33,970 --> 00:20:32,330
down range is a typical sounding rocket

534
00:20:37,480 --> 00:20:33,980
travel and how are the payloads

535
00:20:40,630 --> 00:20:37,490
recovered so some of our smaller rockets

536
00:20:43,750 --> 00:20:40,640
can go about 16 and 90 miles offshore

537
00:20:46,510 --> 00:20:43,760
and on several of our Wallops missions

538
00:20:48,280 --> 00:20:46,520

will use a recovery boat that will go

539
00:20:50,020 --> 00:20:48,290
out and retrieve the the payload from

540
00:20:51,610 --> 00:20:50,030
the water and bring it back for our

541
00:20:54,220 --> 00:20:51,620
white sands missions it's about sixty

542
00:20:56,410 --> 00:20:54,230
miles that they go and again we use a

543
00:20:58,060 --> 00:20:56,420
helicopter that's a land range so we

544
00:20:59,650 --> 00:20:58,070
take a helicopter out and pick up the

545
00:21:02,290 --> 00:20:59,660
payload and bring it back and can

546
00:21:04,930 --> 00:21:02,300
refurbish Andry fly the payload some of

547
00:21:07,630 --> 00:21:04,940
our biggest rockets that we fly can land

548
00:21:09,580 --> 00:21:07,640
about 400 miles off the coast and those

549
00:21:11,470 --> 00:21:09,590
are a little far for us to send a boat

550
00:21:13,000 --> 00:21:11,480
out to to go retrieve so we let those

551
00:21:16,780 --> 00:21:13,010
fall into the ocean and we don't recover

552
00:21:19,030 --> 00:21:16,790
those nakita on Facebook wants to know

553
00:21:20,110 --> 00:21:19,040
how much does it cost to build this kind

554
00:21:21,880 --> 00:21:20,120
of rocket you mentioned a little bit

555
00:21:23,830 --> 00:21:21,890
about this already Kathy but could you

556
00:21:25,420 --> 00:21:23,840
elaborate okay yeah an average mission

557
00:21:27,250 --> 00:21:25,430
average mission cost is about two

558
00:21:29,350 --> 00:21:27,260
million dollars and that covers all of

559
00:21:31,930 --> 00:21:29,360
the labor the parts to build a rocket

560
00:21:33,490 --> 00:21:31,940
the rocket motors as well as any range

561
00:21:37,270 --> 00:21:33,500
costs associated with where we're

562
00:21:39,580 --> 00:21:37,280
launching from a question that we often

563
00:21:42,730 --> 00:21:39,590

get is how do these Rockets take clear

564
00:21:44,590 --> 00:21:42,740
pictures of faraway galaxies so for one

565
00:21:46,990 --> 00:21:44,600
you might think that they've moving a

566
00:21:48,820 --> 00:21:47,000
lot so how do we get around that and

567
00:21:50,740 --> 00:21:48,830
then as a follow-up wouldn't it be

568
00:21:54,250 --> 00:21:50,750
better and easier to use a satellite for

569
00:21:57,240 --> 00:21:54,260
this well over the years nASA has really

570
00:21:59,580 --> 00:21:57,250
developed a very stable ways of

571
00:22:02,220 --> 00:21:59,590
stabilizing the

572
00:22:04,290 --> 00:22:02,230
payload during flight these involve

573
00:22:07,710 --> 00:22:04,300
using gyroscopes in conjunction with

574
00:22:11,340 --> 00:22:07,720
star trackers and then often will fly

575
00:22:14,700 --> 00:22:11,350
cold gas jets in porous and medium and

576
00:22:17,460 --> 00:22:14,710
fine modes to really stabilize that are

577
00:22:19,710 --> 00:22:17,470
pointing we can achieve stabilities that

578
00:22:22,650 --> 00:22:19,720
are equivalent to the seeing limits of

579
00:22:25,530 --> 00:22:22,660
telescopes on on the ground without

580
00:22:27,660 --> 00:22:25,540
adaptive optics about an arc second or

581
00:22:28,950 --> 00:22:27,670
so glasses you can't get really high

582
00:22:30,360 --> 00:22:28,960
resolution really high resolution

583
00:22:32,970 --> 00:22:30,370
because once you get up there you're

584
00:22:36,150 --> 00:22:32,980
basically stable and as long as you have

585
00:22:38,580 --> 00:22:36,160
a gyroscope to keep locked onto to the

586
00:22:41,490 --> 00:22:38,590
Stars with the star tracker you can get

587
00:22:46,110 --> 00:22:41,500
very high stability and the other

588
00:22:48,840 --> 00:22:46,120

question was how how so wouldn't it be

589
00:22:52,830 --> 00:22:48,850
better to use a satellite yes but now a

590
00:22:54,420 --> 00:22:52,840
satellite can always have more observing

591
00:22:56,490 --> 00:22:54,430
time than we can get within the six

592
00:22:59,850 --> 00:22:56,500
minutes of exo-atmospheric time this

593
00:23:01,950 --> 00:22:59,860
typical of the sounding rocket but what

594
00:23:04,680 --> 00:23:01,960
the sounding rock has really offer is a

595
00:23:06,900 --> 00:23:04,690
way to develop new science using new

596
00:23:10,050 --> 00:23:06,910
technologies and then training a next

597
00:23:12,410 --> 00:23:10,060
generation of scientists based

598
00:23:15,120 --> 00:23:12,420
scientists to to carry those

599
00:23:17,700 --> 00:23:15,130
technologies and science techniques into

600
00:23:20,910 --> 00:23:17,710
new orbital missions so we're really

601
00:23:22,890 --> 00:23:20,920
enabling these big missions that NASA is

602
00:23:26,040 --> 00:23:22,900
planning to do in the 10 and 20 year

603
00:23:27,600 --> 00:23:26,050
time frame the hub of all of this work

604
00:23:29,400 --> 00:23:27,610
on sounding rockets is on the Eastern

605
00:23:32,010 --> 00:23:29,410
Shore of Virginia at the Wallops Flight

606
00:23:34,260 --> 00:23:32,020
Facility Wallops is the nation's premier

607
00:23:35,760 --> 00:23:34,270
facility for suborbital flight here's a

608
00:23:40,560 --> 00:23:35,770
quick video to show you what Wallops is

609
00:23:42,690 --> 00:23:40,570
all about founded in 1945 NASA's Wallops

610
00:23:45,300 --> 00:23:42,700
Flight Facility on the Eastern Shore of

611
00:23:48,120 --> 00:23:45,310
Virginia is America's oldest established

612
00:23:50,490 --> 00:23:48,130
launch range over the years it's become

613
00:23:53,670 --> 00:23:50,500

the agency's premier location for sub

614
00:23:55,860 --> 00:23:53,680
orbital flight Wallops is home to NASA's

615
00:23:57,810 --> 00:23:55,870
sounding rockets program from the

616
00:24:00,030 --> 00:23:57,820
earliest designs through to launch and

617
00:24:03,210 --> 00:24:00,040
recovery it all happens through Wallops

618
00:24:04,740 --> 00:24:03,220
it starts with a researcher who has a

619
00:24:07,149 --> 00:24:04,750
science question

620
00:24:08,889 --> 00:24:07,159
Engineers at Wallops then design a

621
00:24:09,940 --> 00:24:08,899
sounding rocket mission to help answer

622
00:24:13,000 --> 00:24:09,950
that question

623
00:24:15,519 --> 00:24:13,010
they have incredible engineers here who

624
00:24:18,820 --> 00:24:15,529
are solving tough technical problems

625
00:24:21,970 --> 00:24:18,830
they design the trajectory machine all

626
00:24:25,120 --> 00:24:21,980
the parts test the payloads and turn it

627
00:24:27,580 --> 00:24:25,130
all into a flight ready rocket the whole

628
00:24:30,880 --> 00:24:27,590
process takes anywhere from a few months

629
00:24:35,409 --> 00:24:30,890
to about two to three years and it

630
00:24:37,899 --> 00:24:35,419
always ends with a bang wallop supports

631
00:24:40,000 --> 00:24:37,909
about 20 to 25 launches a year from

632
00:24:43,539 --> 00:24:40,010
their home base and at locations around

633
00:24:45,879 --> 00:24:43,549
the world wherever they are the team is

634
00:24:48,340 --> 00:24:45,889
there to prepare the rocket coordinate

635
00:24:53,620 --> 00:24:48,350
launches and receive the data for the

636
00:24:54,940 --> 00:24:53,630
mission another unique aspect of the

637
00:24:56,950 --> 00:24:54,950
sounding rockets program is the

638
00:24:58,779 --> 00:24:56,960

involvement of students it's really one

639
00:25:00,639 --> 00:24:58,789
place where students can get hands-on

640
00:25:03,129 --> 00:25:00,649
experience working on a space science

641
00:25:05,230 --> 00:25:03,139
mission even as a university professor

642
00:25:07,060 --> 00:25:05,240
you're around and working with students

643
00:25:09,070 --> 00:25:07,070
a lot and I understand sometimes they're

644
00:25:10,419 --> 00:25:09,080
directly involved in your missions tell

645
00:25:13,600 --> 00:25:10,429
us more about that the students are

646
00:25:17,919 --> 00:25:13,610
essential to our program over the past

647
00:25:20,200 --> 00:25:17,929
60 years we've had undergraduates and

648
00:25:23,529 --> 00:25:20,210
graduate students there have been over

649
00:25:26,470 --> 00:25:23,539
40 PhDs granted within our sounding

650
00:25:28,570 --> 00:25:26,480
rocket program students are involved at

651
00:25:31,060 --> 00:25:28,580
every aspect of the mission development

652
00:25:35,799 --> 00:25:31,070
from the definition of the science

653
00:25:38,230 --> 00:25:35,809
concept to the the flow down of science

654
00:25:41,100 --> 00:25:38,240
requirements into technical requirements

655
00:25:43,990 --> 00:25:41,110
for the mission and then the actual

656
00:25:46,539 --> 00:25:44,000
design and fabrication and procurement

657
00:25:48,310 --> 00:25:46,549
of all the instruments we're going to be

658
00:25:53,169 --> 00:25:48,320
building typically if there involves

659
00:25:56,919 --> 00:25:53,179
telescopes and optical systems vacuum

660
00:25:59,080 --> 00:25:56,929
systems and then we go ahead and involve

661
00:26:01,690 --> 00:25:59,090
them then with the actual planning of

662
00:26:04,120 --> 00:26:01,700
the flights the integration and testing

663
00:26:07,600 --> 00:26:04,130

the calibration of the instruments and

664
00:26:10,659 --> 00:26:07,610
then we over the field so go to the

665
00:26:12,460 --> 00:26:10,669
field - for the astronomy program -

666
00:26:14,860 --> 00:26:12,470
White Sands Missile Range White Sands

667
00:26:16,659 --> 00:26:14,870
Missile Range offers unique capability

668
00:26:17,280 --> 00:26:16,669
in that we can recover the payloads

669
00:26:19,530 --> 00:26:17,290
without

670
00:26:23,280 --> 00:26:19,540
which problem and they also have a

671
00:26:25,800 --> 00:26:23,290
system where we can actually fly the

672
00:26:29,610 --> 00:26:25,810
telescope during flight so the students

673
00:26:32,190 --> 00:26:29,620
will be piloting the telescope over the

674
00:26:35,040 --> 00:26:32,200
first six six minutes of extra time in

675
00:26:36,780 --> 00:26:35,050
the spirit time that we have available

676
00:26:40,590 --> 00:26:36,790
to us so when you when you say fly you

677
00:26:42,960 --> 00:26:40,600
mean like aim it or yeah they'll be with

678
00:26:45,600 --> 00:26:42,970
our precise pointing capability will

679
00:26:47,730 --> 00:26:45,610
have a downlink image of the stellar

680
00:26:51,630 --> 00:26:47,740
field that we're looking at and the

681
00:26:54,300 --> 00:26:51,640
student can then use a joystick to point

682
00:26:55,530 --> 00:26:54,310
the rocket to the actual target that

683
00:26:57,480 --> 00:26:55,540
we're interested in Wow

684
00:26:59,940 --> 00:26:57,490
and then once their pressure a lot of

685
00:27:02,840 --> 00:26:59,950
pressure of course once the flight is

686
00:27:06,030 --> 00:27:02,850
all over and it's over much too quickly

687
00:27:07,890 --> 00:27:06,040
the next morning we we come on back out

688
00:27:09,690 --> 00:27:07,900

and the student goes out on the

689
00:27:12,630 --> 00:27:09,700
helicopter to pick it up and bring it

690
00:27:14,370 --> 00:27:12,640
back and then we refurb it and go to see

691
00:27:17,400 --> 00:27:14,380
Kathy and say hey we'd like another

692
00:27:19,680 --> 00:27:17,410
flight all right Wow so Kathy you you've

693
00:27:21,480 --> 00:27:19,690
been involved with a program that

694
00:27:23,520 --> 00:27:21,490
Wallops where lots of students are

695
00:27:25,080 --> 00:27:23,530
coming through and they're building and

696
00:27:26,580 --> 00:27:25,090
even launching their own rockets right

697
00:27:28,410 --> 00:27:26,590
they're from Wallops tell us more about

698
00:27:30,210 --> 00:27:28,420
what that is yeah Wallops we have

699
00:27:31,800 --> 00:27:30,220
programs for students from the

700
00:27:35,220 --> 00:27:31,810
undergraduate level all the way through

701
00:27:37,530 --> 00:27:35,230
grad school in fact over 400 PhDs have

702
00:27:39,360 --> 00:27:37,540
been awarded over assigning rocket

703
00:27:42,240 --> 00:27:39,370
research that was done on board one of

704
00:27:44,250 --> 00:27:42,250
our one of our missions it Wallops every

705
00:27:47,010 --> 00:27:44,260
year we do two student sounding rocket

706
00:27:48,990 --> 00:27:47,020
missions we partner with the Colorado

707
00:27:52,500 --> 00:27:49,000
Space Grant consortium and they're rock

708
00:27:54,120 --> 00:27:52,510
on program and every year they bring a

709
00:27:56,580 --> 00:27:54,130
group of students to Wallops Flight

710
00:27:58,740 --> 00:27:56,590
Facility for a week and they build these

711
00:28:00,390 --> 00:27:58,750
small payloads that measure the flight

712
00:28:02,520 --> 00:28:00,400
environment of the sounding rocket and

713
00:28:05,070 --> 00:28:02,530

at the end of the week the last day that

714
00:28:07,140 --> 00:28:05,080
they're here we launch and we recover

715
00:28:08,490 --> 00:28:07,150
the Rockets so in a week's time frame

716
00:28:10,500 --> 00:28:08,500
these students get to see an entire

717
00:28:11,370 --> 00:28:10,510
sounding rocket mission from all the way

718
00:28:12,990 --> 00:28:11,380
from the start

719
00:28:15,570 --> 00:28:13,000
through launch and recovery so it's a

720
00:28:17,490 --> 00:28:15,580
really great experience for them as they

721
00:28:20,580 --> 00:28:17,500
graduate through the program they can

722
00:28:23,310 --> 00:28:20,590
then design build and then we will fly

723
00:28:25,320 --> 00:28:23,320
their own their own experiments that

724
00:28:28,770 --> 00:28:25,330
they come up with and we fly them on the

725
00:28:30,419 --> 00:28:28,780
same missions so it's a great way to

726
00:28:32,039 --> 00:28:30,429
train the next gen

727
00:28:34,529 --> 00:28:32,049
raishin of space scientists and

728
00:28:37,259 --> 00:28:34,539
engineers and we've had over 700

729
00:28:39,210 --> 00:28:37,269
students from 43 states participate over

730
00:28:42,389 --> 00:28:39,220
the 13-year life of the rock on program

731
00:28:45,480 --> 00:28:42,399
which is really wonderful it Wallops we

732
00:28:47,519 --> 00:28:45,490
also have our own internal internship

733
00:28:49,350 --> 00:28:47,529
and co-op program for the sounding

734
00:28:51,419 --> 00:28:49,360
rocket program over its 20-year

735
00:28:53,430 --> 00:28:51,429
lifecycle we've had over 200 students

736
00:28:55,590 --> 00:28:53,440
and typically their engineering students

737
00:28:57,419 --> 00:28:55,600
come and they get to work side by side

738
00:29:00,060 --> 00:28:57,429

with our sounding rocket engineers so

739
00:29:01,980 --> 00:29:00,070
they get to design build test and even

740
00:29:04,889 --> 00:29:01,990
sometimes launch and see the recovery

741
00:29:06,840 --> 00:29:04,899
operations of our missions again another

742
00:29:09,060 --> 00:29:06,850
great opportunity for students

743
00:29:11,580 --> 00:29:09,070
engineering students to get involved and

744
00:29:13,730 --> 00:29:11,590
actually that's how I got my start in

745
00:29:16,109 --> 00:29:13,740
sounding rockets so I was a

746
00:29:18,960 --> 00:29:16,119
undergraduate student at Virginia Tech

747
00:29:20,879 --> 00:29:18,970
and they were working on a rocket

748
00:29:23,519 --> 00:29:20,889
program with Wallops at Wallops was

749
00:29:25,830 --> 00:29:23,529
sponsoring and I got involved in the

750
00:29:27,570 --> 00:29:25,840
program and it eventually led to an

751
00:29:29,909 --> 00:29:27,580
internship at Wallops and then that

752
00:29:31,739 --> 00:29:29,919
eventually led to a full time career

753
00:29:33,779 --> 00:29:31,749
after graduation and I've been with a

754
00:29:35,430 --> 00:29:33,789
program ever since Wow how did you get

755
00:29:37,109 --> 00:29:35,440
started as what drew you to it in the

756
00:29:38,580 --> 00:29:37,119
first place well as an engineering

757
00:29:40,739 --> 00:29:38,590
student there is absolutely nothing

758
00:29:42,840 --> 00:29:40,749
better than a rocket they go the fastest

759
00:29:45,600 --> 00:29:42,850
they go the highest the loads that they

760
00:29:47,279 --> 00:29:45,610
go under the thermal loads the Rockets

761
00:29:50,970 --> 00:29:47,289
are bending it's an engineer's dream

762
00:29:53,009 --> 00:29:50,980
right not a bad gig no some of these

763
00:29:55,019 --> 00:29:53,019

launches do happen from Wallops but

764
00:29:57,239 --> 00:29:55,029
Wallops also supports flights all over

765
00:29:59,310 --> 00:29:57,249
the globe in fact right now we have NASA

766
00:30:01,169 --> 00:29:59,320
teams based in Svalbard an island in the

767
00:30:02,940 --> 00:30:01,179
middle of the Arctic Ocean preparing for

768
00:30:05,580 --> 00:30:02,950
the next launches in the Grand Challenge

769
00:30:07,230 --> 00:30:05,590
initiative cusp but the first rockets to

770
00:30:09,060 --> 00:30:07,240
launch as part of that series launched

771
00:30:12,670 --> 00:30:09,070
last year let's see a little bit more

772
00:30:14,800 --> 00:30:12,680
from behind the scenes of that mission

773
00:30:18,280 --> 00:30:14,810
we're in the northernmost place in the

774
00:30:21,160 --> 00:30:18,290
world in the Alison small work Norway we

775
00:30:23,560 --> 00:30:21,170
have 35 residents and 60 of our team

776
00:30:25,060 --> 00:30:23,570
together and a town that is completely

777
00:30:27,250 --> 00:30:25,070
isolated there's a plane twice a week

778
00:30:29,890 --> 00:30:27,260
and there's a thousand polar bears

779
00:30:32,740 --> 00:30:29,900
nearby we're here because it's dark all

780
00:30:34,150 --> 00:30:32,750
the 24 hours a day in the winter so we

781
00:30:36,070 --> 00:30:34,160
can have the beautiful aurora overhead

782
00:30:38,670 --> 00:30:36,080
these are cameras to study it and then

783
00:30:40,750 --> 00:30:38,680
it has the magnetic cusp which is a weak

784
00:30:43,440 --> 00:30:40,760
it's only two points on right that on

785
00:30:48,930 --> 00:30:43,450
the earth and every day than the Alison

786
00:30:54,220 --> 00:30:52,060
so that mission was called visions - and

787
00:30:56,860 --> 00:30:54,230
Doug Rowland who's joining us now was

788
00:30:59,740 --> 00:30:56,870

lead scientist Doug tell us more about

789
00:31:01,450 --> 00:30:59,750
what vision 2 is about and also why you

790
00:31:02,890 --> 00:31:01,460
had to go all the way to small barn to

791
00:31:05,560 --> 00:31:02,900
launch rockets thanks miles

792
00:31:07,840 --> 00:31:05,570
so visions 2 was a study of the aurora

793
00:31:10,000 --> 00:31:07,850
and how the aurora heats our atmosphere

794
00:31:11,680 --> 00:31:10,010
and causes to escape into space don't

795
00:31:13,030 --> 00:31:11,690
worry we've got five billion years or

796
00:31:15,190 --> 00:31:13,040
more of atmosphere left you're not gonna

797
00:31:16,840 --> 00:31:15,200
lose it any time soon but we want to

798
00:31:18,730 --> 00:31:16,850
understand how atmospheric escape works

799
00:31:20,380 --> 00:31:18,740
in the earth because other planets like

800
00:31:21,760 --> 00:31:20,390
Mars or exoplanets

801
00:31:23,770 --> 00:31:21,770
they have different histories and

802
00:31:25,420 --> 00:31:23,780
different life experiences and so Mars

803
00:31:27,490 --> 00:31:25,430
for example lost a lot of us atmosphere

804
00:31:28,720 --> 00:31:27,500
very early on Mars has lots smaller than

805
00:31:30,370 --> 00:31:28,730
Earth it doesn't have a magnetic field

806
00:31:31,510 --> 00:31:30,380
like the earth does so there's very

807
00:31:33,580 --> 00:31:31,520
differences but we want to try to

808
00:31:34,900 --> 00:31:33,590
understand at our local laboratory where

809
00:31:37,060 --> 00:31:34,910
it costs just a few million dollars to

810
00:31:38,980 --> 00:31:37,070
study and then try to strap like that to

811
00:31:41,200 --> 00:31:38,990
elsewhere as opposed to sending many

812
00:31:43,000 --> 00:31:41,210
probes to these other places got it

813
00:31:44,860 --> 00:31:43,010

we've got a graphic here showing Earth

814
00:31:46,060 --> 00:31:44,870
tell us what we're seeing here Doug okay

815
00:31:48,340 --> 00:31:46,070
well this is a picture of the Earth's

816
00:31:50,860 --> 00:31:48,350
magnetic field embedded in the solar

817
00:31:52,180 --> 00:31:50,870
wind so space is not empty you have the

818
00:31:54,340 --> 00:31:52,190
solar wind which is basically the hot

819
00:31:56,290 --> 00:31:54,350
gas flowing out from the Sun it streams

820
00:31:58,090 --> 00:31:56,300
past the earth and the magnetic field

821
00:32:00,190 --> 00:31:58,100
for the most part deflects that solar

822
00:32:02,230 --> 00:32:00,200
wind around the earth but there are two

823
00:32:04,180 --> 00:32:02,240
regions the cusps where there's sort of

824
00:32:05,710 --> 00:32:04,190
a funnel where the magnetic field has a

825
00:32:07,870 --> 00:32:05,720
weak point this whole region stream

826
00:32:09,820 --> 00:32:07,880
right into our atmosphere here and here

827
00:32:11,530 --> 00:32:09,830
the--and those two points are fixed

828
00:32:13,450 --> 00:32:11,540
they're always on the side of the earth

829
00:32:15,760 --> 00:32:13,460
at its base in the Sun but the earth

830
00:32:18,280 --> 00:32:15,770
rotates underneath them and so if you're

831
00:32:20,650 --> 00:32:18,290
at these very high latitudes 79 degrees

832
00:32:21,160 --> 00:32:20,660
or so about 700 miles from the North

833
00:32:23,140 --> 00:32:21,170
Pole

834
00:32:24,340 --> 00:32:23,150
the cost every day will rotate right

835
00:32:25,780 --> 00:32:24,350
over your head and you can

836
00:32:28,270 --> 00:32:25,790
you're rocking too if you want to study

837
00:32:31,330 --> 00:32:28,280
how that solar wind affects the

838
00:32:33,190 --> 00:32:31,340

atmosphere so you mentioned you are

839
00:32:36,310 --> 00:32:33,200
studying oxygen escaping and we're

840
00:32:37,900 --> 00:32:36,320
seeing in part of this graphic we're

841
00:32:39,280 --> 00:32:37,910
seeing the solar wind coming in here but

842
00:32:41,770 --> 00:32:39,290
then we're also seeing a little bit of

843
00:32:43,390 --> 00:32:41,780
particles coming out is that that's the

844
00:32:45,580 --> 00:32:43,400
oxygen mile so yeah so this is the solar

845
00:32:47,650 --> 00:32:45,590
wind kind of coming in this cusp funnel

846
00:32:49,240 --> 00:32:47,660
and as it streams right down in is

847
00:32:50,890 --> 00:32:49,250
hitting the atmosphere directly doesn't

848
00:32:52,780 --> 00:32:50,900
have to go through any other process and

849
00:32:54,820 --> 00:32:52,790
when it does heats that atmosphere gives

850
00:32:56,680 --> 00:32:54,830
off that a rural life and cause that

851
00:32:58,540 --> 00:32:56,690
oxygen to stream out and that's another

852
00:33:00,730 --> 00:32:58,550
beautiful thing what they cost we go

853
00:33:02,140 --> 00:33:00,740
there because in the winter it's dark

854
00:33:03,370 --> 00:33:02,150
all the time this is the only place on

855
00:33:05,620 --> 00:33:03,380
earth where you can see Aurora during

856
00:33:07,600 --> 00:33:05,630
the day and that makes it really cool we

857
00:33:09,400 --> 00:33:07,610
have these cameras on the ground let's

858
00:33:11,320 --> 00:33:09,410
say okay this Aurora is telling us where

859
00:33:13,780 --> 00:33:11,330
the energy is coming in and energizing

860
00:33:15,190 --> 00:33:13,790
that that escaping atmosphere so to see

861
00:33:16,570 --> 00:33:15,200
if it's time to launch or not we don't

862
00:33:17,590 --> 00:33:16,580
want to waste our rocket we want to

863
00:33:19,030 --> 00:33:17,600

launch when there's a brighter were

864
00:33:20,920 --> 00:33:19,040
there we think there's lots of this

865
00:33:22,660 --> 00:33:20,930
happening so we have a sensitive camera

866
00:33:25,330 --> 00:33:22,670
down here if it was daytime would be

867
00:33:28,150 --> 00:33:25,340
washed out but because it's day but dark

868
00:33:29,650 --> 00:33:28,160
there in the winter 24 hours a day we

869
00:33:32,170 --> 00:33:29,660
can have our camera there and no one to

870
00:33:34,000 --> 00:33:32,180
launch and then go wow so yours was just

871
00:33:35,650 --> 00:33:34,010
the first mission though out of a whole

872
00:33:37,690 --> 00:33:35,660
series called the Grand Challenge

873
00:33:39,580 --> 00:33:37,700
initiative cusp can you tell us more

874
00:33:41,260 --> 00:33:39,590
about what that is and also we mentioned

875
00:33:42,970 --> 00:33:41,270
at the top of the show that we have the

876
00:33:44,320 --> 00:33:42,980
next three launches coming up next week

877
00:33:46,030 --> 00:33:44,330
so tell us a little bit more about this

878
00:33:49,180 --> 00:33:46,040
you're the Grand Challenge initiative

879
00:33:50,950 --> 00:33:49,190
cusp is a multinational collaboration we

880
00:33:52,480 --> 00:33:50,960
was developed by the University of Oslo

881
00:33:55,570 --> 00:33:52,490
in Norway and it's a multinational

882
00:33:57,280 --> 00:33:55,580
between Norway the US Japan and we have

883
00:33:59,260 --> 00:33:57,290
contributions from the UK and Canada as

884
00:34:00,070 --> 00:33:59,270
well and the whole idea is you know you

885
00:34:02,290 --> 00:34:00,080
can do a lot

886
00:34:04,540 --> 00:34:02,300
one rocket at a time but you can get

887
00:34:06,610 --> 00:34:04,550
extra bonus out of kind of combining

888
00:34:08,470 --> 00:34:06,620

those rocket missions get you save money

889
00:34:09,820 --> 00:34:08,480
you save time and you can really

890
00:34:12,610 --> 00:34:09,830
leverage the science from each mission

891
00:34:13,990 --> 00:34:12,620
to try to to try to learn more for

892
00:34:15,400 --> 00:34:14,000
example the Grand Challenge it happened

893
00:34:17,169 --> 00:34:15,410
over about two years it started last

894
00:34:19,450 --> 00:34:17,179
November it's continuing through this

895
00:34:21,610 --> 00:34:19,460
winter we have next week three rocket

896
00:34:23,440 --> 00:34:21,620
missions launching potentially as part

897
00:34:26,050 --> 00:34:23,450
of this Grand Challenge and it continues

898
00:34:28,210 --> 00:34:26,060
through to them to 2020 a little bit the

899
00:34:29,950 --> 00:34:28,220
ideas we have two launch sites here

900
00:34:31,570 --> 00:34:29,960
normally we launch our rural rockets

901
00:34:33,280 --> 00:34:31,580
from Alaska Poker flat research range

902
00:34:35,050 --> 00:34:33,290
but here because want to study the cost

903
00:34:36,740 --> 00:34:35,060
we go to northern Norway this is the

904
00:34:38,750 --> 00:34:36,750
north coast of Norway continental

905
00:34:40,669 --> 00:34:38,760
this is Andrea rocket range which is

906
00:34:43,280 --> 00:34:40,679
right on the northern coast there this

907
00:34:45,139 --> 00:34:43,290
is the archipelago small Bart the island

908
00:34:47,950 --> 00:34:45,149
of Spitsbergen is here and the ålesund

909
00:34:49,849 --> 00:34:47,960
at 79 degrees north is the northernmost

910
00:34:52,129 --> 00:34:49,859
permanently inhabited civilian

911
00:34:54,050 --> 00:34:52,139
settlement in the world so it's got an

912
00:34:56,419 --> 00:34:54,060
ice-free Harbor it's got an airport it's

913
00:34:58,370 --> 00:34:56,429

got polar night 24 hours a day it's got

914
00:35:00,589 --> 00:34:58,380
a rocket range the first NASA rockets

915
00:35:02,660 --> 00:35:00,599
were launched in 1997 Rob Taft who you

916
00:35:04,430 --> 00:35:02,670
saw earlier was instrumental in getting

917
00:35:06,140 --> 00:35:04,440
that developed and then we have the

918
00:35:07,700 --> 00:35:06,150
Norwegian scientists who really

919
00:35:09,230 --> 00:35:07,710
developed that and got that going so we

920
00:35:11,720 --> 00:35:09,240
could work together as an international

921
00:35:13,099 --> 00:35:11,730
team and so you can see here these are

922
00:35:14,330 --> 00:35:13,109
just graphical projections of the

923
00:35:16,160 --> 00:35:14,340
trajectories of the rocket there are

924
00:35:18,200 --> 00:35:16,170
these suborbital parabolic trajectories

925
00:35:19,640 --> 00:35:18,210
we go up and we come back down and

926
00:35:21,349 --> 00:35:19,650
there's a launch site here in the

927
00:35:22,609 --> 00:35:21,359
Allison at launch life here in Oya

928
00:35:23,930 --> 00:35:22,619
and we just show the different

929
00:35:25,520 --> 00:35:23,940
trajectories some are going to low

930
00:35:26,960 --> 00:35:25,530
altitudes to measure certain things this

931
00:35:28,730 --> 00:35:26,970
is a student rocket where students

932
00:35:30,170 --> 00:35:28,740
develop this these are other kinds of

933
00:35:32,450 --> 00:35:30,180
rockets of many different altitudes and

934
00:35:33,620 --> 00:35:32,460
then the Trice to rocket led by craig

935
00:35:36,349 --> 00:35:33,630
kletzing at the University of Iowa was

936
00:35:37,550 --> 00:35:36,359
the highest one of the ones we went on

937
00:35:39,410 --> 00:35:37,560
what you want to study you have you can

938
00:35:41,060 --> 00:35:39,420

see how you can tailor this to really

939
00:35:43,220 --> 00:35:41,070
adjust any part of this vertical range

940
00:35:44,900 --> 00:35:43,230
you want to study Wow tell me more about

941
00:35:47,089 --> 00:35:44,910
what it was like to go here I mean this

942
00:35:49,010 --> 00:35:47,099
is not you know New York this is not

943
00:35:50,960 --> 00:35:49,020
Washington where we are now what is it

944
00:35:52,520 --> 00:35:50,970
like to be and launch from a place -

945
00:35:54,440 --> 00:35:52,530
well Nelson's kind of a magical place

946
00:35:56,359 --> 00:35:54,450
it's this one place on earth that's

947
00:35:58,579 --> 00:35:56,369
given 700 miles from the North Pole

948
00:36:01,339 --> 00:35:58,589
there's more polar bears than people and

949
00:36:03,710 --> 00:36:01,349
there's a wonderful town there called me

950
00:36:06,440 --> 00:36:03,720
Allison which is sort of a strange town

951
00:36:07,880 --> 00:36:06,450
it's a private public partnership with

952
00:36:09,650 --> 00:36:07,890
with the Kings Bay Company in the

953
00:36:10,849 --> 00:36:09,660
government of Norway in its research

954
00:36:12,859 --> 00:36:10,859
town you know it used to be a coal

955
00:36:14,060 --> 00:36:12,869
mining town back in the day and now

956
00:36:15,980 --> 00:36:14,070
they've got research when there's all

957
00:36:18,310 --> 00:36:15,990
kinds of research they study Glaciology

958
00:36:22,099 --> 00:36:18,320
marine biology atmospheric pollution

959
00:36:24,260 --> 00:36:22,109
tectonic motion and the aurora and so

960
00:36:25,670 --> 00:36:24,270
they have various international groups

961
00:36:26,900 --> 00:36:25,680
come in and set up and leased space from

962
00:36:28,700 --> 00:36:26,910
the Kings Bay Company they set up their

963
00:36:30,740 --> 00:36:28,710

research sites and they built a rocket

964
00:36:32,329 --> 00:36:30,750
range here and so the beauty of that is

965
00:36:35,570 --> 00:36:32,339
they're so used to having such an

966
00:36:37,400 --> 00:36:35,580
international culture there that it's

967
00:36:38,839 --> 00:36:37,410
very open it's very welcoming you know

968
00:36:40,280 --> 00:36:38,849
it's dark all the time but the people

969
00:36:41,710 --> 00:36:40,290
there kind of brighten it for you you

970
00:36:43,970 --> 00:36:41,720
know it's very nice you have these

971
00:36:44,930 --> 00:36:43,980
communal cafeteria mess hall and

972
00:36:46,400 --> 00:36:44,940
everything where you can kind of eat

973
00:36:47,420 --> 00:36:46,410
together just they welcome you into this

974
00:36:50,089 --> 00:36:47,430
community we're there for five weeks

975
00:36:50,510 --> 00:36:50,099
some of our team was there for many many

976
00:36:51,860 --> 00:36:50,520
months

977
00:36:53,750 --> 00:36:51,870
because they had to set up the launcher

978
00:36:54,860 --> 00:36:53,760
they to bring in the telemetry there's a

979
00:36:56,960 --> 00:36:54,870
lot of the Wallops guys they go over

980
00:36:57,920 --> 00:36:56,970
there for months at a time our science

981
00:37:00,020 --> 00:36:57,930
team was there for about five weeks

982
00:37:01,460 --> 00:37:00,030
setting up and you really become part of

983
00:37:04,280 --> 00:37:01,470
that town and you're really part of that

984
00:37:06,320 --> 00:37:04,290
culture and just a beautiful area Wow we

985
00:37:08,240 --> 00:37:06,330
were gonna have everyone back on now

986
00:37:12,830 --> 00:37:08,250
we'll take some questions from social

987
00:37:14,840 --> 00:37:12,840
media so Zander from periscope is asking

988
00:37:16,460 --> 00:37:14,850

how long does it take from Mission

989
00:37:19,400 --> 00:37:16,470
concept to launch that's probably a

990
00:37:21,380 --> 00:37:19,410
Cathy question about two years for a new

991
00:37:23,300 --> 00:37:21,390
payload but if we have one that's

992
00:37:25,010 --> 00:37:23,310
already flown and we can just refurbish

993
00:37:27,080 --> 00:37:25,020
and fly it again we can do it in a short

994
00:37:30,350 --> 00:37:27,090
is about six months to twelve months on

995
00:37:32,300 --> 00:37:30,360
average Ellie on Twitter is asking how

996
00:37:38,150 --> 00:37:32,310
difficult is it to build and launch a

997
00:37:40,520 --> 00:37:38,160
sounding rocket we we do most of it

998
00:37:42,560 --> 00:37:40,530
in-house at our facility at Wallops we

999
00:37:44,330 --> 00:37:42,570
do all the design and manufacturing for

1000
00:37:45,560 --> 00:37:44,340
most of the pieces in-house and then the

1001
00:37:47,180 --> 00:37:45,570
rocket motors of course are either

1002
00:37:51,530 --> 00:37:47,190
military surplus store we buy them from

1003
00:37:53,480 --> 00:37:51,540
a commercial vendor so not hard I think

1004
00:37:56,210 --> 00:37:53,490
so thanks six months it's only rocket

1005
00:37:59,480 --> 00:37:56,220
science Yeah right exactly no it's it's

1006
00:38:00,920 --> 00:37:59,490
certainly a fun and challenging

1007
00:38:03,740 --> 00:38:00,930
environment it's a build a sounding

1008
00:38:05,630 --> 00:38:03,750
rocket so sure one on Facebook wants to

1009
00:38:07,940 --> 00:38:05,640
know can you watch a sounding rocket

1010
00:38:10,460 --> 00:38:07,950
launch and where do I find out how and

1011
00:38:12,170 --> 00:38:10,470
win where can I do that maybe okay

1012
00:38:14,810 --> 00:38:12,180
well first of all of the NASA sounding

1013
00:38:17,330 --> 00:38:14,820

rockets are announced if we encourage

1014
00:38:19,520 --> 00:38:17,340
everyone to watch them you have to have

1015
00:38:20,930 --> 00:38:19,530
a certain amount of patience though

1016
00:38:22,340 --> 00:38:20,940
because we're not but a lot of the

1017
00:38:23,420 --> 00:38:22,350
science missions you're not sure when

1018
00:38:25,160 --> 00:38:23,430
you're gonna launch you're gonna launch

1019
00:38:26,900 --> 00:38:25,170
when the conditions are just right we

1020
00:38:28,670 --> 00:38:26,910
usually have a two-week window and then

1021
00:38:31,820 --> 00:38:28,680
within every day within that window you

1022
00:38:33,530 --> 00:38:31,830
might have a four or five hour again a

1023
00:38:35,630 --> 00:38:33,540
window which is your window of

1024
00:38:37,820 --> 00:38:35,640
opportunity to launch it when and again

1025
00:38:39,650 --> 00:38:37,830
for the the science conditions to be

1026
00:38:41,270 --> 00:38:39,660
just right I should point out though

1027
00:38:42,680 --> 00:38:41,280
that if you're on the East Coast you can

1028
00:38:44,570 --> 00:38:42,690
welcome to come to Wallops Flight

1029
00:38:46,430 --> 00:38:44,580
Facility to watch launches there if

1030
00:38:48,680 --> 00:38:46,440
you're on the west and up north you can

1031
00:38:51,500 --> 00:38:48,690
go to Alaska to watch launches into the

1032
00:38:54,910 --> 00:38:51,510
aurora from poker flat research range or

1033
00:38:57,200 --> 00:38:54,920
white sands we also have I do all the

1034
00:38:59,630 --> 00:38:57,210
majority of the launches are live

1035
00:39:01,400 --> 00:38:59,640
streamed yeah so you can actually you

1036
00:39:03,340 --> 00:39:01,410
know you can see them on nasa.gov slash

1037
00:39:05,110 --> 00:39:03,350
Wallops so

1038
00:39:07,090 --> 00:39:05,120

we really encourage the public to get

1039
00:39:09,790 --> 00:39:07,100
involved got it

1040
00:39:12,400 --> 00:39:09,800
Christine on Facebook is asking how is

1041
00:39:14,470 --> 00:39:12,410
data retrieval accomplished so for

1042
00:39:15,730 --> 00:39:14,480
example is it collected during flight or

1043
00:39:18,700 --> 00:39:15,740
you have to wait to the rocket falls

1044
00:39:21,580 --> 00:39:18,710
back down maybe just even you ya know we

1045
00:39:26,380 --> 00:39:21,590
have real-time telemetry from the rocket

1046
00:39:30,760 --> 00:39:26,390
it happens onboard it's turned in all

1047
00:39:33,970 --> 00:39:30,770
your housekeeping analog channels and

1048
00:39:35,710 --> 00:39:33,980
all your digital primary science data is

1049
00:39:37,900 --> 00:39:35,720
turned into ones and zeros and put me

1050
00:39:41,410 --> 00:39:37,910
doing great big matrix and this matrix

1051
00:39:43,810 --> 00:39:41,420
is then sent down on the ground via s

1052
00:39:46,090 --> 00:39:43,820
band radio waves and translated by a

1053
00:39:49,720 --> 00:39:46,100
ground station and we have real-time

1054
00:39:51,790 --> 00:39:49,730
contact and sometimes they go ahead and

1055
00:39:54,040 --> 00:39:51,800
record if they have very high data rates

1056
00:39:56,170 --> 00:39:54,050
onboard but for the most part you have

1057
00:39:58,210 --> 00:39:56,180
real-time contract and and you know

1058
00:40:00,370 --> 00:39:58,220
almost instantaneously what has happened

1059
00:40:02,050 --> 00:40:00,380
and that's what telemetry is right it's

1060
00:40:06,130 --> 00:40:02,060
the sending of the informations right

1061
00:40:07,510 --> 00:40:06,140
that's quick school one of our Facebook

1062
00:40:08,860 --> 00:40:07,520
followers is asking in your opinion

1063
00:40:10,660 --> 00:40:08,870

what's the most important thing we've

1064
00:40:11,740 --> 00:40:10,670
learned from the sounding rocket program

1065
00:40:14,050 --> 00:40:11,750
and what is the most interesting

1066
00:40:20,350 --> 00:40:14,060
question you still hope to answer this

1067
00:40:21,790 --> 00:40:20,360
one is a free-for-all can i we've had so

1068
00:40:23,560 --> 00:40:21,800
many discoveries from the rocket

1069
00:40:25,510 --> 00:40:23,570
programming I always think back to the

1070
00:40:28,180 --> 00:40:25,520
Aurora how it was sounding rockets that

1071
00:40:30,490 --> 00:40:28,190
determinar discovered that it was beams

1072
00:40:32,170 --> 00:40:30,500
of energetic electrons coming down the

1073
00:40:34,180 --> 00:40:32,180
magnetic field lines interacting with

1074
00:40:36,460 --> 00:40:34,190
the atmosphere to actually caused the

1075
00:40:38,410 --> 00:40:36,470
Evora but it didn't stop there I mean we

1076
00:40:40,120 --> 00:40:38,420
also did so much more and are doing so

1077
00:40:42,430 --> 00:40:40,130
much more research with the Aurora as

1078
00:40:44,110 --> 00:40:42,440
far as electric fields and waves

1079
00:40:45,700 --> 00:40:44,120
associated with the Aurora how these

1080
00:40:47,620 --> 00:40:45,710
were affect the chemistry of the

1081
00:40:49,780 --> 00:40:47,630
apparatus for the heating the iron

1082
00:40:51,340 --> 00:40:49,790
outflow the Doug was talking about so as

1083
00:40:54,300 --> 00:40:51,350
a whole new field we keep getting more

1084
00:40:57,220 --> 00:40:54,310
we keep being led on to do more

1085
00:40:59,020 --> 00:40:57,230
follow-on missions to go after the

1086
00:41:00,970 --> 00:40:59,030
important processes that we're

1087
00:41:03,070 --> 00:41:00,980
discovering we've also looked at

1088
00:41:04,900 --> 00:41:03,080

noctilucent clouds and the aerosols that

1089
00:41:06,700 --> 00:41:04,910
have i sublimation to create those

1090
00:41:09,340 --> 00:41:06,710
clouds those were discovered on sounding

1091
00:41:11,410 --> 00:41:09,350
rockets lightning studies we've launched

1092
00:41:13,330 --> 00:41:11,420
over thunderstorms and we've discovered

1093
00:41:15,730 --> 00:41:13,340
know that when there's a lightning burst

1094
00:41:16,480 --> 00:41:15,740
a very large electric field associate

1095
00:41:18,820 --> 00:41:16,490
with the lightning

1096
00:41:20,650 --> 00:41:18,830
Paul so to speak goes up into space and

1097
00:41:22,870 --> 00:41:20,660
that actually can do some does heating

1098
00:41:24,700 --> 00:41:22,880
and it's not just waves associated with

1099
00:41:26,859 --> 00:41:24,710
the lightning but these these electric

1100
00:41:29,470 --> 00:41:26,869
field pulses are very important we've

1101
00:41:31,900 --> 00:41:29,480
looked at instabilities associated with

1102
00:41:34,210 --> 00:41:31,910
the electric jet as a region at the base

1103
00:41:35,440 --> 00:41:34,220
of the ionosphere at the equator often

1104
00:41:37,300 --> 00:41:35,450
the auroral zone we've looked at

1105
00:41:38,730 --> 00:41:37,310
turbulence in space it's so important

1106
00:41:41,740 --> 00:41:38,740
for space weather because it causes

1107
00:41:43,540 --> 00:41:41,750
scintillations of radio wave signal is

1108
00:41:45,310 --> 00:41:43,550
important for navigation you know make

1109
00:41:47,770 --> 00:41:45,320
sure your GPS is giving you the right

1110
00:41:50,109 --> 00:41:47,780
information it could be altering it's

1111
00:41:52,000 --> 00:41:50,119
altered by turbulence in the ionosphere

1112
00:41:53,770 --> 00:41:52,010
and we've used rockets to study that so

1113
00:41:57,180 --> 00:41:53,780

this there's really a tremendous amount

1114
00:41:59,680 --> 00:41:57,190
being done in geo space also in the

1115
00:42:01,660 --> 00:41:59,690
astronomy and solar just getting above

1116
00:42:03,370 --> 00:42:01,670
the atmosphere is allowed us to look at

1117
00:42:05,170 --> 00:42:03,380
wavelengths that are normally absorbed

1118
00:42:07,270 --> 00:42:05,180
by the atmosphere in fact but the whole

1119
00:42:10,210 --> 00:42:07,280
field of UV astronomy was started with

1120
00:42:12,010 --> 00:42:10,220
Sonia Marcus as with x-ray astronomy so

1121
00:42:13,990 --> 00:42:12,020
and and the work being done with solar

1122
00:42:15,310 --> 00:42:14,000
the very high time resolution so it's

1123
00:42:17,380 --> 00:42:15,320
really you know we're just getting

1124
00:42:18,339 --> 00:42:17,390
discoveries and discoveries it's really

1125
00:42:23,470 --> 00:42:18,349
a tremendous program

1126
00:42:25,810 --> 00:42:23,480
Wow this is a question probably for

1127
00:42:29,109 --> 00:42:25,820
Kathy what fuel do sounding rockets used

1128
00:42:31,900 --> 00:42:29,119
we solid propellant rocket motors so it

1129
00:42:34,420 --> 00:42:31,910
kind of has a hard rubbery texture to it

1130
00:42:36,550 --> 00:42:34,430
and it carries all of its metallic

1131
00:42:39,609 --> 00:42:36,560
ingredients and its oxidizer & binder

1132
00:42:41,920 --> 00:42:39,619
all together so solid propellant another

1133
00:42:43,780 --> 00:42:41,930
one probably for you as well what

1134
00:42:46,200 --> 00:42:43,790
happens to the rockets that fall into

1135
00:42:49,000 --> 00:42:46,210
the ocean they become homes for fish

1136
00:42:52,329 --> 00:42:49,010
they do they fall into the ocean they're

1137
00:42:54,940 --> 00:42:52,339
just metallic shells and they they sit

1138
00:42:56,079 --> 00:42:54,950

there and become homes for fish it's

1139
00:42:59,099 --> 00:42:56,089
actually like a good home for fish

1140
00:43:02,020 --> 00:42:59,109
location we live in there yeah Wow

1141
00:43:04,150 --> 00:43:02,030
this is for Doug regarding our oxygen

1142
00:43:05,589 --> 00:43:04,160
leaking into space does this sound

1143
00:43:07,570 --> 00:43:05,599
scarier than it actually is or it is

1144
00:43:09,310 --> 00:43:07,580
actually terrifying it sounds much here

1145
00:43:11,680 --> 00:43:09,320
than it is we've got billions of years

1146
00:43:14,050 --> 00:43:11,690
of oxygen left against us very slowly

1147
00:43:15,700 --> 00:43:14,060
gets like a pinhole for us but when you

1148
00:43:17,320 --> 00:43:15,710
look at other planets it can be a giant

1149
00:43:19,030 --> 00:43:17,330
Gus that's blowing their atmosphere away

1150
00:43:20,440 --> 00:43:19,040
so we just want to see how that pinhole

1151
00:43:22,270 --> 00:43:20,450
work sirs we understand that hurricanes

1152
00:43:24,310 --> 00:43:22,280
elsewhere

1153
00:43:26,800 --> 00:43:24,320
it's a really exciting time for sounding

1154
00:43:28,570 --> 00:43:26,810
rocket research head - at NASA Sun on

1155
00:43:29,980 --> 00:43:28,580
Facebook and Twitter for updates on the

1156
00:43:32,230 --> 00:43:29,990
next four launches that are part of the

1157
00:43:34,480 --> 00:43:32,240
Grand Challenge initiative cusp thanks

1158
00:43:35,740 --> 00:43:34,490
to all of you for joining me and for

1159
00:43:46,870 --> 00:43:35,750
viewers at home for tuning in

1160
00:43:49,120 --> 00:43:46,880
alright there's one thing that stands

1161
00:43:52,000 --> 00:43:49,130
between us and the harsh environment of

1162
00:43:56,680 --> 00:43:52,010
space our atmosphere the part of Earth

1163
00:43:58,630 --> 00:43:56,690

that sustains all life but here in the

1164
00:44:03,430 --> 00:43:58,640
closest town to the North Pole it's

1165
00:44:05,710 --> 00:44:03,440
slowly leaking away a team headed there

1166
00:44:07,210 --> 00:44:05,720
to launch rockets into the leak but it's

1167
00:44:09,670 --> 00:44:07,220
not the lack of atmosphere that they're

1168
00:44:11,710 --> 00:44:09,680
concerned about the leak is a natural

1169
00:44:14,350 --> 00:44:11,720
process that will take billions of years

1170
00:44:16,570 --> 00:44:14,360
so we're not gonna run out anytime soon

1171
00:44:19,210 --> 00:44:16,580
it's part of the larger story of how a

1172
00:44:21,310 --> 00:44:19,220
planet's atmosphere changes over time a

1173
00:44:26,920 --> 00:44:21,320
key factor in the search for life on

1174
00:44:29,650 --> 00:44:26,930
other planets we have 35 residents and

1175
00:44:31,000 --> 00:44:29,660
60 of our team together in a town that

1176
00:44:33,370 --> 00:44:31,010
is completely isolate there's a plane

1177
00:44:36,100 --> 00:44:33,380
twice a week and there's a thousand

1178
00:44:38,830 --> 00:44:36,110
polar bears nearby this is Doug Rowland

1179
00:44:41,860 --> 00:44:38,840
a NASA scientist who's taken his team to

1180
00:44:44,140 --> 00:44:41,870
niala s'en on the island of Svalbard the

1181
00:44:46,960 --> 00:44:44,150
island lies beneath one of two regions

1182
00:44:49,000 --> 00:44:46,970
near Earth's poles called the cusps it's

1183
00:44:50,800 --> 00:44:49,010
where we can access space directly and

1184
00:44:53,440 --> 00:44:50,810
where a hundred tons of atmosphere

1185
00:44:55,540 --> 00:44:53,450
escapes into space each day this escape

1186
00:44:57,880 --> 00:44:55,550
gives clues to how long an atmosphere

1187
00:44:59,770 --> 00:44:57,890
will last and ultimately whether it

1188
00:45:02,320 --> 00:44:59,780

stays around long enough to sustain life

1189
00:45:04,240 --> 00:45:02,330
we're trying to understand is how did

1190
00:45:06,070 --> 00:45:04,250
earth sea atmosphere all overtime and

1191
00:45:08,140 --> 00:45:06,080
how do other planets that might be like

1192
00:45:10,110 --> 00:45:08,150
earth or more dissimilar to earth how

1193
00:45:13,540 --> 00:45:10,120
did their atmospheres evolve

1194
00:45:16,000 --> 00:45:13,550
so Doug joined forces with Johan Moen a

1195
00:45:18,100 --> 00:45:16,010
professor at the University of Oslo who

1196
00:45:18,890 --> 00:45:18,110
started the Grand Challenge initiative

1197
00:45:21,050 --> 00:45:18,900
cus

1198
00:45:23,180 --> 00:45:21,060
it's an international mission to launch

1199
00:45:26,030 --> 00:45:23,190
12 rockets into the Earth's northern

1200
00:45:27,710 --> 00:45:26,040
cusp and Doug he's the mission leader

1201
00:45:34,580 --> 00:45:27,720
for the first two rockets of the

1202
00:45:36,380 --> 00:45:34,590
campaign we don't want to waste our

1203
00:45:38,030 --> 00:45:36,390
rocket the think is three years to make

1204
00:45:40,490 --> 00:45:38,040
the rocket on the 15 minutes to use it

1205
00:45:42,290 --> 00:45:40,500
and that ways my shot here he's using a

1206
00:45:43,970 --> 00:45:42,300
sounding rocket which is different from

1207
00:45:46,340 --> 00:45:43,980
the bigger rockets that carry satellites

1208
00:45:48,530 --> 00:45:46,350
and humans into space it's a small

1209
00:45:50,960 --> 00:45:48,540
suborbital rocket that flies briefly

1210
00:45:52,880 --> 00:45:50,970
into space phlex real-time data for

1211
00:45:56,000 --> 00:45:52,890
around 15 minutes then falls back to

1212
00:45:57,980 --> 00:45:56,010
earth it's affordable quick to build and

1213
00:45:59,960 --> 00:45:57,990

can launch towards a precise point

1214
00:46:02,780 --> 00:45:59,970
the major advantage it is that you can

1215
00:46:04,760 --> 00:46:02,790
launch into a target on the sky but

1216
00:46:08,990 --> 00:46:04,770
there's a limited launch window and only

1217
00:46:11,450 --> 00:46:09,000
one chance to get the launch right we

1218
00:46:12,980 --> 00:46:11,460
have these unguided rockets they go

1219
00:46:14,180 --> 00:46:12,990
where you point them unless the wind is

1220
00:46:15,350 --> 00:46:14,190
blowing because the wind literally just

1221
00:46:16,820 --> 00:46:15,360
blows them over we don't watch when

1222
00:46:19,100 --> 00:46:16,830
there's high wind so to measure the

1223
00:46:21,560 --> 00:46:19,110
winds they launch balloons with GPS

1224
00:46:23,540 --> 00:46:21,570
trackers they're released every fifteen

1225
00:46:25,940 --> 00:46:23,550
to thirty minutes and then they're

1226
00:46:30,940 --> 00:46:25,950
monitored to see how fast the winds are

1227
00:46:38,840 --> 00:46:34,880
bronwen's were 12 13 meters per second

1228
00:46:40,400 --> 00:46:38,850
Augustin 17 which is way off you're

1229
00:46:42,230 --> 00:46:40,410
filled with trepidation oh my gosh with

1230
00:46:48,620 --> 00:46:42,240
this thing that I felt is it gonna work

1231
00:46:51,020 --> 00:46:48,630
after all this so I think we're gonna

1232
00:46:52,490 --> 00:46:51,030
scrub for today I'd like to thank the

1233
00:47:04,160 --> 00:46:52,500
everyone has needs a great performance

1234
00:47:07,100 --> 00:47:04,170
thanks a lot the mission is named

1235
00:47:10,520 --> 00:47:07,110
visualizing ion outflow via neutral atom

1236
00:47:12,470 --> 00:47:10,530
sensing - or visions - in short they're

1237
00:47:15,170 --> 00:47:12,480
looking at how oxygen is getting enough

1238
00:47:17,330 --> 00:47:15,180

energy to escape it's a good test of how

1239
00:47:19,460 --> 00:47:17,340
atmospheric escape works Earth's gravity

1240
00:47:21,320 --> 00:47:19,470
should hold on to the oxygen and yet we

1241
00:47:23,300 --> 00:47:21,330
see this gas shooting off into space

1242
00:47:23,810 --> 00:47:23,310
we're trying to figure out how that

1243
00:47:25,760 --> 00:47:23,820
works

1244
00:47:28,750 --> 00:47:25,770
that is a science question though that's

1245
00:47:31,460 --> 00:47:28,760
been hanging around for four decades

1246
00:47:33,860 --> 00:47:31,470
fortunately anyone can see atmospheric

1247
00:47:35,840 --> 00:47:33,870
escape at the right place and time in

1248
00:47:39,770 --> 00:47:35,850
small bar we are the social polar nights

1249
00:47:42,680 --> 00:47:39,780
is dark all 24 hours his continual

1250
00:47:44,540 --> 00:47:42,690
darkness is key for witnessing this this

1251
00:47:46,670 --> 00:47:44,550
is the cusp Aurora it's a type of

1252
00:47:48,950 --> 00:47:46,680
Northern Lights that appears between 8

1253
00:47:51,080 --> 00:47:48,960
a.m. and noon and you can only see it

1254
00:47:52,880 --> 00:47:51,090
when it's dark during the day it looks

1255
00:47:54,980 --> 00:47:52,890
similar to the Aurora that occurs at

1256
00:47:57,110 --> 00:47:54,990
night but when these iridescent colors

1257
00:47:59,570 --> 00:47:57,120
dance at this hour each day a hundred

1258
00:48:02,750 --> 00:47:59,580
tons of oxygen escapes from Earth's

1259
00:48:05,860 --> 00:48:02,760
atmosphere into space this is over a

1260
00:48:08,750 --> 00:48:05,870
sport no two to chase the Aurora

1261
00:48:11,480 --> 00:48:08,760
working with them is the icecat radar

1262
00:48:13,280 --> 00:48:11,490
and chaough Henriksen Observatory they

1263
00:48:16,100 --> 00:48:13,290

have additional instruments to find the

1264
00:48:19,220 --> 00:48:16,110
Aurora sometimes it's cloudy so we use

1265
00:48:22,190 --> 00:48:19,230
radars to track it the customer we can

1266
00:48:25,070 --> 00:48:22,200
give advice that this is the right type

1267
00:48:27,110 --> 00:48:25,080
of Aurora this is the wall of science a

1268
00:48:28,670 --> 00:48:27,120
collection of data from satellites and

1269
00:48:30,800 --> 00:48:28,680
ground instruments that helps them

1270
00:48:33,500 --> 00:48:30,810
predict where the cusps Aurora will be

1271
00:48:35,029 --> 00:48:33,510
the customer actually isn't a fixed

1272
00:48:37,920 --> 00:48:35,039
point in space it kind of moves you

1273
00:48:40,829 --> 00:48:37,930
what's controlling the cusps movement is

1274
00:48:42,930 --> 00:48:40,839
the Sun interacting with earth our

1275
00:48:45,359 --> 00:48:42,940
planet is surrounded by a magnetic field

1276
00:48:47,339 --> 00:48:45,369
that helps us hold on to our atmosphere

1277
00:48:49,980 --> 00:48:47,349
but at the North and South Poles the

1278
00:48:52,559 --> 00:48:49,990
magnetic field bends inwards creating a

1279
00:48:55,349 --> 00:48:52,569
corridor between Earth and space when

1280
00:48:57,900 --> 00:48:55,359
energy is released from the Sun via a

1281
00:49:00,089 --> 00:48:57,910
solar flare a coronal mass ejection all

1282
00:49:01,980 --> 00:49:00,099
of that energy in the form of radiations

1283
00:49:04,529 --> 00:49:01,990
rides down the magnetic field lines of

1284
00:49:07,140 --> 00:49:04,539
the earth and is transferred and dumped

1285
00:49:09,420 --> 00:49:07,150
into the Earth's atmosphere electrons

1286
00:49:11,160 --> 00:49:09,430
cascade in the Earth's atmosphere they

1287
00:49:13,680 --> 00:49:11,170
accelerate and collide with oxygen

1288
00:49:15,960 --> 00:49:13,690

particles giving them energy to release

1289
00:49:19,109 --> 00:49:15,970
light and sometimes enough energy to

1290
00:49:21,900 --> 00:49:19,119
escape collectively this forms the cusps

1291
00:49:25,529 --> 00:49:21,910
Aurora and streams of escaping oxygen

1292
00:49:27,180 --> 00:49:25,539
this cusp is in constant motion and

1293
00:49:29,190 --> 00:49:27,190
we've got a fixed trajectory you really

1294
00:49:30,630 --> 00:49:29,200
can't aim where the cusp is we have to

1295
00:49:33,569 --> 00:49:30,640
wait for the cuff to come across our

1296
00:49:35,250 --> 00:49:33,579
line of sight we'd like you as soon as

1297
00:49:37,559 --> 00:49:35,260
you see an indication across between too

1298
00:49:39,779 --> 00:49:37,569
close to move it the radar dishes we can

1299
00:49:49,920 --> 00:49:39,789
this is ice get it's been very quiet

1300
00:50:00,700 --> 00:49:55,390
no probably Bob a 60% chance of

1301
00:50:02,620 --> 00:50:00,710
launching when we started seeing this

1302
00:50:04,060 --> 00:50:02,630
really good data this clock started

1303
00:50:06,490 --> 00:50:04,070
counting down and that's when everyone

1304
00:50:08,920 --> 00:50:06,500
realized this is gonna happen we're

1305
00:50:11,650 --> 00:50:08,930
going to launch we're doing everything

1306
00:50:14,950 --> 00:50:11,660
we can to get that launch off before the

1307
00:50:16,930 --> 00:50:14,960
aurora goes away it is really really

1308
00:50:20,280 --> 00:50:16,940
challenging and nerve-wracking at that

1309
00:50:22,600 --> 00:50:20,290
point you can see the tension just rise

1310
00:50:25,390 --> 00:50:22,610
and everybody would not would that

1311
00:50:27,430 --> 00:50:25,400
happens and so everyone's watching their

1312
00:50:30,940 --> 00:50:27,440
instruments getting really excited and

1313
00:50:32,950 --> 00:50:30,950

then at t-minus one minute all of us ran

1314
00:50:42,980 --> 00:50:32,960
out to go see the launch happen

1315
00:50:45,720 --> 00:50:42,990
[Music]

1316
00:50:47,970 --> 00:50:45,730
and then we immediately turn town and

1317
00:50:50,130 --> 00:50:47,980
friend right back in to look at all the

1318
00:50:54,210 --> 00:50:50,140
data that was coming back from the

1319
00:50:56,970 --> 00:50:54,220
instruments you know how much time and

1320
00:50:59,120 --> 00:50:56,980
effort went into it because we all

1321
00:51:02,700 --> 00:50:59,130
worked on it and there's just nothing

1322
00:51:05,190 --> 00:51:02,710
that compares to that feeling everybody

1323
00:51:08,490 --> 00:51:05,200
of every one of those little places no

1324
00:51:11,040 --> 00:51:08,500
really just so happy to contribute to to

1325
00:51:14,190 --> 00:51:11,050
getting the science it's really an

1326
00:51:15,990 --> 00:51:14,200
incredible experience this is a story

1327
00:51:17,310 --> 00:51:16,000
about what it takes to launch science

1328
00:51:19,260 --> 00:51:17,320
instruments into space

1329
00:51:21,810 --> 00:51:19,270
but the real adventure will be in the

1330
00:51:23,610 --> 00:51:21,820
data they sent back hidden within the

1331
00:51:26,310 --> 00:51:23,620
numbers will be answers that reach far

1332
00:51:27,930 --> 00:51:26,320
beyond Earth shedding light on how

1333
00:51:38,450 --> 00:51:27,940
atmospheres throughout the universe

1334
00:51:42,990 --> 00:51:40,920
the jet stream may be the best known

1335
00:51:45,450 --> 00:51:43,000
high-altitude air current but it is not

1336
00:51:47,610 --> 00:51:45,460
the only one measurements from the last

1337
00:51:49,250 --> 00:51:47,620
60 years and observations of the

1338
00:51:51,270 --> 00:51:49,260

movement of space shuttle exhaust

1339
00:51:54,660 --> 00:51:51,280
indicate that there is a region between

1340
00:51:57,270 --> 00:51:54,670
62 and 68 miles up that experiences wind

1341
00:51:59,850 --> 00:51:57,280
speeds of 200 to 300 miles per hour at

1342
00:52:02,280 --> 00:51:59,860
that altitude right on the official

1343
00:52:03,600 --> 00:52:02,290
boundary of space it is extremely hard

1344
00:52:06,180 --> 00:52:03,610
to measure the wind because the

1345
00:52:07,980 --> 00:52:06,190
atmosphere is so thin it is also high

1346
00:52:10,740 --> 00:52:07,990
enough that only powerful rockets are

1347
00:52:12,930 --> 00:52:10,750
capable of reaching it the Atrix or

1348
00:52:15,540 --> 00:52:12,940
anomalous transport rocket experiment

1349
00:52:17,280 --> 00:52:15,550
mission is launching to study this ultra

1350
00:52:20,280 --> 00:52:17,290
high altitude wind over the eastern

1351
00:52:22,380 --> 00:52:20,290
seaboard of the u.s. it will consist of

1352
00:52:23,640 --> 00:52:22,390
five rockets launched within minutes of

1353
00:52:26,940 --> 00:52:23,650
each other from the Wallops Flight

1354
00:52:29,100 --> 00:52:26,950
Facility in Virginia as each rocket

1355
00:52:30,810 --> 00:52:29,110
rises above 50 miles it will release a

1356
00:52:32,580 --> 00:52:30,820
chemical tracer into the upper

1357
00:52:35,640 --> 00:52:32,590
atmosphere dispersed over a horizontal

1358
00:52:38,460 --> 00:52:35,650
range that extends approximately 340

1359
00:52:40,950 --> 00:52:38,470
miles east-southeast for melons

1360
00:52:43,079 --> 00:52:40,960
the tracer is tri methyl aluminum which

1361
00:52:45,359 --> 00:52:43,089
glows when it reacts with oxygen the

1362
00:52:47,819 --> 00:52:45,369
products of this reaction are aluminum

1363
00:52:49,880 --> 00:52:47,829

oxide carbon dioxide and water vapor all

1364
00:52:52,260 --> 00:52:49,890
of which are found in the atmosphere

1365
00:52:53,760 --> 00:52:52,270
cameras positioned in North Carolina and

1366
00:52:55,470 --> 00:52:53,770
New Jersey will watch for the glowing

1367
00:52:58,170 --> 00:52:55,480
trails which will reveal the wings

1368
00:53:00,059 --> 00:52:58,180
direction and speed understanding the

1369
00:53:01,859 --> 00:53:00,069
patterns and causes of this wind will

1370
00:53:04,609 --> 00:53:01,869
help NASA and private corporations with

1371
00:53:07,470 --> 00:53:04,619
feature high altitude low orbit missions

1372
00:53:09,599 --> 00:53:07,480
it is possible to have five rockets for

1373
00:53:12,180 --> 00:53:09,609
one mission because Atrix is using

1374
00:53:14,130 --> 00:53:12,190
sounding rockets sounding rockets are

1375
00:53:16,020 --> 00:53:14,140
small powerful rockets that usually

1376
00:53:19,170 --> 00:53:16,030
carry a payload up and then back down to

1377
00:53:21,180 --> 00:53:19,180
earth but can't carry much weight but

1378
00:53:23,010 --> 00:53:21,190
this makes them far less expensive and a

1379
00:53:36,090 --> 00:53:23,020
good way to make observations at the

1380
00:54:04,339 --> 00:54:00,370
[Music]

1381
00:54:05,990 --> 00:54:04,349
I think the students are here really to

1382
00:54:08,690 --> 00:54:06,000
know what it's like to build a sonic

1383
00:54:11,420 --> 00:54:08,700
rocket payload really what NASA does

1384
00:54:14,670 --> 00:54:11,430
best is you know not only inspiring but

1385
00:54:17,180 --> 00:54:14,680
connecting people with space

1386
00:54:19,950 --> 00:54:17,190
[Music]

1387
00:54:22,410 --> 00:54:19,960
so rock on is just one of those steps

1388
00:54:24,330 --> 00:54:22,420

that create those openings for students

1389
00:54:26,460 --> 00:54:24,340
around the country to have some

1390
00:54:28,620 --> 00:54:26,470
real-world hands-on experience with a

1391
00:54:30,150 --> 00:54:28,630
connection to an actual spaceflight I

1392
00:54:32,160 --> 00:54:30,160
think one of the most rewarding things

1393
00:54:34,350 --> 00:54:32,170
for me to seeing a transformation of the

1394
00:54:36,270 --> 00:54:34,360
students throughout the workshop by the

1395
00:54:38,070 --> 00:54:36,280
time it's Monday or Tuesday and we're

1396
00:54:40,170 --> 00:54:38,080
getting ready for integration they're

1397
00:54:42,330 --> 00:54:40,180
high five and the helpers helpers all

1398
00:54:45,720 --> 00:54:42,340
know them by name and it's just great

1399
00:54:47,070 --> 00:54:45,730
seeing this transformation of someone

1400
00:54:48,350 --> 00:54:47,080
who's so close off someone who's

1401
00:54:50,490 --> 00:54:48,360
completely broken out of their shell

1402
00:54:51,840 --> 00:54:50,500
when I interact with students I want

1403
00:54:53,760 --> 00:54:51,850
them to feel comfortable I want them to

1404
00:54:55,470 --> 00:54:53,770
have fun because I feel like that's when

1405
00:54:57,120 --> 00:54:55,480
they're gonna learn their modes it's not

1406
00:54:59,550 --> 00:54:57,130
uncommon for me when I'm working with

1407
00:55:01,740 --> 00:54:59,560
students to be in costume today even I'm

1408
00:55:04,170 --> 00:55:01,750
Captain Picard from the Starship

1409
00:55:05,580 --> 00:55:04,180
Enterprise try to break down walls when

1410
00:55:08,400 --> 00:55:05,590
I'm working with students and faculty

1411
00:55:11,700 --> 00:55:08,410
but suddenly the focus is on the crazy

1412
00:55:14,220 --> 00:55:11,710
guy and not do I belong here so they're

1413
00:55:16,590 --> 00:55:14,230

most comfortable ready to have fun and

1414
00:55:18,450 --> 00:55:16,600
but also ready to learn we have students

1415
00:55:21,120 --> 00:55:18,460
and that's loitering on two on four

1416
00:55:24,210 --> 00:55:21,130
sisters and passengers and LEDs and a

1417
00:55:25,950 --> 00:55:24,220
bunch of other connectors and they build

1418
00:55:28,290 --> 00:55:25,960
all that up we run them through code

1419
00:55:29,880 --> 00:55:28,300
Monday we finish up the coding and let

1420
00:55:31,920 --> 00:55:29,890
me put everything on the plate do a

1421
00:55:33,900 --> 00:55:31,930
final check-in and we integrate to the

1422
00:55:36,420 --> 00:55:33,910
canisters and it's just a whirlwind of a

1423
00:55:38,220 --> 00:55:36,430
day there are students here who aren't

1424
00:55:40,680 --> 00:55:38,230
engineering students or you know we're

1425
00:55:42,150 --> 00:55:40,690
just majoring in physics or chemistry

1426
00:55:44,280 --> 00:55:42,160
and we had a couple humanities people

1427
00:55:46,170 --> 00:55:44,290
here and in the end they came out with a

1428
00:55:47,700 --> 00:55:46,180
rocket payload so it doesn't really

1429
00:55:50,580 --> 00:55:47,710
matter where you're from but what your

1430
00:55:51,960 --> 00:55:50,590
background is you can do it it's just a

1431
00:55:53,400 --> 00:55:51,970
really unique experience I think

1432
00:55:55,500 --> 00:55:53,410
everyone should do it even if they're

1433
00:55:58,050 --> 00:55:55,510
not interested in engineering or

1434
00:56:00,240 --> 00:55:58,060
anything space related cool I haven't

1435
00:56:02,099 --> 00:56:00,250
been to a launch before by the feeling

1436
00:56:03,510 --> 00:56:02,109
that it's going to be kind of surreal

1437
00:56:05,010 --> 00:56:03,520
I've seen it on TV into seeing it in

1438
00:56:07,080 --> 00:56:05,020

person it's actually a blessing I'm

1439
00:56:07,790 --> 00:56:07,090
expecting it to be loud I'm expecting it

1440
00:56:13,100 --> 00:56:07,800
to be

1441
00:56:14,720 --> 00:56:13,110
so excited like every time I think about

1442
00:56:18,100 --> 00:56:14,730
it my heart starts racing and I'm like

1443
00:56:20,390 --> 00:56:18,110
okay yeah I'm waiting for that day

1444
00:56:23,030 --> 00:56:20,400
launch is definitely the highlight to

1445
00:56:29,000 --> 00:56:23,040
see that thing ignite so everyone still

1446
00:56:37,660 --> 00:56:32,080
three two

1447
00:56:41,020 --> 00:56:39,010
it's hard to take your eyes off the

1448
00:56:43,300 --> 00:56:41,030
flame but if you do just for that moment

1449
00:56:45,280 --> 00:56:43,310
you see life happening all around you

1450
00:56:46,810 --> 00:56:45,290
their brains are recording this for the

1451
00:56:48,670 --> 00:56:46,820
rest of their lives their experience

1452
00:56:51,460 --> 00:56:48,680
something that they've worked hard for

1453
00:56:53,650 --> 00:56:51,470
and to me that's almost as exciting as

1454
00:56:55,840 --> 00:56:53,660
watching the launch I also feel as if

1455
00:56:57,430 --> 00:56:55,850
you can learn this stuff here you're

1456
00:56:58,840 --> 00:56:57,440
ready to take the next steps towards

1457
00:57:01,270 --> 00:56:58,850
what you want to do in the future I

1458
00:57:03,460 --> 00:57:01,280
think just having you know a student who

1459
00:57:05,050 --> 00:57:03,470
clearly been affected by rock on in this

1460
00:57:07,090 --> 00:57:05,060
way in terms of their personality in

1461
00:57:09,760 --> 00:57:07,100
terms of their confidence level kind of

1462
00:57:11,110 --> 00:57:09,770
speaks to the success of the program it

1463
00:57:12,730 --> 00:57:11,120

doesn't really matter if your experiment

1464
00:57:13,630 --> 00:57:12,740
comes back and it didn't work we like to

1465
00:57:16,150 --> 00:57:13,640
make sure that people are comfortable

1466
00:57:17,860 --> 00:57:16,160
here and I think that we do a good job

1467
00:57:19,900 --> 00:57:17,870
doing that and everyone leaves here

1468
00:57:20,920 --> 00:57:19,910
pretty satisfied with the program so I

1469
00:57:29,550 --> 00:57:20,930
can say whenever I want

1470
00:57:34,359 --> 00:57:31,960
constantly shielding us from the sun's

1471
00:57:35,790 --> 00:57:34,369
high-energy particles is the Earth's

1472
00:57:38,560 --> 00:57:35,800
magnetic field

1473
00:57:41,650 --> 00:57:38,570
many imagine this field as a circle

1474
00:57:44,650 --> 00:57:41,660
slightly larger than our planet but it's

1475
00:57:47,740 --> 00:57:44,660
actually shaped like this and near our

1476
00:57:50,280 --> 00:57:47,750
North and South Poles there is a cusp a

1477
00:57:53,080 --> 00:57:50,290
point where two branches of a curve meet

1478
00:57:56,020 --> 00:57:53,090
it's here that a magnetic bubble that

1479
00:57:58,390 --> 00:57:56,030
surrounds us dips inward creating a

1480
00:58:01,180 --> 00:57:58,400
funnel of magnetic lines that touch down

1481
00:58:03,580 --> 00:58:01,190
to earth this funnel allows the sun's

1482
00:58:06,250 --> 00:58:03,590
high-energy particles to race toward our

1483
00:58:09,420 --> 00:58:06,260
planet and deposit themselves in our ion

1484
00:58:13,000 --> 00:58:09,430
asphere 80 to 800 kilometers above Earth

1485
00:58:15,310 --> 00:58:13,010
we can even see the result they create

1486
00:58:18,010 --> 00:58:15,320
beautiful Aurora similar to the

1487
00:58:20,710 --> 00:58:18,020
spectacular displays at night but on the

1488
00:58:22,510 --> 00:58:20,720

day side of Earth and only visible to

1489
00:58:26,020 --> 00:58:22,520
the naked eye during the long polar

1490
00:58:27,880 --> 00:58:26,030
night now scientists who want to learn

1491
00:58:30,250 --> 00:58:27,890
more about effects of these particles

1492
00:58:32,950 --> 00:58:30,260
are embarking on a special initiative

1493
00:58:36,910 --> 00:58:32,960
that is taking place from December 2018

1494
00:58:39,220 --> 00:58:36,920
to January 2020 in a coordinated effort

1495
00:58:42,190 --> 00:58:39,230
between multiple countries to understand

1496
00:58:45,099 --> 00:58:42,200
the physics of the polar cusp scientists

1497
00:58:47,859 --> 00:58:45,109
from NASA and the US as well as from

1498
00:58:50,380 --> 00:58:47,869
Japan Norway Canada and Great Britain

1499
00:58:53,740 --> 00:58:50,390
have launched the Grand Challenge

1500
00:58:55,870 --> 00:58:53,750
initiative cusp a series of salvan

1501
00:58:57,540 --> 00:58:55,880
rocket missions that will provide the

1502
00:58:59,920 --> 00:58:57,550
data needed to conduct nine

1503
00:59:03,700 --> 00:58:59,930
unprecedented studies of near-earth

1504
00:59:06,130 --> 00:59:03,710
space at the polar regions this series

1505
00:59:09,250 --> 00:59:06,140
will help scientists glean answers to a

1506
00:59:11,440 --> 00:59:09,260
number of questions about the cusps why

1507
00:59:14,410 --> 00:59:11,450
is our atmosphere leaking out into space

1508
00:59:16,480 --> 00:59:14,420
from the cusps how and why do the

1509
00:59:19,089 --> 00:59:16,490
turbulent hot patches of dense plasma

1510
00:59:22,180 --> 00:59:19,099
that exists inside the aurora region

1511
00:59:24,579 --> 00:59:22,190
disrupt global communications what