



1
00:00:15,140 --> 00:00:08,270

[Music]

2
00:00:17,179 --> 00:00:15,150

a very pleasant good evening to you

3
00:00:19,519 --> 00:00:17,189

wherever you are my name is Brian white

4
00:00:20,690 --> 00:00:19,529

I am from the JPL's education and

5
00:00:22,850 --> 00:00:20,700

communications Directorate

6
00:00:27,470 --> 00:00:22,860

welcome to the von Karman lecture series

7
00:00:30,590 --> 00:00:27,480

in 1783 the first crewed hot-air balloon

8
00:00:32,000 --> 00:00:30,600

took flight in Paris crowds came from

9
00:00:33,799 --> 00:00:32,010

miles around to view the spectacle

10
00:00:36,170 --> 00:00:33,809

including a few signatories of the

11
00:00:37,820 --> 00:00:36,180

Declaration of Independence as the

12
00:00:39,320 --> 00:00:37,830

balloon lifted higher a spectator asked

13
00:00:42,440 --> 00:00:39,330

the inventor and American founding

14

00:00:46,040 --> 00:00:42,450

father Benjamin Franklin what this new

15

00:00:48,709 --> 00:00:46,050

invention would be used for Franklin

16

00:00:51,560 --> 00:00:48,719

replied what is the use of a newborn

17

00:00:52,970 --> 00:00:51,570

baby days later and a letter to a

18

00:00:54,470 --> 00:00:52,980

colleague in a more serious tone he

19

00:00:56,240 --> 00:00:54,480

concluded that ballooning could pave the

20

00:00:58,729 --> 00:00:56,250

way to some discoveries in natural

21

00:01:02,540 --> 00:00:58,739

philosophy which at present we have no

22

00:01:03,889 --> 00:01:02,550

conception how right he was today's

23

00:01:06,080 --> 00:01:03,899

scientific ballooning is the last

24

00:01:07,580 --> 00:01:06,090

bastion of guerrilla science providing

25

00:01:09,770 --> 00:01:07,590

well tested reliable low-cost

26

00:01:11,090 --> 00:01:09,780

moderate-risk platform that helps

27

00:01:14,600 --> 00:01:11,100

prepare the next generation of

28

00:01:17,270 --> 00:01:14,610

scientists engineers and instruments our

29

00:01:19,670 --> 00:01:17,280

first speaker tonight dr. Jose sealless

30

00:01:20,990 --> 00:01:19,680

earned his MS and his PhD in electrical

31

00:01:23,300 --> 00:01:21,000

engineering at the Technical University

32

00:01:25,880 --> 00:01:23,310

of Madrid Spain is a Fulbright

33

00:01:27,770 --> 00:01:25,890

postdoctoral research Award winner has

34

00:01:29,810 --> 00:01:27,780

done study at the University of tort of

35

00:01:31,910 --> 00:01:29,820

erragadda in Rome Italy and at the

36

00:01:34,219 --> 00:01:31,920

observatory of Paris in France he was

37

00:01:36,560 --> 00:01:34,229

the elbow subsystem lead the

38

00:01:38,810 --> 00:01:36,570

stratospheric terahertz Observatory and

39

00:01:42,080 --> 00:01:38,820

part of the Antarctic team deployed in

40

00:01:45,050 --> 00:01:42,090

2015 and 2016 for the integration test

41

00:01:47,480 --> 00:01:45,060

and flight of this NASA balloon mission

42

00:01:49,460 --> 00:01:47,490

he has been a total of five months on

43

00:01:51,679 --> 00:01:49,470

the ice during those two campaigns and

44

00:01:53,660 --> 00:01:51,689

currently he is a research engineer at

45

00:01:55,730 --> 00:01:53,670

JPL working on the next generation of

46

00:01:59,120 --> 00:01:55,740

sub millimeter wave high spectral

47

00:02:01,090 --> 00:01:59,130

resolution cameras for astrophysics

48

00:02:03,139 --> 00:02:01,100

planetary science and earth science

49

00:02:05,209 --> 00:02:03,149

finally he is an instrument-rated pilot

50

00:02:06,950 --> 00:02:05,219

and volunteers as president of the LA

51
00:02:10,409 --> 00:02:06,960
chapter the Fulbright Association

52
00:02:20,220 --> 00:02:10,419
please welcome dr. Silas

53
00:02:23,380 --> 00:02:22,090
thank you everyone for being here

54
00:02:25,480 --> 00:02:23,390
tonight

55
00:02:27,160 --> 00:02:25,490
I hope I see less I'm a research

56
00:02:29,140 --> 00:02:27,170
engineer here at JPL I've been working

57
00:02:31,090 --> 00:02:29,150
here for eight ER so far actually I live

58
00:02:36,220 --> 00:02:31,100
in more of eight years eight years and a

59
00:02:38,550 --> 00:02:36,230
half but half five old months of that

60
00:02:40,809 --> 00:02:38,560
time I'd spend it here on the ice

61
00:02:42,729 --> 00:02:40,819
working on this crazy idea which was

62
00:02:44,650 --> 00:02:42,739
taking a large telescope put it on a

63
00:02:47,740 --> 00:02:44,660

giant balloon take it all the way up to

64

00:02:49,120 --> 00:02:47,750

the stratosphere to look at the Stars so

65

00:02:50,979 --> 00:02:49,130

when these guys had the public office

66

00:02:53,020 --> 00:02:50,989

asked me to give this talk I couldn't

67

00:02:55,360 --> 00:02:53,030

find a better way to do it than taking

68

00:02:57,759 --> 00:02:55,370

with you taking you with me on a journey

69

00:03:00,040 --> 00:02:57,769

to explore the universe from Turkey to

70

00:03:01,870 --> 00:03:00,050

the Stars so I hoped you were warm

71

00:03:04,059 --> 00:03:01,880

uncomfortable it's been actually week

72

00:03:07,000 --> 00:03:04,069

here in LA not as cold as it was there

73

00:03:09,880 --> 00:03:07,010

when I was there so I hope you do like

74

00:03:11,920 --> 00:03:09,890

this this is my murder station and

75

00:03:13,780 --> 00:03:11,930

tareka just a few months before our team

76

00:03:15,699 --> 00:03:13,790

they start off Eric Tara head of

77

00:03:18,460 --> 00:03:15,709

servitor e team sto to are right there

78

00:03:20,770 --> 00:03:18,470

to mount this telescope and here's the

79

00:03:22,569 --> 00:03:20,780

nighttime we didn't get to see this

80

00:03:24,759 --> 00:03:22,579

beautiful picture because it was daytime

81

00:03:26,740 --> 00:03:24,769

when I when we were there but I want to

82

00:03:28,150 --> 00:03:26,750

point out a couple of things here first

83

00:03:30,160 --> 00:03:28,160

of all of course this is the Milky Way

84

00:03:32,830 --> 00:03:30,170

but what we see here is the past

85

00:03:33,940 --> 00:03:32,840

actually the Milky Way expands one

86

00:03:36,069 --> 00:03:33,950

hundred eighty thousand light-years

87

00:03:39,310 --> 00:03:36,079

across the two thousand light years old

88

00:03:41,979 --> 00:03:39,320

but the most amazing thing here is that

89

00:03:44,440 --> 00:03:41,989

there are 100 to 400 billion stars in

90

00:03:47,500 --> 00:03:44,450

our galaxy so you cannot imagine how

91

00:03:50,020 --> 00:03:47,510

many star how many galaxies there in the

92

00:03:51,910 --> 00:03:50,030

universe and just try to strap like that

93

00:03:54,370 --> 00:03:51,920

to the number of stars it will just blow

94

00:03:56,979 --> 00:03:54,380

your mind number but it's obvious that

95

00:04:02,370 --> 00:03:56,989

with that with so many stars the Stars

96

00:04:05,229 --> 00:04:02,380

has to play an important role in how the

97

00:04:07,599 --> 00:04:05,239

universe evolves every scientific

98

00:04:09,220 --> 00:04:07,609

questions start with every scientific

99

00:04:10,360 --> 00:04:09,230

mission start with a question and we

100

00:04:14,759 --> 00:04:10,370

need to find answers to that question

101
00:04:16,960 --> 00:04:14,769
and that's what sto - I wanted to do

102
00:04:20,500 --> 00:04:16,970
let's start with this molecular cloud

103
00:04:22,510 --> 00:04:20,510
it's a lot of gas particle dust but a

104
00:04:24,760 --> 00:04:22,520
certain point collapses because of

105
00:04:26,290 --> 00:04:24,770
gravitational attraction and then all

106
00:04:28,390 --> 00:04:26,300
these particles start hitting each other

107
00:04:29,610 --> 00:04:28,400
and the temperature rises from kelvins

108
00:04:31,950 --> 00:04:29,620
to millions of

109
00:04:34,950 --> 00:04:31,960
degrees Celsius and because of the NSA

110
00:04:37,050 --> 00:04:34,960
gas the gas is gonna tend to expand so

111
00:04:40,580 --> 00:04:37,060
it has to be something that that cools

112
00:04:42,810 --> 00:04:40,590
down that cloud to make that collapse

113
00:04:46,920 --> 00:04:42,820

continue in order to eventually form the

114

00:04:48,570 --> 00:04:46,930

start so that happens with the two major

115

00:04:52,440 --> 00:04:48,580

coolants of the interstellar medium and

116

00:04:56,010 --> 00:04:52,450

ionized carbon and atomic oxygen so sto

117

00:04:58,970 --> 00:04:56,020

to will look at those emissions to try

118

00:05:01,770 --> 00:04:58,980

to trace this star form in Williams

119

00:05:04,290 --> 00:05:01,780

eventually we form stars and then

120

00:05:07,650 --> 00:05:04,300

planets and then the star will die as

121

00:05:09,240 --> 00:05:07,660

for sample a supernova and all that

122

00:05:11,730 --> 00:05:09,250

material is ejected back to the

123

00:05:14,129 --> 00:05:11,740

interstellar medium and the cycle just

124

00:05:16,700 --> 00:05:14,139

gets back to the beginning at every

125

00:05:20,010 --> 00:05:16,710

single point of this cycle we have a

126

00:05:21,960 --> 00:05:20,020

emissions in the far infrared of

127

00:05:24,780 --> 00:05:21,970

sub-meter waves that give us information

128

00:05:26,280 --> 00:05:24,790

and on what's going on we cannot see

129

00:05:28,200 --> 00:05:26,290

this in the optical spectrum because the

130

00:05:30,270 --> 00:05:28,210

clouds are back at those wavelength at

131

00:05:33,270 --> 00:05:30,280

these frequencies we can actually see

132

00:05:35,850 --> 00:05:33,280

through different clouds that are on the

133

00:05:38,760 --> 00:05:35,860

on your line of sight and see things

134

00:05:42,600 --> 00:05:38,770

that that basically happened in all in

135

00:05:45,150 --> 00:05:42,610

all of them these are the science goal

136

00:05:46,800 --> 00:05:45,160

of sto - as I said that our mind the

137

00:05:50,640 --> 00:05:46,810

lifecycle of interstellar dust and

138

00:05:51,900 --> 00:05:50,650

provide templates for star formation so

139

00:05:53,940 --> 00:05:51,910

coming back to these four in the

140

00:05:57,029 --> 00:05:53,950

beginning this is what we can see with

141

00:05:59,760 --> 00:05:57,039

our bare eye so quiet universe quite a

142

00:06:02,940 --> 00:05:59,770

sky we see our galaxy in the center it's

143

00:06:05,210 --> 00:06:02,950

beautiful right nothing not much going

144

00:06:07,620 --> 00:06:05,220

on it looks like it this is the visible

145

00:06:09,540 --> 00:06:07,630

but if we look at other frequency range

146

00:06:10,740 --> 00:06:09,550

things are different now there are lot

147

00:06:12,600 --> 00:06:10,750

of things that we cannot see with our

148

00:06:14,730 --> 00:06:12,610

bare eye that are going on this is for

149

00:06:16,230 --> 00:06:14,740

example gamma rays and this is the far

150

00:06:18,330 --> 00:06:16,240

infrared into some millimeter wave

151
00:06:23,219 --> 00:06:18,340
spectrum so now you can see here a lot

152
00:06:24,629 --> 00:06:23,229
of gas clouds nebulas that totally are

153
00:06:27,330 --> 00:06:24,639
for ministers there a lot of process

154
00:06:30,480 --> 00:06:27,340
going on there it's actually zoom in in

155
00:06:33,840 --> 00:06:30,490
one region here this is Orion this is a

156
00:06:35,700 --> 00:06:33,850
map of Orion at this a millimeter wave

157
00:06:37,409 --> 00:06:35,710
range and you can see all these

158
00:06:39,390 --> 00:06:37,419
emissions which are different molecules

159
00:06:41,580 --> 00:06:39,400
which are actually life enabling

160
00:06:43,380 --> 00:06:41,590
molecules to study in the universe at

161
00:06:45,210 --> 00:06:43,390
these frequencies give us an idea

162
00:06:49,370 --> 00:06:45,220
where we're coming from and when we're

163
00:06:52,320 --> 00:06:49,380

going in fact NASA Scobie this mission

164

00:06:54,960 --> 00:06:52,330

found out that 50% of the luminosity and

165

00:06:56,220 --> 00:06:54,970

90% of the photos immediately since the

166

00:06:57,840 --> 00:06:56,230

deep burn are in the sub millimeter

167

00:07:00,170 --> 00:06:57,850

range so it's really important to study

168

00:07:02,460 --> 00:07:00,180

the universe in these frequency ranges

169

00:07:04,440 --> 00:07:02,470

but how do we listen to the star

170

00:07:08,130 --> 00:07:04,450

well at the end it's like a radio so you

171

00:07:09,390 --> 00:07:08,140

have this a typical radio saying that

172

00:07:11,850 --> 00:07:09,400

you would use to tune your favorite

173

00:07:12,500 --> 00:07:11,860

radio station working at around 100

174

00:07:15,480 --> 00:07:12,510

megahertz

175

00:07:18,630 --> 00:07:15,490

so when we want to tune a carbon oxygen

176

00:07:20,190 --> 00:07:18,640

nitrogen we do the same it's pretty much

177

00:07:21,690 --> 00:07:20,200

the same concept is that the frequency

178

00:07:25,470 --> 00:07:21,700

is like 10,000 times

179

00:07:28,110 --> 00:07:25,480

Haggar which means that the circuit is

180

00:07:30,270 --> 00:07:28,120

that you have to build to build this

181

00:07:32,820 --> 00:07:30,280

radio actually now at this frequency are

182

00:07:34,920 --> 00:07:32,830

so small that actually fit in a piece of

183

00:07:36,390 --> 00:07:34,930

your hair they are micro sized so it's

184

00:07:39,780 --> 00:07:36,400

really challenging to design this

185

00:07:43,140 --> 00:07:39,790

technology to build a radio which we

186

00:07:46,350 --> 00:07:43,150

call now radio telescope to tune carbon

187

00:07:50,910 --> 00:07:46,360

nitrogen or other molecules so that's

188

00:07:52,470 --> 00:07:50,920

what we wanted to do so four or five

189

00:07:54,540 --> 00:07:52,480

years ago or four or five years before

190

00:07:56,760 --> 00:07:54,550

the mission started or the we went to

191

00:07:58,290 --> 00:07:56,770

Antarctica actually this is the concept

192

00:08:00,150 --> 00:07:58,300

this is the concept of the mission so we

193

00:08:02,550 --> 00:08:00,160

have a telescope it was a 0.8 meter

194

00:08:06,030 --> 00:08:02,560

telescope the signals of course are

195

00:08:07,350 --> 00:08:06,040

faint so we need large apertures you put

196

00:08:09,060 --> 00:08:07,360

everything you have there actually the

197

00:08:10,980 --> 00:08:09,070

receivers there on the back you put

198

00:08:13,280 --> 00:08:10,990

everything in the gondola that will hold

199

00:08:16,320 --> 00:08:13,290

to the volume you have certain

200

00:08:19,170 --> 00:08:16,330

electronics and computers here Sanjay

201
00:08:21,540 --> 00:08:19,180
communications antennas GPS of course

202
00:08:24,350 --> 00:08:21,550
elevations NASA mood control Laura will

203
00:08:26,670 --> 00:08:24,360
talk more about that on her talk and

204
00:08:28,740 --> 00:08:26,680
four years later four five years later

205
00:08:32,730 --> 00:08:28,750
here we are still two launch day in

206
00:08:36,170 --> 00:08:32,740
Antarctica December 2016 and now you

207
00:08:38,580 --> 00:08:36,180
have this beautiful concept so reality

208
00:08:41,070 --> 00:08:38,590
and these are radio telescope but I like

209
00:08:42,630 --> 00:08:41,080
to call it actually a time machine

210
00:08:43,800 --> 00:08:42,640
because I said that when we're looking

211
00:08:46,560 --> 00:08:43,810
at the start we're looking at the path

212
00:08:48,120 --> 00:08:46,570
so so I don't know if you really already

213
00:08:50,910 --> 00:08:48,130

a telescope or a time machine I think

214

00:08:53,280 --> 00:08:50,920

it's a very much in launch configuration

215

00:08:57,210 --> 00:08:53,290

so we have a huge helium balloon 40

216

00:08:59,249 --> 00:08:57,220

million cubic feet around 140 meter

217

00:09:01,610 --> 00:08:59,259

diameter at float you don't see him you

218

00:09:04,290 --> 00:09:01,620

don't see it fully inflated here because

219

00:09:06,389 --> 00:09:04,300

because it's just actually actually gets

220

00:09:09,929 --> 00:09:06,399

fully inflated when is our fluid

221

00:09:11,579 --> 00:09:09,939

altitude at 130,000 feet this is a cable

222

00:09:13,800 --> 00:09:11,589

that connects with the payload that you

223

00:09:19,340 --> 00:09:13,810

see here which is actually this is 22

224

00:09:25,999 --> 00:09:19,350

feet tall and the launch vehicle and

225

00:09:34,120 --> 00:09:28,230

so they're going to release the balloon

226

00:09:39,040 --> 00:09:36,400

the balloon is gonna line up there on

227

00:09:41,800 --> 00:09:39,050

top of the track the track is going to

228

00:09:44,610 --> 00:09:41,810

back off and police there alone without

229

00:10:25,370 --> 00:09:44,620

the payload of course crossing into the

230

00:10:25,380 --> 00:10:28,980

okay

231

00:10:38,030 --> 00:10:33,560

go away there you go

232

00:10:41,759 --> 00:10:39,990

so this actually is one of the most

233

00:10:43,470 --> 00:10:41,769

critical particle we have to go all the

234

00:10:45,389 --> 00:10:43,480

way through the atmosphere through all

235

00:10:47,670 --> 00:10:45,399

these thermal variation until we get up

236

00:10:49,650 --> 00:10:47,680

to to the stratosphere so you have to

237

00:10:53,449 --> 00:10:49,660

really design all these components very

238

00:11:12,400 --> 00:10:53,459

well so they take all that temperature

239

00:11:12,410 --> 00:11:19,420

[Applause]

240

00:11:19,430 --> 00:11:33,920

it's flying it's not spinning

241

00:11:45,810 --> 00:11:36,240

this is how it will look like from the

242

00:11:48,960 --> 00:11:45,820

gondola actually crazy right it's really

243

00:11:53,280 --> 00:11:48,970

impressive that's Mount Erebus

244

00:11:56,220 --> 00:11:53,290

huge volcano in the background and if

245

00:11:59,580 --> 00:11:56,230

you remember this from November right

246

00:12:01,320 --> 00:11:59,590

there's a very fancy looking control

247

00:12:03,210 --> 00:12:01,330

room that we have here at JPL and you

248

00:12:07,350 --> 00:12:03,220

have all these guys very happy with the

249

00:12:08,970 --> 00:12:07,360

inside landing on Mars it was after

250

00:12:11,850 --> 00:12:08,980

landing everyone concentrated here

251
00:12:17,370 --> 00:12:11,860
before so I'm tired guys pretty much the

252
00:12:18,810 --> 00:12:17,380
same right so this is Chris Walker the

253
00:12:20,850 --> 00:12:18,820
principal investigator of the mission

254
00:12:23,700 --> 00:12:20,860
from University of Arizona or the

255
00:12:25,920 --> 00:12:23,710
colleagues myself after lunch we were

256
00:12:27,540 --> 00:12:25,930
happy and concentrated here during the

257
00:12:30,660 --> 00:12:27,550
ascent and making sure that everything

258
00:12:32,310 --> 00:12:30,670
was working well so again balloon is

259
00:12:34,290 --> 00:12:32,320
just like doing science like in the old

260
00:12:36,450 --> 00:12:34,300
days right it's not as fancy as the

261
00:12:40,290 --> 00:12:36,460
flight missions that is really cool to

262
00:12:42,810 --> 00:12:40,300
be there so one of the regions that we

263
00:12:44,700 --> 00:12:42,820

saw with this mission was the Carina

264

00:12:47,190 --> 00:12:44,710

Nebula it's beautiful it's one of the

265

00:12:49,530 --> 00:12:47,200

most active star-forming regions Naru

266

00:12:50,910 --> 00:12:49,540

galaxy and I'm gonna let it here let

267

00:12:54,650 --> 00:12:50,920

this here and I will come back to this

268

00:12:58,650 --> 00:12:54,660

later this go back in time a little bit

269

00:12:59,990 --> 00:12:58,660

so this is not the first volume mission

270

00:13:02,670 --> 00:13:00,000

of course the first scientific balloon

271

00:13:05,430 --> 00:13:02,680

and none of the missions that you can

272

00:13:07,800 --> 00:13:05,440

find online is the first one actually

273

00:13:10,560 --> 00:13:07,810

the first NASA a long mission or if one

274

00:13:12,090 --> 00:13:10,570

of the first was this NASA echo it when

275

00:13:16,290 --> 00:13:12,100

all the way up to space this volume was

276
00:13:17,760 --> 00:13:16,300
inspected in the space 1500 kilometers

277
00:13:20,490 --> 00:13:17,770
and it was a communications relay

278
00:13:23,790 --> 00:13:20,500
actually only some almost ferret

279
00:13:25,500 --> 00:13:23,800
measurements but again that's not again

280
00:13:28,910 --> 00:13:25,510
that's not either the first scientific

281
00:13:31,110 --> 00:13:28,920
mission we go back to 1912 victor has

282
00:13:32,820 --> 00:13:31,120
took a ride on a balloon went all the

283
00:13:35,250 --> 00:13:32,830
way up to five point three kilometer to

284
00:13:38,430 --> 00:13:35,260
measure variations on radiation and

285
00:13:39,990 --> 00:13:38,440
because of these experiments in 1936 he

286
00:13:43,079 --> 00:13:40,000
got the Nobel Prize in thesis for

287
00:13:44,580 --> 00:13:43,089
discovering the cosmic rays so balloons

288
00:13:49,380 --> 00:13:44,590

give you made

289

00:13:51,840 --> 00:13:49,390

in science since then more than 10,000

290

00:13:54,180 --> 00:13:51,850

million missions and Counting in

291

00:13:55,890 --> 00:13:54,190

astrophysics earth planetary science

292

00:13:58,200 --> 00:13:55,900

most of them actually are in

293

00:14:00,090 --> 00:13:58,210

astrophysics and I don't wanna go

294

00:14:01,440 --> 00:14:00,100

through the list but I want to point out

295

00:14:05,130 --> 00:14:01,450

that many of the holes are in the far

296

00:14:06,630 --> 00:14:05,140

infrared gamma rays cause x-rays and

297

00:14:09,480 --> 00:14:06,640

this is a reason for that

298

00:14:11,130 --> 00:14:09,490

and the reason is there are most fear

299

00:14:14,100 --> 00:14:11,140

blogs the radiation at those frequency

300

00:14:17,790 --> 00:14:14,110

wavelengths so you really need to go to

301
00:14:20,010 --> 00:14:17,800
a space or go almost to a space which is

302
00:14:21,660 --> 00:14:20,020
for example why you want to go up alone

303
00:14:23,700 --> 00:14:21,670
you could go to to an airplane as well

304
00:14:27,030 --> 00:14:23,710
not in this frequency range but in this

305
00:14:30,000 --> 00:14:27,040
but again it's not as clear as it is no

306
00:14:33,110 --> 00:14:30,010
space for our specific project or

307
00:14:35,640 --> 00:14:33,120
mission the Semana bit of wave spectrum

308
00:14:37,410 --> 00:14:35,650
this is how they cooperate imagine your

309
00:14:40,020 --> 00:14:37,420
cell phone and going here to Atacama and

310
00:14:42,330 --> 00:14:40,030
now your cell phone is trying to receive

311
00:14:45,270 --> 00:14:42,340
this ionized carbon and oxygen from

312
00:14:46,980 --> 00:14:45,280
start at four point two kilometers where

313
00:14:49,020 --> 00:14:46,990

those carbon and oxygen emissions lines

314

00:14:51,300 --> 00:14:49,030

hurt there's no coverage so we cannot

315

00:14:53,820 --> 00:14:51,310

see anything well let's go to an

316

00:14:55,620 --> 00:14:53,830

airplane this is how the sky looks like

317

00:14:57,570 --> 00:14:55,630

with the Sofia and NASA Sofia airplane

318

00:14:59,390 --> 00:14:57,580

it's getting better but still a lot of

319

00:15:02,790 --> 00:14:59,400

regions where you cannot really see much

320

00:15:07,920 --> 00:15:02,800

so we go with a balloon things look much

321

00:15:10,110 --> 00:15:07,930

better so that's one reason why we want

322

00:15:12,450 --> 00:15:10,120

to use balloons but there are other

323

00:15:14,640 --> 00:15:12,460

reasons like the noisy demonstrations

324

00:15:16,650 --> 00:15:14,650

caused we have seen that for our

325

00:15:18,450 --> 00:15:16,660

specific application we don't really

326

00:15:22,260 --> 00:15:18,460

want to go with a ground telescope

327

00:15:24,660 --> 00:15:22,270

because we cannot see anything but it's

328

00:15:26,700 --> 00:15:24,670

not cheap either so the course of Alma

329

00:15:30,000 --> 00:15:26,710

for example it is more than 1 billion

330

00:15:32,250 --> 00:15:30,010

dollar it's not cheap we can go to space

331

00:15:34,110 --> 00:15:32,260

but it's of course very expensive you

332

00:15:36,090 --> 00:15:34,120

have to have a very reliable Airy well

333

00:15:38,850 --> 00:15:36,100

test is reliable technology very much it

334

00:15:42,000 --> 00:15:38,860

and not only very low raise things have

335

00:15:43,710 --> 00:15:42,010

to be tested and documented properly so

336

00:15:45,870 --> 00:15:43,720

this mission Herschel Space Telescope

337

00:15:49,500 --> 00:15:45,880

goes has some limited wave

338

00:15:53,040 --> 00:15:49,510

mission far infrared it cost is around 1

339

00:15:55,350 --> 00:15:53,050

billion dollars we can go airborne with

340

00:15:57,300 --> 00:15:55,360

Sofia again is for what we wanted to do

341

00:15:59,850 --> 00:15:57,310

is not the best but is be blueberry

342

00:16:03,809 --> 00:15:59,860

data but it's not cheap either because

343

00:16:06,239 --> 00:16:03,819

100 million per year more or less but if

344

00:16:08,610 --> 00:16:06,249

we go with a balloon now the course is

345

00:16:10,139 --> 00:16:08,620

between five and ten million dollar so

346

00:16:12,179 --> 00:16:10,149

that means that you can test new

347

00:16:13,590 --> 00:16:12,189

technologies get that level of maturity

348

00:16:16,799 --> 00:16:13,600

they must read those technologies in

349

00:16:19,860 --> 00:16:16,809

flight and that way you can pave the

350

00:16:22,079 --> 00:16:19,870

future for future space missions and

351
00:16:25,980 --> 00:16:22,089
then you can also learn and recover the

352
00:16:28,889 --> 00:16:25,990
the payload do updates and fly again

353
00:16:30,299 --> 00:16:28,899
it's actually a perfect way to do this

354
00:16:34,290 --> 00:16:30,309
technology demonstration at the same

355
00:16:36,299 --> 00:16:34,300
time that you get great science but the

356
00:16:38,129 --> 00:16:36,309
no degree that we use in balloons it can

357
00:16:40,230 --> 00:16:38,139
be used for many other space missions in

358
00:16:41,730 --> 00:16:40,240
the future as we are saying it paves the

359
00:16:43,530 --> 00:16:41,740
way for future space missions so for

360
00:16:45,269 --> 00:16:43,540
this specific technology that we were

361
00:16:47,519 --> 00:16:45,279
using an sto tool it can be used for

362
00:16:48,989 --> 00:16:47,529
water mapping ocean walls it could be

363
00:16:49,670 --> 00:16:48,999

used for water and thermal map Eirik

364

00:16:52,079 --> 00:16:49,680

comets

365

00:16:55,319 --> 00:16:52,089

it could be used for monitoring Earth's

366

00:16:57,329 --> 00:16:55,329

health for somebody's ass so also on map

367

00:17:01,499 --> 00:16:57,339

and I was taken with our mission that is

368

00:17:03,840 --> 00:17:01,509

currently flying we can do Atmospheric

369

00:17:05,549 --> 00:17:03,850

experiments as well like are going range

370

00:17:08,549 --> 00:17:05,559

weather imaging or understand clouds

371

00:17:12,000 --> 00:17:08,559

humidity so a lot of applications well

372

00:17:14,460 --> 00:17:12,010

okay for years we have all these crazy

373

00:17:18,510 --> 00:17:14,470

small series that we have to develop and

374

00:17:21,029 --> 00:17:18,520

put together and we did it this is in

375

00:17:23,309 --> 00:17:21,039

Texas when we put all this together the

376

00:17:24,960 --> 00:17:23,319

first time and this old a tin and I

377

00:17:27,539 --> 00:17:24,970

imagine that you bill at 10,000 pieces

378

00:17:29,730 --> 00:17:27,549

possible and I tell you you need to take

379

00:17:31,320 --> 00:17:29,740

it apart and rebuild it in just a couple

380

00:17:33,210 --> 00:17:31,330

of hours you will tell me why you're

381

00:17:34,799 --> 00:17:33,220

crazy we're not going to do that well

382

00:17:36,810 --> 00:17:34,809

that what we did we took the telescope

383

00:17:41,190 --> 00:17:36,820

apart put it in boxes and send it to

384

00:17:44,789 --> 00:17:41,200

Ontario so here we go everyone in the

385

00:17:47,760 --> 00:17:44,799

team the others in LA we fly from here

386

00:17:49,649 --> 00:17:47,770

to Sydney Australia a few hours there

387

00:17:50,430 --> 00:17:49,659

then Kreitzer New Zealand you have some

388

00:17:53,100 --> 00:17:50,440

training there

389

00:17:56,149 --> 00:17:53,110

survival training you get the cold

390

00:17:59,340 --> 00:17:56,159

weather gear there finally you take a

391

00:18:03,990 --> 00:17:59,350

military an Air Force aircraft to go to

392

00:18:05,880 --> 00:18:04,000

McMurdo Station Antarctica this is the

393

00:18:08,510 --> 00:18:05,890

beginning of my trip and it's not that I

394

00:18:11,070 --> 00:18:08,520

thought I was very interesting for you

395

00:18:15,149 --> 00:18:11,080

in my luggage

396

00:18:17,440 --> 00:18:15,159

but what you see here is actually a

397

00:18:19,450 --> 00:18:17,450

subsystem of the radio telescope it's

398

00:18:21,640 --> 00:18:19,460

very sensitive for the list of static

399

00:18:24,010 --> 00:18:21,650

discharges so we kind of just put it in

400

00:18:25,419 --> 00:18:24,020

our boat for six months and aspect that

401
00:18:26,860 --> 00:18:25,429
is working we need to take it with us

402
00:18:29,140 --> 00:18:26,870
and make sure that it's transport in the

403
00:18:30,130 --> 00:18:29,150
correct way sand it's like doing science

404
00:18:32,770 --> 00:18:30,140
like in the old days right

405
00:18:35,830 --> 00:18:32,780
so I crossed when I cross the wall with

406
00:18:37,570 --> 00:18:35,840
that actually you see there in the table

407
00:18:39,490 --> 00:18:37,580
you can see it afterwards the big piece

408
00:18:42,640 --> 00:18:39,500
there is one of the part over here that

409
00:18:46,659 --> 00:18:42,650
flew and would recover after I brought

410
00:18:48,789 --> 00:18:46,669
it back this is myself were in the cold

411
00:18:50,860 --> 00:18:48,799
weather here in before boarding the

412
00:18:53,770 --> 00:18:50,870
flight and it's not that I wanted just

413
00:18:55,779 --> 00:18:53,780

to take their clothes to I mean put on

414

00:18:58,450 --> 00:18:55,789

those clothes to take a photo in front

415

00:19:01,680 --> 00:18:58,460

of the passenger terminal here for

416

00:19:03,610 --> 00:19:01,690

Facebook which I really wanted okay

417

00:19:05,200 --> 00:19:03,620

it's because we need to board the

418

00:19:07,810 --> 00:19:05,210

airplane like that just in case that

419

00:19:09,399 --> 00:19:07,820

something happen you you know you maybe

420

00:19:13,570 --> 00:19:09,409

you can survive on the ice for I don't

421

00:19:16,990 --> 00:19:13,580

know a couple of hours so here we go it

422

00:19:23,409 --> 00:19:17,000

this is the airplane the user for

423

00:19:31,060 --> 00:19:23,419

airplane and you fly like like this stop

424

00:19:35,049 --> 00:19:31,070

working okay so do you fly like cargo so

425

00:19:36,010 --> 00:19:35,059

you have all the the food their parts

426

00:19:38,350 --> 00:19:36,020

and everything you know all the

427

00:19:39,880 --> 00:19:38,360

scientists and all the person and their

428

00:19:41,710 --> 00:19:39,890

cargo but believe it or not is more

429

00:19:48,450 --> 00:19:41,720

comfortable than a commercial flight see

430

00:19:55,419 --> 00:19:52,659

okay so another reason why we want to go

431

00:19:56,860 --> 00:19:55,429

to Antarctica well it's one of the first

432

00:19:59,110 --> 00:19:56,870

photos I took from the airplane when we

433

00:20:01,090 --> 00:19:59,120

got there and you see here is beautiful

434

00:20:03,460 --> 00:20:01,100

right but there's nothing so your

435

00:20:04,750 --> 00:20:03,470

balloon fails and falls the worst thing

436

00:20:08,799 --> 00:20:04,760

that can happen is you make a hole on

437

00:20:13,659 --> 00:20:08,809

the ice not a big deal but the key point

438

00:20:16,149 --> 00:20:13,669

is that the Antarctic borders keep this

439

00:20:17,680 --> 00:20:16,159

wind circulating around the continent so

440

00:20:20,260 --> 00:20:17,690

when we launch the balloon the balloon

441

00:20:21,850 --> 00:20:20,270

goes around and around the continent it

442

00:20:23,230 --> 00:20:21,860

doesn't go out and then you can just

443

00:20:23,930 --> 00:20:23,240

after your mission is complete you can

444

00:20:28,249 --> 00:20:23,940

recover the

445

00:20:30,830 --> 00:20:28,259

you can continue another problem well

446

00:20:32,840 --> 00:20:30,840

there's no really a an airport so here

447

00:20:35,720 --> 00:20:32,850

you have this huge airplane landing on

448

00:20:39,049 --> 00:20:35,730

the ice is this smooth as landing and I

449

00:20:43,369 --> 00:20:39,059

ever seen in an airplane is it was

450

00:20:48,799 --> 00:20:43,379

amazing just really really soft my MARTA

451
00:20:51,519 --> 00:20:48,809
station you see looks like like a whole

452
00:20:54,740 --> 00:20:51,529
scientific base but really really cool

453
00:20:57,529 --> 00:20:54,750
the sea is there more interesting things

454
00:20:59,419 --> 00:20:57,539
this is Robert five bonus codes had that

455
00:21:00,529 --> 00:20:59,429
he will enduring suspicion to the South

456
00:21:02,269 --> 00:21:00,539
Pole is still there

457
00:21:04,789 --> 00:21:02,279
actually you can go in there and you

458
00:21:06,860 --> 00:21:04,799
have even these food cans still there it

459
00:21:09,019 --> 00:21:06,870
smells not really well but it's very

460
00:21:11,269 --> 00:21:09,029
cool to feel like those whole explorers

461
00:21:13,190 --> 00:21:11,279
and that's what balloon is in the end

462
00:21:15,019 --> 00:21:13,200
right you just go there and try to put

463
00:21:16,909 --> 00:21:15,029

the time balloon on a giant telescope in

464

00:21:17,779 --> 00:21:16,919

a balloon and feel like a Explorer it's

465

00:21:22,310 --> 00:21:17,789

really really cool

466

00:21:24,259 --> 00:21:22,320

the beach is frozen they tell you that

467

00:21:26,419 --> 00:21:24,269

they do there is a crack and you fool

468

00:21:28,850 --> 00:21:26,429

you have ten minutes to get out I found

469

00:21:30,680 --> 00:21:28,860

a crack I put my hand and tell anyone I

470

00:21:32,299 --> 00:21:30,690

think that I wouldn't make it more than

471

00:21:39,039 --> 00:21:32,309

one minute this is really really cool

472

00:21:41,060 --> 00:21:39,049

a galley first station a small hospital

473

00:21:43,129 --> 00:21:41,070

don't expect to get hardly there

474

00:21:44,779 --> 00:21:43,139

something happened they need to medevac

475

00:21:46,639 --> 00:21:44,789

you and there are not many flight so

476
00:21:49,549 --> 00:21:46,649
there's you get really well tested

477
00:21:52,249 --> 00:21:49,559
before going there and ice a lot of ice

478
00:21:54,950 --> 00:21:52,259
this is most beautiful eyes I ever seen

479
00:21:59,090 --> 00:21:54,960
in my life it's just this turquoise blue

480
00:22:01,159 --> 00:21:59,100
just beautiful and some challenges well

481
00:22:03,320 --> 00:22:01,169
this is malaria view this is the view

482
00:22:06,700 --> 00:22:03,330
from our office or our hangar we were

483
00:22:10,340 --> 00:22:06,710
when we were building telescopes is

484
00:22:12,529 --> 00:22:10,350
active supervolcano this actual fumes

485
00:22:14,210 --> 00:22:12,539
from the volcano and it's very close if

486
00:22:20,899 --> 00:22:14,220
these things get crazy I don't think

487
00:22:22,580 --> 00:22:20,909
that we can run or ski fast enough this

488
00:22:24,110 --> 00:22:22,590

is the hunger it was we were not at my

489

00:22:25,669 --> 00:22:24,120

mother we were like 40 minutes away from

490

00:22:28,369 --> 00:22:25,679

a murder we have to take a transport

491

00:22:30,499 --> 00:22:28,379

every morning this is the sea ice and

492

00:22:32,480 --> 00:22:30,509

this is important because we have this

493

00:22:32,990 --> 00:22:32,490

very small devices that they are really

494

00:22:35,570 --> 00:22:33,000

sensitive

495

00:22:37,700 --> 00:22:35,580

there's no ground connection here

496

00:22:39,799 --> 00:22:37,710

you basically have to be very very

497

00:22:42,350 --> 00:22:39,809

careful when you assemble the telescope

498

00:22:43,789 --> 00:22:42,360

back again because any discharge and is

499

00:22:45,049 --> 00:22:43,799

worried right there so you have to be

500

00:22:47,690 --> 00:22:45,059

really careful on where all these

501
00:22:49,340 --> 00:22:47,700
protections because if you discharge on

502
00:22:53,930 --> 00:22:49,350
your equipment

503
00:22:56,180 --> 00:22:53,940
you know you kill it stormy days is the

504
00:22:58,820 --> 00:22:56,190
same photo a stormy days in two or three

505
00:23:00,259 --> 00:22:58,830
minutes do you get whiteout so you need

506
00:23:02,269 --> 00:23:00,269
to be careful when this happened because

507
00:23:03,619 --> 00:23:02,279
you don't pretend to be walking around

508
00:23:06,680 --> 00:23:03,629
when you don't see anything you don't

509
00:23:07,359 --> 00:23:06,690
want to fall into a crevasse not a good

510
00:23:10,070 --> 00:23:07,369
idea

511
00:23:12,049 --> 00:23:10,080
and another important thing again we

512
00:23:14,450 --> 00:23:12,059
have to put together these 10,000 pieces

513
00:23:16,820 --> 00:23:14,460

passive in you know it takes four weeks

514

00:23:19,430 --> 00:23:16,830

so don't forget anything we have to take

515

00:23:20,989 --> 00:23:19,440

all the tools all the parts all the part

516

00:23:22,940 --> 00:23:20,999

that we might need if something goes

517

00:23:26,239 --> 00:23:22,950

wrong to fit wood whatever it goes wrong

518

00:23:29,419 --> 00:23:26,249

their own place because if something

519

00:23:30,799 --> 00:23:29,429

goes bad you cannot call Amazon you have

520

00:23:33,680 --> 00:23:30,809

to do it yourself so you remember this

521

00:23:35,899 --> 00:23:33,690

one Apollo 13 the issue of AC to filter

522

00:23:39,259 --> 00:23:35,909

when they have to make the round filters

523

00:23:40,639 --> 00:23:39,269

to to fit in the square hole and they

524

00:23:42,830 --> 00:23:40,649

have to do it with whatever they have in

525

00:23:44,509 --> 00:23:42,840

the spacecraft so pretty much like that

526
00:23:47,450 --> 00:23:44,519
there so whatever you have there would

527
00:23:50,710 --> 00:23:47,460
you need to use inside the hangar the

528
00:23:52,879 --> 00:23:50,720
scientists it in there and top floor

529
00:23:55,669 --> 00:23:52,889
engineers working on the telescope here

530
00:23:56,960 --> 00:23:55,679
a lot of parts again all these powerful

531
00:24:00,379 --> 00:23:56,970
this pass shall have to come back

532
00:24:01,940 --> 00:24:00,389
together in four weeks the receiver the

533
00:24:03,799 --> 00:24:01,950
silicon a metre telescope that you see

534
00:24:06,289 --> 00:24:03,809
here the solar panels thousands of

535
00:24:09,560 --> 00:24:06,299
cables here you really need to get

536
00:24:11,899 --> 00:24:09,570
inside and connect cables so we're

537
00:24:13,820 --> 00:24:11,909
telemetry to control the gondola and the

538
00:24:17,989 --> 00:24:13,830

instrument on flight the parachute for

539

00:24:20,029 --> 00:24:17,999

the landing and at some point again we

540

00:24:23,599 --> 00:24:20,039

think we made it happen and that was

541

00:24:26,330 --> 00:24:23,609

back together one piece pork in but we

542

00:24:28,310 --> 00:24:26,340

have a last problem which is like you

543

00:24:30,259 --> 00:24:28,320

have a telescope right so what you need

544

00:24:33,200 --> 00:24:30,269

to test a telescope you need stars or

545

00:24:34,970 --> 00:24:33,210

planets right but it's daylight so how

546

00:24:37,039 --> 00:24:34,980

do we find or how do we really point to

547

00:24:38,810 --> 00:24:37,049

stars and also we have seen we have that

548

00:24:41,029 --> 00:24:38,820

we cannot receive the signal that we

549

00:24:43,159 --> 00:24:41,039

want to see from the ground right okay

550

00:24:45,889 --> 00:24:43,169

well you know have a start do it

551
00:24:47,570 --> 00:24:45,899
yourselves so what we did is to create a

552
00:24:49,129 --> 00:24:47,580
transmitter that you can see here in

553
00:24:50,979 --> 00:24:49,139
front of the telescope

554
00:24:53,330 --> 00:24:50,989
transmitted a signal that somehow

555
00:24:56,210 --> 00:24:53,340
reproduce the signal that we will see

556
00:24:57,739 --> 00:24:56,220
from a star transmitted here to this

557
00:25:01,039 --> 00:24:57,749
reflector which was on top of a

558
00:25:03,619 --> 00:25:01,049
container far away and point the

559
00:25:06,789 --> 00:25:03,629
telescope to that fake star and do all

560
00:25:10,609 --> 00:25:06,799
the calibration focusing pointing

561
00:25:12,039 --> 00:25:10,619
adjustment that we needed of course at

562
00:25:14,210 --> 00:25:12,049
the end you have to make sure that

563
00:25:16,399 --> 00:25:14,220

you're actually looking at your fake

564

00:25:17,779 --> 00:25:16,409

star so you have to go there and cover

565

00:25:19,159 --> 00:25:17,789

the reflector and make sure the signal

566

00:25:19,940 --> 00:25:19,169

goes away please don't do this with a

567

00:25:25,489 --> 00:25:19,950

real star

568

00:25:29,649 --> 00:25:25,499

you'll get burned okay for I said four

569

00:25:36,259 --> 00:25:29,659

years in four weeks but in 90 second

570

00:25:38,330 --> 00:25:36,269

this is how it looks like so what you're

571

00:25:40,430 --> 00:25:38,340

seeing is the telescope just four on top

572

00:25:44,119 --> 00:25:40,440

of the receiver and now advanced in the

573

00:25:46,279 --> 00:25:44,129

gondola they're going to put on the boat

574

00:25:48,549 --> 00:25:46,289

on the computers and communication

575

00:25:51,590 --> 00:25:48,559

systems and then we're going to start

576
00:25:54,139 --> 00:25:51,600
assembling the solar panels and when all

577
00:25:56,830 --> 00:25:54,149
that is done they get outside and do all

578
00:25:59,389 --> 00:25:56,840
these communication tests and

579
00:26:00,560 --> 00:25:59,399
transmission tests to make sure that the

580
00:26:01,970 --> 00:26:00,570
instrument does interfere with the

581
00:26:04,789 --> 00:26:01,980
communications and all that and of

582
00:26:07,580 --> 00:26:04,799
course that everything is working after

583
00:26:09,560 --> 00:26:07,590
that you are ready to fly you bring it

584
00:26:11,180 --> 00:26:09,570
back inside and you just wait until

585
00:26:14,450 --> 00:26:11,190
there's a day where the weather is good

586
00:26:16,190 --> 00:26:14,460
the winds are good to go for launch

587
00:26:19,970 --> 00:26:16,200
so here you see we were doing some

588
00:26:22,659 --> 00:26:19,980

communication tests back inside everyone

589

00:26:25,039 --> 00:26:22,669

happy getting ready for launch

590

00:26:28,279 --> 00:26:25,049

as you see everyone was so excited and

591

00:26:32,509 --> 00:26:28,289

doing things very fast we were not that

592

00:26:35,479 --> 00:26:32,519

fast though they put the landing pads on

593

00:26:38,810 --> 00:26:35,489

the bottom and it's waiting for the

594

00:26:40,820 --> 00:26:38,820

winds to come down and you go to the

595

00:26:53,990 --> 00:26:40,830

launch pad which is very fancy and it's

596

00:27:01,889 --> 00:26:56,310

previous one was real timed is it not

597

00:27:02,370 --> 00:27:01,899

obviously and everyone was really really

598

00:27:05,399 --> 00:27:02,380

happy

599

00:27:08,490 --> 00:27:05,409

teamwork thing works teamwork so you

600

00:27:09,240 --> 00:27:08,500

kind of really build this rebuild this

601
00:27:11,750 --> 00:27:09,250
in four weeks

602
00:27:13,649 --> 00:27:11,760
if you don't really work well alone I

603
00:27:15,240 --> 00:27:13,659
wouldn't call them colleagues I think

604
00:27:17,549 --> 00:27:15,250
they are really really good friends we

605
00:27:20,250 --> 00:27:17,559
spend so much time together that we got

606
00:27:23,310 --> 00:27:20,260
really really close do you have to do

607
00:27:24,509 --> 00:27:23,320
this very fast as I said it's different

608
00:27:26,730 --> 00:27:24,519
to a space mission where you have much

609
00:27:27,899 --> 00:27:26,740
more time you do this relatively fast so

610
00:27:30,419 --> 00:27:27,909
you don't really need to trust each

611
00:27:32,159 --> 00:27:30,429
other all these guys are amazing in what

612
00:27:34,169 --> 00:27:32,169
they do and you have to really trust

613
00:27:36,629 --> 00:27:34,179

each other work well together

614

00:27:38,820 --> 00:27:36,639

you're there on the ice 24 hours a day

615

00:27:41,370 --> 00:27:38,830

together and you really need to work

616

00:27:42,930 --> 00:27:41,380

well also balanced and Laura will talk

617

00:27:47,340 --> 00:27:42,940

more about that it's a great way to

618

00:27:49,169 --> 00:27:47,350

bring students young scientists to

619

00:27:52,259 --> 00:27:49,179

basically bring them to the process of

620

00:27:56,120 --> 00:27:52,269

building a whole mission from end to end

621

00:28:02,220 --> 00:27:56,130

and pregnant for future space missions a

622

00:28:04,889 --> 00:28:02,230

lot of universities and another centers

623

00:28:06,560 --> 00:28:04,899

working together so again you cannot

624

00:28:09,090 --> 00:28:06,570

really do this alone there's a lot of

625

00:28:12,600 --> 00:28:09,100

people working on this and a lot of them

626

00:28:15,539 --> 00:28:12,610

that are not in the photo so sto to flew

627

00:28:17,879 --> 00:28:15,549

for 21 days it went around the continent

628

00:28:21,509 --> 00:28:17,889

twice and when the mission was completed

629

00:28:33,899 --> 00:28:21,519

well we just landed so it's not fun our

630

00:28:37,520 --> 00:28:33,909

mission but is how it looks like and

631

00:28:43,580 --> 00:28:40,910

now start fooling this is from from

632

00:28:47,450 --> 00:28:43,590

outside view you can see how massive the

633

00:28:51,740 --> 00:28:47,460

balloon is compared to the payload that

634

00:28:54,290 --> 00:28:51,750

is their really really impressive this

635

00:28:55,940 --> 00:28:54,300

is how it duplex on so it's really space

636

00:29:00,440 --> 00:28:55,950

is pretty much the space you can see how

637

00:29:05,120 --> 00:29:00,450

high we're flying 130,000 feet and you

638

00:29:06,650 --> 00:29:05,130

can land back on the ice and I know that

639

00:29:08,330 --> 00:29:06,660

you were wondering if we do something

640

00:29:11,150 --> 00:29:08,340

else than other than working in

641

00:29:13,310 --> 00:29:11,160

Antarctica well this is New Year's Eve

642

00:29:16,010 --> 00:29:13,320

in Antarctica ice token starting Music

643

00:29:19,610 --> 00:29:16,020

Festival we actually have like 20 bands

644

00:29:21,170 --> 00:29:19,620

playing that day and it happened it was

645

00:29:24,710 --> 00:29:21,180

a coincidence that we ended our mission

646

00:29:26,480 --> 00:29:24,720

just and New Year's you know it was not

647

00:29:28,400 --> 00:29:26,490

for us but you know we can say that they

648

00:29:30,920 --> 00:29:28,410

organized a party for the team

649

00:29:34,460 --> 00:29:30,930

it was really cool by the way midnight

650

00:29:37,280 --> 00:29:34,470

they liked all the time so it was very

651
00:29:40,270 --> 00:29:37,290
very cool to to be in New Year's

652
00:29:42,920 --> 00:29:40,280
actually in the big light all the time a

653
00:29:43,940 --> 00:29:42,930
few weeks later I think was two weeks we

654
00:29:46,160 --> 00:29:43,950
recovered the payload

655
00:29:47,780 --> 00:29:46,170
this is how it look like so you see the

656
00:29:49,220 --> 00:29:47,790
solar panels are of course broken but

657
00:29:52,070 --> 00:29:49,230
the solar panels are cheap you can just

658
00:29:54,980 --> 00:29:52,080
buy new ones um and put them back

659
00:29:59,060 --> 00:29:54,990
together the gondola was intact this is

660
00:30:00,680 --> 00:29:59,070
the force data and this is how it looks

661
00:30:03,050 --> 00:30:00,690
like in the hangar back in the hangar so

662
00:30:06,860 --> 00:30:03,060
again it just looks like new everything

663
00:30:08,480 --> 00:30:06,870

was working this part who was one of the

664

00:30:11,000 --> 00:30:08,490

subsystem that I took with me you can

665

00:30:12,740 --> 00:30:11,010

have a look afterwards still working we

666

00:30:15,110 --> 00:30:12,750

recover from the eyes we brought it back

667

00:30:17,330 --> 00:30:15,120

still working and the other one there is

668

00:30:20,750 --> 00:30:17,340

the new generation that we're trying to

669

00:30:23,120 --> 00:30:20,760

fly in it because that's the advantage

670

00:30:24,890 --> 00:30:23,130

of the alone we can now update with new

671

00:30:26,690 --> 00:30:24,900

technology with an a generation of

672

00:30:29,600 --> 00:30:26,700

technology and fly again

673

00:30:31,550 --> 00:30:29,610

and try new things actually because of

674

00:30:32,960 --> 00:30:31,560

the success of Sto - there's another

675

00:30:36,200 --> 00:30:32,970

mission called gas - that will fly in

676
00:30:40,880 --> 00:30:36,210
2021 and we're working on other concepts

677
00:30:43,190 --> 00:30:40,890
to fly larger telescopes more broadband

678
00:30:46,280 --> 00:30:43,200
coverage - tuned to different frequency

679
00:30:49,940 --> 00:30:46,290
lines so so this just again paves the

680
00:30:51,430 --> 00:30:49,950
way for future missions but yeah we're

681
00:30:53,889 --> 00:30:51,440
ready for another flight yeah

682
00:31:08,740 --> 00:30:53,899
but I think after all those that time in

683
00:31:10,990 --> 00:31:08,750
the eyes I think the team but the

684
00:31:13,600 --> 00:31:11,000
mission is not accomplished unless you

685
00:31:18,100 --> 00:31:13,610
don't get science and this is the

686
00:31:21,430 --> 00:31:18,110
science with God from the sto - you can

687
00:31:24,399 --> 00:31:21,440
see here rotate those bags or space or

688
00:31:27,879 --> 00:31:24,409

carbon that we saw I showed you this

689

00:31:29,710 --> 00:31:27,889

photo before and if you see an optical

690

00:31:32,529 --> 00:31:29,720

image of there really on there there is

691

00:31:35,350 --> 00:31:32,539

nothing here with sto - we saw carbons

692

00:31:38,769 --> 00:31:35,360

emission there so sto - actually found

693

00:31:43,930 --> 00:31:38,779

out how young massive stars impact the

694

00:31:46,060 --> 00:31:43,940

surrounding cloud and that maybe maybe

695

00:31:49,330 --> 00:31:46,070

regulate how they start forming process

696

00:31:51,669 --> 00:31:49,340

work so really good science again it

697

00:31:54,220 --> 00:31:51,679

will be more in future flies but we got

698

00:31:59,440 --> 00:31:54,230

an amazing science with this low budget

699

00:32:01,180 --> 00:31:59,450

value mission so I want to conclude with

700

00:32:04,090 --> 00:32:01,190

this paragraph that aggro'd and December

701
00:32:05,919 --> 00:32:04,100
15 from a mother station target so today

702
00:32:09,549 --> 00:32:05,929
we got the first detection of carbon

703
00:32:12,129 --> 00:32:09,559
emitted by nearby ETA Carinae 7500 years

704
00:32:13,360 --> 00:32:12,139
ago that's the time the signal takes to

705
00:32:15,820 --> 00:32:13,370
get to Earth from the Carina

706
00:32:17,889 --> 00:32:15,830
constellation carbon is basic to life

707
00:32:19,930 --> 00:32:17,899
and this carbon emissions we are seeing

708
00:32:21,299 --> 00:32:19,940
today might turn into life in several

709
00:32:24,610 --> 00:32:21,309
million years from now

710
00:32:26,110 --> 00:32:24,620
likewise ourselves our carbon was

711
00:32:29,379 --> 00:32:26,120
probably part of a distant star-forming

712
00:32:30,789 --> 00:32:29,389
region millions of years ago so today as

713
00:32:33,460 --> 00:32:30,799

we look at the stars from the most

714

00:32:36,310 --> 00:32:33,470

remote part of our plane a planet using

715

00:32:38,139 --> 00:32:36,320

a large telescope on a giant balloon we

716

00:32:40,270 --> 00:32:38,149

dig into our paths to pry understand our

717

00:32:49,230 --> 00:32:40,280

future thank you

718

00:32:52,210 --> 00:32:49,240

[Applause]

719

00:32:55,030 --> 00:32:52,220

Thank You Jose now our second speaker

720

00:32:56,740 --> 00:32:55,040

dr. Laura Jones Wilson earned her BS in

721

00:32:59,590 --> 00:32:56,750

aerospace engineering at Virginia Tech

722

00:33:01,510 --> 00:32:59,600

in 2007 went on to study at Cornell

723

00:33:03,480 --> 00:33:01,520

University where she obtained her MS and

724

00:33:06,880 --> 00:33:03,490

PhD in aerospace engineering

725

00:33:07,870 --> 00:33:06,890

specializing in dynamics and controls of

726

00:33:10,390 --> 00:33:07,880

space systems

727

00:33:12,940 --> 00:33:10,400

she joined JPL in 2012 as a guidance

728

00:33:14,650 --> 00:33:12,950

engineer for stable a balloon based

729

00:33:16,540 --> 00:33:14,660

pointing technology demonstration

730

00:33:18,790 --> 00:33:16,550

mission currently she is a systems

731

00:33:20,020 --> 00:33:18,800

engineer on Europa clipper responsible

732

00:33:21,820 --> 00:33:20,030

for ensuring the solar arrays

733

00:33:31,840 --> 00:33:21,830

accommodate the radar instrument please

734

00:33:33,190 --> 00:33:31,850

welcome dr. Jones Wilson hi thanks for

735

00:33:34,990 --> 00:33:33,200

coming out tonight I'm really excited to

736

00:33:36,790 --> 00:33:35,000

be here so I'm Laura

737

00:33:39,940 --> 00:33:36,800

and I am going to be talking to you

738

00:33:42,070 --> 00:33:39,950

about how the kind of other side the

739

00:33:43,330 --> 00:33:42,080

darks the dark arts of the ballooning

740

00:33:45,700 --> 00:33:43,340

missions which was the engineering side

741

00:33:47,350 --> 00:33:45,710

and how it's really a crucible for not

742

00:33:49,630 --> 00:33:47,360

only the science as Jose was talking

743

00:33:53,890 --> 00:33:49,640

about but also the the technology and

744

00:33:55,510 --> 00:33:53,900

the teaming so Jose went and gave a

745

00:33:56,920 --> 00:33:55,520

really good introduction about all the

746

00:33:59,320 --> 00:33:56,930

different science you can do on here and

747

00:34:01,030 --> 00:33:59,330

some really cool apps aspects of it so

748

00:34:02,470 --> 00:34:01,040

as he mentioned one of the reasons

749

00:34:04,000 --> 00:34:02,480

balloons are so interesting as a

750

00:34:06,100 --> 00:34:04,010

platform is because they offer a lot of

751
00:34:07,960 --> 00:34:06,110
advantages over other opportunities for

752
00:34:09,730 --> 00:34:07,970
science so for example from a

753
00:34:11,530 --> 00:34:09,740
ground-based mission you can actually

754
00:34:13,870 --> 00:34:11,540
have more tailored hardware you can pick

755
00:34:15,940 --> 00:34:13,880
your own particular instrument or

756
00:34:17,409 --> 00:34:15,950
mission and fly that instead of maybe

757
00:34:19,570 --> 00:34:17,419
what's available on the ground already

758
00:34:21,520 --> 00:34:19,580
you also get really clear seeing you get

759
00:34:23,740 --> 00:34:21,530
lower wind speeds and larger coherence

760
00:34:25,960 --> 00:34:23,750
lengths higher up and you can actually

761
00:34:27,130 --> 00:34:25,970
access different spectral bands so Jose

762
00:34:28,630 --> 00:34:27,140
was talking about all the different ones

763
00:34:30,250 --> 00:34:28,640

that get blocked by the atmosphere in

764

00:34:31,630 --> 00:34:30,260

order to be able to see those you really

765

00:34:32,669 --> 00:34:31,640

have to go above the atmosphere and

766

00:34:35,169 --> 00:34:32,679

balloons give you that opportunity

767

00:34:37,030 --> 00:34:35,179

another thing you can do as compared to

768

00:34:39,040 --> 00:34:37,040

orbital systems for example it's a much

769

00:34:40,900 --> 00:34:39,050

lower cost so obviously Jose I was

770

00:34:42,220 --> 00:34:40,910

talking about how that's a more frequent

771

00:34:44,470 --> 00:34:42,230

you can actually put up some more

772

00:34:46,090 --> 00:34:44,480

opportunities with your instrument and

773

00:34:47,200 --> 00:34:46,100

you get to recover your hardware which

774

00:34:48,430 --> 00:34:47,210

isn't usually what you get to do with

775

00:34:49,990 --> 00:34:48,440

spacecraft and you can maybe even

776

00:34:52,240 --> 00:34:50,000

upgrade it and fly it again or over and

777

00:34:53,440 --> 00:34:52,250

over and get science and increasing

778

00:34:56,710 --> 00:34:53,450

quantities as you go through the

779

00:34:57,940 --> 00:34:56,720

different life cycles so all the

780

00:34:59,650 --> 00:34:57,950

different science we talked a little bit

781

00:35:00,290 --> 00:34:59,660

about astronomy and the astronomy that

782

00:35:01,430 --> 00:35:00,300

you can do from

783

00:35:03,890 --> 00:35:01,440

there's a lot of really cool things you

784

00:35:06,740 --> 00:35:03,900

can see black holes dark matter cosmic

785

00:35:08,150 --> 00:35:06,750

rays even exoplanets there's also some

786

00:35:09,740 --> 00:35:08,160

proposed to explorations out there that

787

00:35:11,690 --> 00:35:09,750

are really cool some of the work that

788

00:35:14,990 --> 00:35:11,700

there's being done right here at JPL is

789

00:35:17,060 --> 00:35:15,000

studying ways of measuring quakes on

790

00:35:19,370 --> 00:35:17,070

Venus from balloons that you put around

791

00:35:22,220 --> 00:35:19,380

on Venus itself so you don't have to sit

792

00:35:23,180 --> 00:35:22,230

on the ground at 800 Fahrenheit and try

793

00:35:24,380 --> 00:35:23,190

to take the measurements you can

794

00:35:26,120 --> 00:35:24,390

actually try to make those measurements

795

00:35:28,850 --> 00:35:26,130

from higher up and get the measurements

796

00:35:30,710 --> 00:35:28,860

that way on earth we can actually do

797

00:35:32,840 --> 00:35:30,720

climate measurements magnetic field

798

00:35:34,400 --> 00:35:32,850

stratospheric chemistry winds all of

799

00:35:36,440 --> 00:35:34,410

these other great things we can learn by

800

00:35:38,420 --> 00:35:36,450

actually being in that wind collar or

801
00:35:39,770 --> 00:35:38,430
that air column there and then solar

802
00:35:42,410 --> 00:35:39,780
science we can actually study how the

803
00:35:43,850 --> 00:35:42,420
solar winds come out from the Sun and

804
00:35:45,890 --> 00:35:43,860
interact with magnetic fields here at

805
00:35:48,650 --> 00:35:45,900
earth and all the different cool

806
00:35:50,270 --> 00:35:48,660
interactions you may get with that so as

807
00:35:51,920 --> 00:35:50,280
an engineer though this all science is

808
00:35:54,620 --> 00:35:51,930
great but what I hear as an engineer is

809
00:35:56,420 --> 00:35:54,630
there's technology to be had here this

810
00:35:58,160 --> 00:35:56,430
has needs for different parts of what

811
00:35:59,810 --> 00:35:58,170
engineers can do so what can technology

812
00:36:02,510 --> 00:35:59,820
do on balloons there's a couple of

813
00:36:04,370 --> 00:36:02,520

different things so for example you can

814

00:36:07,190 --> 00:36:04,380

develop technology for other worlds and

815

00:36:08,480 --> 00:36:07,200

so if you're going to for example do

816

00:36:11,270 --> 00:36:08,490

that remote sensing technique where

817

00:36:12,740 --> 00:36:11,280

you're listening to the airwaves and and

818

00:36:15,410 --> 00:36:12,750

trying to understand what the quakes are

819

00:36:16,820 --> 00:36:15,420

doing on the seismic activity you can do

820

00:36:17,840 --> 00:36:16,830

that on a balloon platform here and if

821

00:36:19,130 --> 00:36:17,850

you're gonna send it to Venus you're

822

00:36:20,240 --> 00:36:19,140

gonna try it here on earth first so

823

00:36:22,550 --> 00:36:20,250

that's the technology we can start

824

00:36:24,890 --> 00:36:22,560

developing on balloons another thing you

825

00:36:26,540 --> 00:36:24,900

can do is develop new concepts for for

826

00:36:28,220 --> 00:36:26,550

something so I know that a lot of the

827

00:36:30,110 --> 00:36:28,230

new missions that Jose pointed out are

828

00:36:32,330 --> 00:36:30,120

actually trying out different detection

829

00:36:34,610 --> 00:36:32,340

types and different detectors qualifying

830

00:36:36,500 --> 00:36:34,620

them to the technology on a balloon

831

00:36:37,670 --> 00:36:36,510

first and then making the case that it's

832

00:36:40,820 --> 00:36:37,680

got really good science and maybe you

833

00:36:42,740 --> 00:36:40,830

should go on a space mission you can

834

00:36:45,050 --> 00:36:42,750

also test in the upper atmosphere of

835

00:36:47,240 --> 00:36:45,060

Earth as an analog for other planets so

836

00:36:49,490 --> 00:36:47,250

for example if you wanted to test

837

00:36:51,380 --> 00:36:49,500

different sensors that are bound for

838

00:36:52,970 --> 00:36:51,390

Mars you want to make sure that the

839

00:36:54,920 --> 00:36:52,980

atmosphere you're testing in is similar

840

00:36:56,540 --> 00:36:54,930

to Mars one of the ways to do that is to

841

00:36:58,850 --> 00:36:56,550

go into our upper atmosphere where it's

842

00:37:01,310 --> 00:36:58,860

very thin and less dense and use it as a

843

00:37:03,620 --> 00:37:01,320

Martian analog so Astra was actually a

844

00:37:05,690 --> 00:37:03,630

mission done here at JPL that was

845

00:37:08,780 --> 00:37:05,700

testing some of those like an anemometer

846

00:37:10,400 --> 00:37:08,790

a wind speed measurement for Mars in our

847

00:37:12,050 --> 00:37:10,410

atmosphere so these are all great

848

00:37:14,150 --> 00:37:12,060

platforms but the really exciting thing

849

00:37:15,799 --> 00:37:14,160

for me is being able to build the

850

00:37:17,329 --> 00:37:15,809

the Loon technology itself to be able to

851
00:37:18,200 --> 00:37:17,339
enable all of these missions if you're

852
00:37:19,279 --> 00:37:18,210
going to be able to do any of these

853
00:37:21,140 --> 00:37:19,289
other cool things you need a good

854
00:37:23,150 --> 00:37:21,150
balloon platform and that's really where

855
00:37:24,859 --> 00:37:23,160
the mission that I work John comes in so

856
00:37:26,269 --> 00:37:24,869
I was on a mission called bit stable and

857
00:37:27,880 --> 00:37:26,279
it was really about advancing the

858
00:37:30,700 --> 00:37:27,890
Poynting capability of these platforms

859
00:37:32,749 --> 00:37:30,710
so let's talk about bit stable so--but

860
00:37:34,069 --> 00:37:32,759
these are maybe a little tortured

861
00:37:35,960 --> 00:37:34,079
acronyms but that was the balloon for an

862
00:37:38,569 --> 00:37:35,970
imaging test fed engineers are maybe

863
00:37:40,099 --> 00:37:38,579

known for being bad about that but the

864

00:37:41,900 --> 00:37:40,109

Bloomberg imaging test hood was done by

865

00:37:43,940 --> 00:37:41,910

the University of Toronto and now they

866

00:37:45,109 --> 00:37:43,950

were building the gondola part of our

867

00:37:46,730 --> 00:37:45,119

balloon so the idea is that you attach

868

00:37:49,609 --> 00:37:46,740

your balloon up here off of a tether and

869

00:37:52,069 --> 00:37:49,619

this gondola is what it held the the

870

00:37:53,599 --> 00:37:52,079

stable portion and so stable sub

871

00:37:56,599 --> 00:37:53,609

arcsecond telescope and balloon

872

00:37:58,490 --> 00:37:56,609

experiment was done here at JPL with the

873

00:38:01,400 --> 00:37:58,500

contribution of the camera by one of the

874

00:38:03,289 --> 00:38:01,410

folks that you the in the UK and so bit

875

00:38:05,480 --> 00:38:03,299

stable the whole mission overall was

876
00:38:06,950 --> 00:38:05,490
technology demonstration mission with

877
00:38:09,769 --> 00:38:06,960
the intent of proving that we can get

878
00:38:12,769 --> 00:38:09,779
really stable pointing platforms on/off

879
00:38:14,329 --> 00:38:12,779
balloons so the main objectives and

880
00:38:16,339 --> 00:38:14,339
here's where I get into my engineering

881
00:38:18,349 --> 00:38:16,349
is to demonstrate a hundred milli arc

882
00:38:21,380 --> 00:38:18,359
second point stability over at least

883
00:38:22,730 --> 00:38:21,390
sixty Seconds one Sigma praxis given a

884
00:38:24,440 --> 00:38:22,740
certain course stage pointing to within

885
00:38:26,809 --> 00:38:24,450
two are seconds over 120 seconds so what

886
00:38:28,849 --> 00:38:26,819
does that actually mean if you're

887
00:38:29,809 --> 00:38:28,859
sitting on a really bouncy car and

888
00:38:31,640 --> 00:38:29,819

you're trying to take a picture out the

889

00:38:33,859 --> 00:38:31,650

window you're gonna get blurry images

890

00:38:35,390 --> 00:38:33,869

right like so the the problem here is

891

00:38:37,220 --> 00:38:35,400

that if you're pointing platform is

892

00:38:38,240 --> 00:38:37,230

shaking all over the place and you're

893

00:38:40,880 --> 00:38:38,250

trying to take a picture of something

894

00:38:42,650 --> 00:38:40,890

extremely far away and and maybe even

895

00:38:44,720 --> 00:38:42,660

very dim or small you're gonna get

896

00:38:47,059 --> 00:38:44,730

blurry images and maybe not even see it

897

00:38:49,730 --> 00:38:47,069

so what 100 milli arc seconds actually

898

00:38:51,170 --> 00:38:49,740

means is if you were sitting on earth

899

00:38:53,240 --> 00:38:51,180

and we're looking at the moon so that

900

00:38:56,779 --> 00:38:53,250

distance you'd be able to point your

901
00:38:58,220 --> 00:38:56,789
telescope such that it didn't vary by

902
00:38:59,960 --> 00:38:58,230
more than two Statue of Liberty is

903
00:39:02,089 --> 00:38:59,970
standing on the moon so it's really

904
00:39:05,120 --> 00:39:02,099
tight pointing this was an order of

905
00:39:06,589 --> 00:39:05,130
magnitude or or so better than some of

906
00:39:07,730 --> 00:39:06,599
the capability is out there so is one of

907
00:39:10,160 --> 00:39:07,740
those things that we're really trying to

908
00:39:11,779 --> 00:39:10,170
do to me to prove that this telescope

909
00:39:14,980 --> 00:39:11,789
could really actually achieve this

910
00:39:17,870 --> 00:39:14,990
really tight pointing from a balloon so

911
00:39:19,400 --> 00:39:17,880
we also had a couple other objectives we

912
00:39:20,960 --> 00:39:19,410
were using a point source of light and

913
00:39:22,849 --> 00:39:20,970

this is because we didn't want to use

914

00:39:24,589 --> 00:39:22,859

Jupiter because if all you can use is

915

00:39:26,630 --> 00:39:24,599

Jupiter it's nice and fat and a lot of

916

00:39:27,569 --> 00:39:26,640

light coming off of it then the only

917

00:39:29,249 --> 00:39:27,579

thing you can do with your

918

00:39:30,809 --> 00:39:29,259

instrument is stare at Jupiter and maybe

919

00:39:32,249 --> 00:39:30,819

maybe you want to see it other things

920

00:39:34,920 --> 00:39:32,259

and so we wanted to use a point source

921

00:39:36,599 --> 00:39:34,930

of light in the visible spectrum because

922

00:39:38,069 --> 00:39:36,609

as Jose showed you if you look at the

923

00:39:39,420 --> 00:39:38,079

universe in the in the visible spectrum

924

00:39:41,039 --> 00:39:39,430

there's a lot of really cool points of

925

00:39:42,839 --> 00:39:41,049

light all over the map and so you can

926

00:39:44,699 --> 00:39:42,849

look at any part of the sky and probably

927

00:39:46,259 --> 00:39:44,709

find a star that'll work for you as

928

00:39:46,709 --> 00:39:46,269

opposed to say the infrared or something

929

00:39:49,380 --> 00:39:46,719

like that

930

00:39:51,479 --> 00:39:49,390

we also had a signal noise ratio which

931

00:39:52,859 --> 00:39:51,489

is basically identifying how dim we

932

00:39:54,089 --> 00:39:52,869

wanted to be able to see the star so we

933

00:39:56,039 --> 00:39:54,099

wanted to be able to look at relatively

934

00:39:57,569 --> 00:39:56,049

dim stars because they're more common in

935

00:39:59,309 --> 00:39:57,579

the sky if you can only look at again

936

00:40:00,779 --> 00:39:59,319

really bright stars you get to look at

937

00:40:02,459 --> 00:40:00,789

that one part of the sky but if you can

938

00:40:04,170 --> 00:40:02,469

prove that it's a pretty dim star and

939

00:40:05,670 --> 00:40:04,180

you can look at any part of the sky it

940

00:40:08,190 --> 00:40:05,680

gives you better opportunity to do

941

00:40:10,680 --> 00:40:08,200

things like surveys or maps and we

942

00:40:11,910 --> 00:40:10,690

wanted to do it on a balloon above 25

943

00:40:13,019 --> 00:40:11,920

kilometers because that's where the

944

00:40:15,989 --> 00:40:13,029

technology is really gonna make the

945

00:40:18,630 --> 00:40:15,999

difference for the scientists okay so

946

00:40:21,029 --> 00:40:18,640

why is that hard the first is is really

947

00:40:23,190 --> 00:40:21,039

thermal and dynamic disturbances so when

948

00:40:24,719 --> 00:40:23,200

you start having a balloon that's going

949

00:40:27,599 --> 00:40:24,729

up to all of these different at

950

00:40:29,549 --> 00:40:27,609

different elevations we actually had an

951
00:40:30,989 --> 00:40:29,559
80 degree C difference between our hot

952
00:40:32,729 --> 00:40:30,999
case in our cold case and making sure

953
00:40:34,439 --> 00:40:32,739
that our telescope would be nice and

954
00:40:36,239 --> 00:40:34,449
happy and give us a beautiful spot on to

955
00:40:38,130 --> 00:40:36,249
our detector of the star that we were

956
00:40:40,019 --> 00:40:38,140
imaging and all of these different cases

957
00:40:41,609 --> 00:40:40,029
was a very big deal so we spent a lot of

958
00:40:43,109 --> 00:40:41,619
time figuring out how to focus the

959
00:40:44,459 --> 00:40:43,119
system and how to manage all of these

960
00:40:46,769 --> 00:40:44,469
thermal unknowns that we weren't going

961
00:40:48,059 --> 00:40:46,779
to know until we got down to the you

962
00:40:49,890 --> 00:40:48,069
know to the ice and we're trying to

963
00:40:51,269 --> 00:40:49,900

trying it out so we needed a system that

964

00:40:53,549 --> 00:40:51,279

was pretty impervious to thermal at

965

00:40:56,219 --> 00:40:53,559

disturbances but the real doozy is that

966

00:40:58,469 --> 00:40:56,229

is the dynamic one so the problem of

967

00:41:00,120 --> 00:40:58,479

dynamic disturbances is especially when

968

00:41:01,620 --> 00:41:00,130

you go up on a balloon you're gonna have

969

00:41:02,819 --> 00:41:01,630

motors and other things that need to

970

00:41:04,140 --> 00:41:02,829

actuate because you're trying to move

971

00:41:05,999 --> 00:41:04,150

your telescope to point at different

972

00:41:07,769 --> 00:41:06,009

parts of the sky those things you bring

973

00:41:09,420 --> 00:41:07,779

with you actually cause a lot of

974

00:41:11,910 --> 00:41:09,430

disturbances especially high frequency

975

00:41:13,140 --> 00:41:11,920

ones and so you know your motor just

976

00:41:15,269 --> 00:41:13,150

like in your phone things kind of buzz

977

00:41:16,799 --> 00:41:15,279

and by vibrate those are disturbances

978

00:41:18,180 --> 00:41:16,809

from the environments under those motors

979

00:41:20,459 --> 00:41:18,190

and reaction noodles can really mess up

980

00:41:23,130 --> 00:41:20,469

a pointing system if if you don't take

981

00:41:25,319 --> 00:41:23,140

care of it so we did unstable is we

982

00:41:27,239 --> 00:41:25,329

developed we call a power spectral

983

00:41:28,499 --> 00:41:27,249

density function that told us what we

984

00:41:29,939 --> 00:41:28,509

needed to reject you can see over

985

00:41:31,680 --> 00:41:29,949

frequency we said there's these little

986

00:41:33,900 --> 00:41:31,690

spikes of things that we know are going

987

00:41:36,059 --> 00:41:33,910

to be on our system and might cause more

988

00:41:38,219 --> 00:41:36,069

energy going into our telescope than we

989

00:41:39,360 --> 00:41:38,229

really like so the idea here is that we

990

00:41:41,430 --> 00:41:39,370

we knew that this is what

991

00:41:43,110 --> 00:41:41,440

trying to reject and we built a control

992

00:41:44,970 --> 00:41:43,120

system to say at each of these

993

00:41:46,890 --> 00:41:44,980

frequencies be able to knock it down so

994

00:41:49,440 --> 00:41:46,900

that we had a really clear stable

995

00:41:50,820 --> 00:41:49,450

platform for taking pictures all right

996

00:41:52,470 --> 00:41:50,830

so let me show you a little bit about

997

00:41:54,150 --> 00:41:52,480

how we were gonna do this as a

998

00:41:56,100 --> 00:41:54,160

technology demonstration we were only

999

00:41:58,200 --> 00:41:56,110

gonna do this for one day the idea was

1000

00:41:59,850 --> 00:41:58,210

get up there so we can do it over one

1001
00:42:01,560 --> 00:41:59,860
night and once that's done we can

1002
00:42:02,940 --> 00:42:01,570
actually do a really long-term science

1003
00:42:05,160 --> 00:42:02,950
mission like the one in the Antarctic

1004
00:42:07,250 --> 00:42:05,170
that would allow you to do longer-term

1005
00:42:10,470 --> 00:42:07,260
observations this was just a tech demo

1006
00:42:13,320 --> 00:42:10,480
so the tech demo was that we'd take off

1007
00:42:15,990 --> 00:42:13,330
we'd go to float around 35 kilometers

1008
00:42:18,570 --> 00:42:16,000
and just for reference that's between

1009
00:42:21,090 --> 00:42:18,580
commercial airliners in Aurora so kind

1010
00:42:22,920 --> 00:42:21,100
of in that range we achieve our float

1011
00:42:25,020 --> 00:42:22,930
we'd be around 35 kilometers for the

1012
00:42:27,360 --> 00:42:25,030
eight hours overnight we do our

1013
00:42:29,490 --> 00:42:27,370

observations on various stars and then

1014

00:42:32,940 --> 00:42:29,500

at the end of the night we would release

1015

00:42:34,680 --> 00:42:32,950

and we would land and recover so that

1016

00:42:36,420 --> 00:42:34,690

was the idea and let's show you the

1017

00:42:38,820 --> 00:42:36,430

hardware that he had built to do it

1018

00:42:40,470 --> 00:42:38,830

so like I mentioned before this is the

1019

00:42:42,450 --> 00:42:40,480

tether to the telescope and this is the

1020

00:42:44,730 --> 00:42:42,460

gondola and the things that move the

1021

00:42:47,430 --> 00:42:44,740

gondola are there's one up here this is

1022

00:42:49,380 --> 00:42:47,440

actually a motor that allows you to to

1023

00:42:51,030 --> 00:42:49,390

pivot so you can kind of unwind the

1024

00:42:52,320 --> 00:42:51,040

string you could imagine that if you're

1025

00:42:54,300 --> 00:42:52,330

trying to take pictures being on a

1026

00:42:56,010 --> 00:42:54,310

Disney teacup ride is not the most

1027

00:42:58,380 --> 00:42:56,020

exciting parts that take pictures off of

1028

00:43:00,270 --> 00:42:58,390

so you have this thing here to unwind so

1029

00:43:01,740 --> 00:43:00,280

the the tether you also have this down

1030

00:43:03,600 --> 00:43:01,750

here it's a basically a reaction wheel

1031

00:43:05,340 --> 00:43:03,610

and uses conservation of momentum so

1032

00:43:06,570 --> 00:43:05,350

when it spins up one way you spin your

1033

00:43:09,240 --> 00:43:06,580

gondola the other way and this allows

1034

00:43:11,160 --> 00:43:09,250

you to move in asmath and actually see

1035

00:43:13,320 --> 00:43:11,170

different parts of the sky and then if

1036

00:43:14,700 --> 00:43:13,330

you peel back that gondola you can

1037

00:43:17,010 --> 00:43:14,710

actually see here so this is our

1038

00:43:19,830 --> 00:43:17,020

telescope and right here is where we

1039

00:43:22,200 --> 00:43:19,840

actually grab for elevation so this this

1040

00:43:23,580 --> 00:43:22,210

part here has a motor on it and it was

1041

00:43:24,960 --> 00:43:23,590

an elevation motor so you can connect up

1042

00:43:27,240 --> 00:43:24,970

ourselves up and down and actually see

1043

00:43:28,470 --> 00:43:27,250

different parts of the sky that way so

1044

00:43:31,320 --> 00:43:28,480

if you peel that back and you just get

1045

00:43:32,790 --> 00:43:31,330

the stable part stable here has looks

1046

00:43:35,700 --> 00:43:32,800

like this to give you some sense of

1047

00:43:39,060 --> 00:43:35,710

perspective this is about it a bad thing

1048

00:43:39,660 --> 00:43:39,070

so this is about as big as I am about as

1049

00:43:41,970 --> 00:43:39,670

tall as I am

1050

00:43:44,190 --> 00:43:41,980

it's a point six meter telescope and

1051
00:43:45,210 --> 00:43:44,200
what happens is the light comes in here

1052
00:43:47,880 --> 00:43:45,220
so we're looking at a star for example

1053
00:43:49,380 --> 00:43:47,890
it hits our primary mirror it goes into

1054
00:43:49,950 --> 00:43:49,390
this part here which is our secondary

1055
00:43:51,839 --> 00:43:49,960
mirror

1056
00:43:53,790 --> 00:43:51,849
and there's this kind of baffle here so

1057
00:43:55,140 --> 00:43:53,800
it goes into that hole and it gets

1058
00:43:57,540 --> 00:43:55,150
picked up by this fold mirror on the

1059
00:43:58,680 --> 00:43:57,550
back it gets reflected to our tilt

1060
00:44:00,480 --> 00:43:58,690
mirror I'll show you that in a second

1061
00:44:02,190 --> 00:44:00,490
and onto the camera and so the camera is

1062
00:44:04,230 --> 00:44:02,200
what actually takes the images and we

1063
00:44:06,359 --> 00:44:04,240

use that to sense right and say oh if

1064

00:44:08,640 --> 00:44:06,369

our spot is drifting off of a pixel too

1065

00:44:10,079 --> 00:44:08,650

much then we've we need to correct for

1066

00:44:12,870 --> 00:44:10,089

it and so we'll tip a mirror to tip it

1067

00:44:14,070 --> 00:44:12,880

back on to the pixels we wanted so kind

1068

00:44:15,810 --> 00:44:14,080

of show you we broke it up into two

1069

00:44:17,130 --> 00:44:15,820

parts so the telescope part was the the

1070

00:44:18,480 --> 00:44:17,140

front end of the optical part and the

1071

00:44:20,550 --> 00:44:18,490

optical bench is assembly was on the

1072

00:44:22,109 --> 00:44:20,560

back so again the telescope was a

1073

00:44:24,030 --> 00:44:22,119

primary rapport point of this telescope

1074

00:44:26,099 --> 00:44:24,040

was to actually get the star light onto

1075

00:44:27,870 --> 00:44:26,109

our the back end and the back end here

1076

00:44:31,380 --> 00:44:27,880

the point was to actually get that light

1077

00:44:33,510 --> 00:44:31,390

back into the TEL into the camera and do

1078

00:44:34,650 --> 00:44:33,520

the control system and kind of brains of

1079

00:44:36,839 --> 00:44:34,660

the operation to make sure that we're

1080

00:44:38,640 --> 00:44:36,849

doing the control system properly so the

1081

00:44:40,500 --> 00:44:38,650

parts of Stables technology that are

1082

00:44:43,050 --> 00:44:40,510

really relevant actually lived here on

1083

00:44:44,370 --> 00:44:43,060

the back on the optical bench assembly

1084

00:44:45,870 --> 00:44:44,380

so this is the part that faces the

1085

00:44:48,270 --> 00:44:45,880

telescope and this is the part you can

1086

00:44:50,089 --> 00:44:48,280

see from the back of it and so the main

1087

00:44:52,470 --> 00:44:50,099

parts of the control system we had two

1088

00:44:54,810 --> 00:44:52,480

computers so there was a computer

1089

00:44:57,270 --> 00:44:54,820

dedicated just to managing the data off

1090

00:44:58,680 --> 00:44:57,280

of the camera itself and that data that

1091

00:44:59,790 --> 00:44:58,690

came off the camera was again we're

1092

00:45:01,380 --> 00:44:59,800

really trying to centroid it we're

1093

00:45:03,690 --> 00:45:01,390

saying okay the spot is we're on our

1094

00:45:05,160 --> 00:45:03,700

detector and where's the center of that

1095

00:45:06,570 --> 00:45:05,170

spot and so once we knew the center of

1096

00:45:08,460 --> 00:45:06,580

that spot we could cut a track how it

1097

00:45:10,770 --> 00:45:08,470

was drifting over time and correct for

1098

00:45:12,839 --> 00:45:10,780

it in our computer so this is the brains

1099

00:45:14,700 --> 00:45:12,849

of the operation so our C and E HR

1100

00:45:16,620 --> 00:45:14,710

commanded data handling assembly

1101
00:45:18,510 --> 00:45:16,630
actually did made the decisions it

1102
00:45:20,010 --> 00:45:18,520
looked at all the sensor data and then

1103
00:45:21,570 --> 00:45:20,020
it actually sent commands out to our

1104
00:45:24,810 --> 00:45:21,580
actuators to make sure that we corrected

1105
00:45:26,790 --> 00:45:24,820
for it and then here our sensors so this

1106
00:45:28,760 --> 00:45:26,800
is an attitude rate sensor it's like the

1107
00:45:31,530 --> 00:45:28,770
gyro and your phone except way better

1108
00:45:33,660 --> 00:45:31,540
the fine guidance camera here is that

1109
00:45:34,890 --> 00:45:33,670
from the University of Durham and it's

1110
00:45:36,270 --> 00:45:34,900
basically an optical camera that we

1111
00:45:38,790 --> 00:45:36,280
characterize so that we could get the

1112
00:45:40,440 --> 00:45:38,800
Sun charting data and then our actuators

1113
00:45:42,000 --> 00:45:40,450

we had a refocusing stage so this

1114

00:45:44,609 --> 00:45:42,010

basically moved the camera back and

1115

00:45:46,800 --> 00:45:44,619

forth along the optical path so we could

1116

00:45:48,720 --> 00:45:46,810

actually focus off across a bunch of

1117

00:45:49,829 --> 00:45:48,730

different thermal conditions and then we

1118

00:45:51,150 --> 00:45:49,839

had a fast steering mirror which

1119

00:45:53,310 --> 00:45:51,160

basically has a little mirror on the end

1120

00:45:55,950 --> 00:45:53,320

here and it tips and tilted it very fine

1121

00:45:57,990 --> 00:45:55,960

and high-frequency motions so that when

1122

00:45:59,790 --> 00:45:58,000

the the computer realized that we were

1123

00:46:03,359 --> 00:45:59,800

drifting off too much it would correct

1124

00:46:03,770 --> 00:46:03,369

for it using this thing okay so how do

1125

00:46:05,090 --> 00:46:03,780

we know

1126
00:46:06,350 --> 00:46:05,100
it were so we put all the technology

1127
00:46:06,830 --> 00:46:06,360
together we have this system it was

1128
00:46:08,750 --> 00:46:06,840
great

1129
00:46:10,070 --> 00:46:08,760
so we actually built it up in the lab so

1130
00:46:12,770 --> 00:46:10,080
this is actually here at the MEC lab in

1131
00:46:14,420 --> 00:46:12,780
JPL and here's our bench assembly you're

1132
00:46:15,740 --> 00:46:14,430
looking at the fold mirror here and the

1133
00:46:17,630 --> 00:46:15,750
way that we tested it in the passive

1134
00:46:19,040 --> 00:46:17,640
system as we said okay we're gonna give

1135
00:46:21,050 --> 00:46:19,050
it a light source so this is an optical

1136
00:46:22,940 --> 00:46:21,060
bench we put a light source here and

1137
00:46:25,220 --> 00:46:22,950
shown it on to it like a fake star

1138
00:46:27,350 --> 00:46:25,230

coming through our telescope and then we

1139

00:46:29,240 --> 00:46:27,360

just let the California seismic

1140

00:46:31,460 --> 00:46:29,250

environment do its job and so if we

1141

00:46:33,440 --> 00:46:31,470

actually could reject our ambient and so

1142

00:46:35,150 --> 00:46:33,450

what happens is that it worked

1143

00:46:38,360 --> 00:46:35,160

we're like okay we can reject noise

1144

00:46:39,650 --> 00:46:38,370

great so we have that and then we

1145

00:46:40,790 --> 00:46:39,660

actually decided let's see if we can

1146

00:46:43,550 --> 00:46:40,800

make this a little harder for ourselves

1147

00:46:45,020 --> 00:46:43,560

and we put a little stinger up here and

1148

00:46:46,250 --> 00:46:45,030

when a stinger is basically just a poker

1149

00:46:47,960 --> 00:46:46,260

I think of like a three all

1150

00:46:49,970 --> 00:46:47,970

three-year-old kind of poking poking

1151
00:46:52,220 --> 00:46:49,980
poking so what we did here is we had

1152
00:46:53,930 --> 00:46:52,230
again a light source and an optical

1153
00:46:55,250 --> 00:46:53,940
table but this time we actually poked it

1154
00:46:56,990 --> 00:46:55,260
at specific frequencies I showed you

1155
00:46:58,190 --> 00:46:57,000
those little spikes and our PSD we

1156
00:46:59,780 --> 00:46:58,200
wanted to know could be rejected the

1157
00:47:00,980 --> 00:46:59,790
frequencies we were worried about and so

1158
00:47:02,690 --> 00:47:00,990
what we showed here is that it worked

1159
00:47:03,770 --> 00:47:02,700
I'm not going to go into all the details

1160
00:47:05,060 --> 00:47:03,780
I don't have enough time but there's a

1161
00:47:07,970 --> 00:47:05,070
really cool paper you should definitely

1162
00:47:09,680 --> 00:47:07,980
go read talks all about it so that being

1163
00:47:11,690 --> 00:47:09,690

said this isn't a lab environment

1164

00:47:13,130 --> 00:47:11,700

everything is like and the environment

1165

00:47:15,170 --> 00:47:13,140

for temperature we don't have to worry

1166

00:47:16,610 --> 00:47:15,180

about all the excitement's of you know

1167

00:47:18,260 --> 00:47:16,620

putting things together in the Antarctic

1168

00:47:20,360 --> 00:47:18,270

so how do we know it's going to work

1169

00:47:21,530 --> 00:47:20,370

when we actually get to flow so the way

1170

00:47:23,330 --> 00:47:21,540

that we did that it was we had an

1171

00:47:25,310 --> 00:47:23,340

analytical analysis we call this a stop

1172

00:47:26,900 --> 00:47:25,320

analysis which goes through each phase

1173

00:47:28,760 --> 00:47:26,910

of the different parts of the system and

1174

00:47:30,290 --> 00:47:28,770

make sure that at the end we're gonna

1175

00:47:32,330 --> 00:47:30,300

get the right answer so the way that

1176

00:47:34,160 --> 00:47:32,340

works is that we had a thorough analysis

1177

00:47:35,390 --> 00:47:34,170

first so we basically went out and

1178

00:47:37,190 --> 00:47:35,400

looked at all the different environments

1179

00:47:38,480 --> 00:47:37,200

we might see when we route flow we put

1180

00:47:39,560 --> 00:47:38,490

them together and did some statistics on

1181

00:47:41,750 --> 00:47:39,570

it figured out what that would look like

1182

00:47:43,610 --> 00:47:41,760

and that actually told us okay how is

1183

00:47:45,140 --> 00:47:43,620

this thing gonna be you know are mirrors

1184

00:47:47,450 --> 00:47:45,150

gonna be at this temperature aren't our

1185

00:47:49,550 --> 00:47:47,460

systems gonna have various temperatures

1186

00:47:51,110 --> 00:47:49,560

across the gradients here once we had

1187

00:47:52,850 --> 00:47:51,120

that we passed it over to the structures

1188

00:47:54,470 --> 00:47:52,860

guys and the structure people took that

1189

00:47:55,760 --> 00:47:54,480

and said okay if it shrinks by this much

1190

00:47:57,110 --> 00:47:55,770

and it moves by this much this is how

1191

00:47:59,300 --> 00:47:57,120

everything's gonna move relative to each

1192

00:48:01,070 --> 00:47:59,310

other once you know that you can pass it

1193

00:48:02,900 --> 00:48:01,080

over to the optics guys who say okay now

1194

00:48:04,580 --> 00:48:02,910

my mirrors are now spaced this way

1195

00:48:05,990 --> 00:48:04,590

instead of this way and they can

1196

00:48:07,760 --> 00:48:06,000

actually tell you what the quality of

1197

00:48:09,410 --> 00:48:07,770

that light spot is gonna look like on

1198

00:48:10,640 --> 00:48:09,420

your detector once you know what that

1199

00:48:12,020 --> 00:48:10,650

quality is your light spot looks like

1200

00:48:13,640 --> 00:48:12,030

you hand it over to the controls people

1201
00:48:15,680 --> 00:48:13,650
and say hey controls people here's the

1202
00:48:17,059 --> 00:48:15,690
spot you get what is it going to do so

1203
00:48:19,549 --> 00:48:17,069
the controls folks also take all

1204
00:48:21,019 --> 00:48:19,559
disturbances from the environment timing

1205
00:48:23,059 --> 00:48:21,029
frequencies information about the

1206
00:48:25,099 --> 00:48:23,069
computer and the control system timing

1207
00:48:26,390 --> 00:48:25,109
and they do some analysis to show what

1208
00:48:28,400 --> 00:48:26,400
the answer is and that gives us our

1209
00:48:30,620 --> 00:48:28,410
predicted at point point at flow

1210
00:48:32,479 --> 00:48:30,630
pointing performance so we did all this

1211
00:48:35,390 --> 00:48:32,489
I know they're really cool paper you

1212
00:48:37,069 --> 00:48:35,400
should definitely go read so we actually

1213
00:48:38,569 --> 00:48:37,079

found out that we at our worst case

1214

00:48:40,400 --> 00:48:38,579

scenario got ninety four point five

1215

00:48:43,099 --> 00:48:40,410

million seconds over sixty seconds if

1216

00:48:44,209 --> 00:48:43,109

you fell asleep it's a hundred million

1217

00:48:46,099 --> 00:48:44,219

arc seconds and what we were going for

1218

00:48:47,179 --> 00:48:46,109

so we actually were able to prove that

1219

00:48:48,829 --> 00:48:47,189

even in the worst case we're gonna

1220

00:48:50,689 --> 00:48:48,839

achieve the Poynting that we expected

1221

00:48:52,189 --> 00:48:50,699

which is fantastic we're like hey this

1222

00:48:54,309 --> 00:48:52,199

technology is great if we're gonna get

1223

00:48:56,870 --> 00:48:54,319

great astronomy out of it so

1224

00:48:58,849 --> 00:48:56,880

unfortunately we lost our flight

1225

00:49:02,719 --> 00:48:58,859

opportunity and so this is about as far

1226

00:49:05,509 --> 00:49:02,729

off the ground as a stable guy so our

1227

00:49:07,640 --> 00:49:05,519

beautiful telescopes under here and it

1228

00:49:08,630 --> 00:49:07,650

ended up in an Indiana Jones warehouse

1229

00:49:11,719 --> 00:49:08,640

next to the Ark of the Covenant

1230

00:49:13,579 --> 00:49:11,729

somewhere so so that's where it's table

1231

00:49:15,169 --> 00:49:13,589

is right now that thing said that's not

1232

00:49:16,339 --> 00:49:15,179

the end of the story you know the cool

1233

00:49:18,289 --> 00:49:16,349

thing about engineering is that you

1234

00:49:20,809 --> 00:49:18,299

learn things even if you don't really go

1235

00:49:22,880 --> 00:49:20,819

out and fly so one of the things that we

1236

00:49:24,349 --> 00:49:22,890

were able to do is that our partners at

1237

00:49:25,759 --> 00:49:24,359

the University of Toronto kept pushing

1238

00:49:27,620 --> 00:49:25,769

this technology they went out and

1239

00:49:30,049 --> 00:49:27,630

actually built a mission called super

1240

00:49:31,789 --> 00:49:30,059

bit and super bit went and took this

1241

00:49:34,699 --> 00:49:31,799

absolutely beautiful picture of the

1242

00:49:36,319 --> 00:49:34,709

Eagle Nebula and this is about 600

1243

00:49:38,059 --> 00:49:36,329

milliseconds if you can imagine doing

1244

00:49:38,929 --> 00:49:38,069

like six times better it even gets

1245

00:49:41,449 --> 00:49:38,939

better from there

1246

00:49:43,069 --> 00:49:41,459

so this is so so we knew the technology

1247

00:49:45,439 --> 00:49:43,079

worked and our partners were able to go

1248

00:49:47,959 --> 00:49:45,449

on and actually show it was able to make

1249

00:49:49,549 --> 00:49:47,969

the job the other thing that we got out

1250

00:49:52,399 --> 00:49:49,559

of this was actually team training so

1251
00:49:53,029 --> 00:49:52,409
the staples legacy is that we were all

1252
00:49:55,069 --> 00:49:53,039
actually

1253
00:49:57,349 --> 00:49:55,079
everyone in this picture was on the team

1254
00:49:59,599 --> 00:49:57,359
and every one of us had been out of

1255
00:50:01,489 --> 00:49:59,609
school for less than three years so this

1256
00:50:03,169 --> 00:50:01,499
was actually built as a project at JPL

1257
00:50:05,569 --> 00:50:03,179
to train us and under help us understand

1258
00:50:07,819 --> 00:50:05,579
all the intricacies of how teaming works

1259
00:50:10,399 --> 00:50:07,829
and how engineering works at JPL so you

1260
00:50:12,109 --> 00:50:10,409
can see we got exposures and in the

1261
00:50:14,689 --> 00:50:12,119
admission in about three years and so

1262
00:50:16,489 --> 00:50:14,699
those three years at JPL is really small

1263
00:50:18,559 --> 00:50:16,499

scale and I'm on Europa clipper now

1264

00:50:19,759 --> 00:50:18,569

which is decades long so being able to

1265

00:50:21,799 --> 00:50:19,769

see something like that in three years

1266

00:50:24,559 --> 00:50:21,809

it's really an exciting opportunity for

1267

00:50:26,599 --> 00:50:24,569

teams and gives you a much higher dose

1268

00:50:29,990 --> 00:50:26,609

of what it means to be an engineer in

1269

00:50:31,820 --> 00:50:30,000

this kind of team we also had a lot more

1270

00:50:33,410 --> 00:50:31,830

to interface with hardware you see we're

1271

00:50:35,420 --> 00:50:33,420

all standing around our flight hardware

1272

00:50:36,710 --> 00:50:35,430

here everyone got a chance to touch it

1273

00:50:38,330 --> 00:50:36,720

we all got a chance to get in there and

1274

00:50:39,500 --> 00:50:38,340

see what it meant you know when we

1275

00:50:40,820 --> 00:50:39,510

designed something on the white board

1276

00:50:41,990 --> 00:50:40,830

what does it mean when we actually have

1277

00:50:43,730 --> 00:50:42,000

to plug it in and so that was a really

1278

00:50:45,980 --> 00:50:43,740

op excellent opportunity for us and

1279

00:50:47,630 --> 00:50:45,990

because the risks were a lot lower on

1280

00:50:48,980 --> 00:50:47,640

something that's only a five million

1281

00:50:50,420 --> 00:50:48,990

dollar mission instead of hundreds of

1282

00:50:51,560 --> 00:50:50,430

millions of dollars we had a chance to

1283

00:50:53,960 --> 00:50:51,570

actually get in there and really try

1284

00:50:54,680 --> 00:50:53,970

things out and for me in particular so

1285

00:50:56,540 --> 00:50:54,690

here I am

1286

00:50:58,460 --> 00:50:56,550

I was the project systems engineer on

1287

00:51:00,470 --> 00:50:58,470

this mission and a project systems

1288

00:51:03,710 --> 00:51:00,480

engineer is responsible for everything

1289

00:51:05,540 --> 00:51:03,720

that no one else thought of and smorc so

1290

00:51:08,150 --> 00:51:05,550

for example one of the my tasks was to

1291

00:51:09,770 --> 00:51:08,160

figure out if we had a treaty agreement

1292

00:51:10,790 --> 00:51:09,780

with Canada to ensure that our balloon

1293

00:51:16,220 --> 00:51:10,800

was not going to land on a world

1294

00:51:17,600 --> 00:51:16,230

heritage site so so all these little

1295

00:51:18,920 --> 00:51:17,610

things that have to get put together to

1296

00:51:20,360 --> 00:51:18,930

make sure that the thing works it was a

1297

00:51:23,780 --> 00:51:20,370

really excellent opportunity to see that

1298

00:51:25,910 --> 00:51:23,790

in fact here's some pictures again of me

1299

00:51:27,860 --> 00:51:25,920

and here's the the truth of the matter

1300

00:51:29,180 --> 00:51:27,870

is that all the cool Antarctic pictures

1301

00:51:31,160 --> 00:51:29,190

you know are in that four week time

1302

00:51:32,510 --> 00:51:31,170

period all of the years that will add up

1303

00:51:33,950 --> 00:51:32,520

to it are mostly in conference rooms

1304

00:51:36,230 --> 00:51:33,960

like this where you're drawing things on

1305

00:51:37,580 --> 00:51:36,240

a board and every every engineer from

1306

00:51:39,320 --> 00:51:37,590

different subsystems are all standing

1307

00:51:40,790 --> 00:51:39,330

together and the systems engineers on

1308

00:51:42,710 --> 00:51:40,800

the board is like all right guys you got

1309

00:51:44,810 --> 00:51:42,720

to tell me when this signal goes to here

1310

00:51:46,340 --> 00:51:44,820

who picks it up you do what happens next

1311

00:51:48,650 --> 00:51:46,350

then we kind of draw it out it all comes

1312

00:51:50,210 --> 00:51:48,660

together in you know a whiteboard or in

1313

00:51:52,220 --> 00:51:50,220

a conference room and the really cool

1314

00:51:53,930 --> 00:51:52,230

thing about balloons is that you

1315

00:51:55,730 --> 00:51:53,940

actually get to go then build it and see

1316

00:51:57,320 --> 00:51:55,740

it and actually be the one to implement

1317

00:51:59,120 --> 00:51:57,330

it and so that's one of the real magics

1318

00:52:01,700 --> 00:51:59,130

of these type of team is that you know I

1319

00:52:04,430 --> 00:52:01,710

got to be here and here in the span of

1320

00:52:06,740 --> 00:52:04,440

just three years so three years later

1321

00:52:09,950 --> 00:52:06,750

where did this end up so it's a stable

1322

00:52:12,140 --> 00:52:09,960

is still in a beautiful warehouse but

1323

00:52:14,090 --> 00:52:12,150

but it really did have lasting benefits

1324

00:52:15,470 --> 00:52:14,100

so for me for instance I'm actually now

1325

00:52:17,480 --> 00:52:15,480

on the Europa clipper mission where I'm

1326

00:52:19,370 --> 00:52:17,490

a systems engineer and I'll tell you

1327

00:52:21,470 --> 00:52:19,380

this is the Europe a clipper project

1328

00:52:23,810 --> 00:52:21,480

science group and I'm one of a much

1329

00:52:25,370 --> 00:52:23,820

bigger team now and so being able to

1330

00:52:27,140 --> 00:52:25,380

understand how all of these interfaces

1331

00:52:28,790 --> 00:52:27,150

work together is a really big part of

1332

00:52:30,380 --> 00:52:28,800

why I feel like I can actually be in a

1333

00:52:32,180 --> 00:52:30,390

team that's big and still be able to

1334

00:52:33,770 --> 00:52:32,190

communicate across all these people so

1335

00:52:35,180 --> 00:52:33,780

it's a really excellent opportunity and

1336

00:52:36,710 --> 00:52:35,190

so now we're actually building a

1337

00:52:38,510 --> 00:52:36,720

spacecraft that's going to go explore

1338

00:52:40,700 --> 00:52:38,520

the habit or habitability of one of the

1339

00:52:42,560 --> 00:52:40,710

icy moons of Jupiter and to me that

1340

00:52:43,640 --> 00:52:42,570

that's exciting if that's not exciting I

1341

00:52:46,670 --> 00:52:43,650

don't know what excites you

1342

00:52:48,230 --> 00:52:46,680

so so the thing that's really cool

1343

00:52:50,780 --> 00:52:48,240

though is that it doesn't actually have

1344

00:52:52,700 --> 00:52:50,790

to be at JPL JPL was my first

1345

00:52:53,810 --> 00:52:52,710

introduction to JPL was this mission but

1346

00:52:55,970 --> 00:52:53,820

it was also my first introduction to

1347

00:52:57,980 --> 00:52:55,980

NASA was was ballooning so my very first

1348

00:52:59,630 --> 00:52:57,990

internship in 2005 was at Wallops Flight

1349

00:53:01,520 --> 00:52:59,640

Facility where they actually have a

1350

00:53:04,340 --> 00:53:01,530

large balloon program there and so the

1351
00:53:06,620 --> 00:53:04,350
balloon program office has this balloon

1352
00:53:08,920 --> 00:53:06,630
making lab and so my internship project

1353
00:53:11,570 --> 00:53:08,930
my very first internship at NASA was

1354
00:53:13,820 --> 00:53:11,580
designing and building these balloons in

1355
00:53:15,230 --> 00:53:13,830
their lab and actually coming up with

1356
00:53:17,900 --> 00:53:15,240
different ways to fold and pack it so

1357
00:53:20,960 --> 00:53:17,910
that we could see inflation dynamics so

1358
00:53:22,130 --> 00:53:20,970
here I am with my design balloons and I

1359
00:53:23,530 --> 00:53:22,140
came up with some different packing

1360
00:53:26,360 --> 00:53:23,540
techniques using parachute packing

1361
00:53:28,580 --> 00:53:26,370
approaches and we packed it into the

1362
00:53:30,680 --> 00:53:28,590
back of a little rocket nose cone that

1363
00:53:31,520 --> 00:53:30,690

we put on the back of this nineteen

1364

00:53:35,120 --> 00:53:31,530

seventies NASA

1365

00:53:36,800 --> 00:53:35,130

pickup truck and what happened is we we

1366

00:53:39,020 --> 00:53:36,810

actually flew data we drove down the

1367

00:53:40,190 --> 00:53:39,030

road and this parachute would pick up at

1368

00:53:41,870 --> 00:53:40,200

the right speed and it would actually

1369

00:53:43,520 --> 00:53:41,880

pull this thing off the back you can

1370

00:53:44,960 --> 00:53:43,530

kind of see it landing here the balloon

1371

00:53:46,730 --> 00:53:44,970

would pop out and we'd study the

1372

00:53:48,350 --> 00:53:46,740

inflation dynamics as we were driving

1373

00:53:49,970 --> 00:53:48,360

down the road and saw how different

1374

00:53:51,520 --> 00:53:49,980

packing techniques affected the

1375

00:53:54,620 --> 00:53:51,530

inflation time and things like that so

1376

00:53:56,120 --> 00:53:54,630

again I mean this is the the really you

1377

00:53:58,070 --> 00:53:56,130

know cut your teeth on engineering

1378

00:54:01,070 --> 00:53:58,080

dumpster-diving shopping at the Pocomoke

1379

00:54:02,120 --> 00:54:01,080

City Walmart for four components kind of

1380

00:54:03,560 --> 00:54:02,130

engineering that you don't really get a

1381

00:54:05,990 --> 00:54:03,570

chance to see it kind of harkens back to

1382

00:54:07,460 --> 00:54:06,000

the early days of rocketry and whatnot

1383

00:54:09,050 --> 00:54:07,470

where everyone was just trying to figure

1384

00:54:10,370 --> 00:54:09,060

it out and so a lot of that still

1385

00:54:12,320 --> 00:54:10,380

happens in ballooning which makes it

1386

00:54:13,550 --> 00:54:12,330

that kind of guerilla atmosphere where

1387

00:54:16,670 --> 00:54:13,560

everyone's just like let's make it work

1388

00:54:17,690 --> 00:54:16,680

and you're all in it together the cool

1389

00:54:19,610 --> 00:54:17,700

thing about that was that we were

1390

00:54:22,220 --> 00:54:19,620

actually studying my intern project was

1391

00:54:23,570 --> 00:54:22,230

studying what this inflation dynamics

1392

00:54:25,220 --> 00:54:23,580

because they wanted to put this on Mars

1393

00:54:26,930 --> 00:54:25,230

the idea is that if you had a parachute

1394

00:54:28,430 --> 00:54:26,940

and you could decelerate a drop a heat

1395

00:54:30,740 --> 00:54:28,440

shield actually inflate with the

1396

00:54:32,780 --> 00:54:30,750

atmosphere as you were coming down and

1397

00:54:34,160 --> 00:54:32,790

then the envelope itself could be

1398

00:54:35,930 --> 00:54:34,170

painted in such a way that it would warm

1399

00:54:37,310 --> 00:54:35,940

up the atmosphere that was in trapped

1400

00:54:38,810 --> 00:54:37,320

inside the balloon and it kind of create

1401
00:54:40,940 --> 00:54:38,820
like a hot air balloon that could go

1402
00:54:42,830 --> 00:54:40,950
down and sample some things so I took

1403
00:54:44,780 --> 00:54:42,840
this for my intern presentation in 2005

1404
00:54:46,520 --> 00:54:44,790
and I was looking around on the the

1405
00:54:50,000 --> 00:54:46,530
balloon program website and found this

1406
00:54:51,470 --> 00:54:50,010
in it ten years later so they're still

1407
00:54:52,910 --> 00:54:51,480
looking concepts like this the really

1408
00:54:54,560 --> 00:54:52,920
cool thing is the balloons you know are

1409
00:54:56,240 --> 00:54:54,570
a great way to study what we do here on

1410
00:54:56,990 --> 00:54:56,250
earth but we're looking at ways to

1411
00:55:00,260 --> 00:54:57,000
explore the

1412
00:55:01,790 --> 00:55:00,270
as a platform even further out so if you

1413
00:55:03,320 --> 00:55:01,800

look at it I mean it's got a lot of cool

1414

00:55:05,890 --> 00:55:03,330

advantages now if you were talking about

1415

00:55:08,300 --> 00:55:05,900

balloons on Mars well if you have a

1416

00:55:10,190 --> 00:55:08,310

rover which is excellent we love the

1417

00:55:12,050 --> 00:55:10,200

Rovers but a balloon allows you to cover

1418

00:55:14,420 --> 00:55:12,060

more horizontal distance you can revisit

1419

00:55:16,310 --> 00:55:14,430

locations over time you get more diverse

1420

00:55:17,660 --> 00:55:16,320

coverage of regions perhaps because you

1421

00:55:19,190 --> 00:55:17,670

get a little bit you don't have to worry

1422

00:55:21,020 --> 00:55:19,200

about topography or wheels or something

1423

00:55:22,099 --> 00:55:21,030

like that and then compared to some of

1424

00:55:23,510 --> 00:55:22,109

your orbiters you can also get higher

1425

00:55:25,160 --> 00:55:23,520

resolution you're a little closer to the

1426

00:55:26,960 --> 00:55:25,170

surface and it's one of the only ways to

1427

00:55:28,370 --> 00:55:26,970

actually get information along that

1428

00:55:30,170 --> 00:55:28,380

vertical column and so it's a really

1429

00:55:33,710 --> 00:55:30,180

exciting way to add to our understanding

1430

00:55:35,180 --> 00:55:33,720

of some of these planets so blue

1431

00:55:36,680 --> 00:55:35,190

missions to kind of summarize all of

1432

00:55:38,780 --> 00:55:36,690

this talk so that both Jose and I did

1433

00:55:41,000 --> 00:55:38,790

they're really valuable contributors to

1434

00:55:42,290 --> 00:55:41,010

NASA's mission both to pioneer the

1435

00:55:44,150 --> 00:55:42,300

future and space exploration for

1436

00:55:47,200 --> 00:55:44,160

scientific discovery whether we're doing

1437

00:55:50,390 --> 00:55:47,210

them on Earth's Mars Venus Titan someday

1438

00:55:52,370 --> 00:55:50,400

it's a really valuable way of taking

1439

00:55:53,900 --> 00:55:52,380

information training teams getting the

1440

00:55:56,030 --> 00:55:53,910

technology and getting the science out

1441

00:55:57,500 --> 00:55:56,040

of it and as I mentioned before it's

1442

00:55:59,510 --> 00:55:57,510

also really important for training us

1443

00:56:00,930 --> 00:55:59,520

this next generation of explorers so

1444

00:56:13,670 --> 00:56:00,940

with that thank you so much

1445

00:56:16,009 --> 00:56:13,680

[Applause]

1446

00:56:17,870 --> 00:56:16,019

thank you folks and wonderful job from

1447

00:56:19,670 --> 00:56:17,880

our speakers here we are gonna open it

1448

00:56:21,470 --> 00:56:19,680

up for questions now now if you're here

1449

00:56:24,200 --> 00:56:21,480

in the house we do have a microphone

1450

00:56:26,599 --> 00:56:24,210

right there in that center aisle go

1451

00:56:29,960 --> 00:56:26,609

ahead and line up there you can ask your

1452

00:56:32,569 --> 00:56:29,970

questions they will happily repeat the

1453

00:56:34,700 --> 00:56:32,579

question so everybody can hear it and if

1454

00:56:36,170 --> 00:56:34,710

you're watching home online please type

1455

00:56:39,019 --> 00:56:36,180

those questions in and we'll bring them

1456

00:56:40,190 --> 00:56:39,029

up and try to get them on so questions

1457

00:56:42,200 --> 00:56:40,200

please take it away

1458

00:56:46,130 --> 00:56:42,210

there we go somebody's working their way

1459

00:56:48,259 --> 00:56:46,140

up there well I noticed we didn't talk

1460

00:56:51,680 --> 00:56:48,269

much about the materials are the Blues

1461

00:56:53,359 --> 00:56:51,690

mylar is element hydrogen used is there

1462

00:56:55,130 --> 00:56:53,369

a prosody factor do you need to

1463

00:56:59,480 --> 00:56:55,140

regenerate if there's a porosity factor

1464

00:57:02,660 --> 00:56:59,490

that stuff what do you get it's not the

1465

00:57:04,999 --> 00:57:02,670

screen back there anymore and one of the

1466

00:57:06,589 --> 00:57:05,009

website you can actually have all the

1467

00:57:08,269 --> 00:57:06,599

there are different types of balloon

1468

00:57:10,490 --> 00:57:08,279

that nASA has depends on the duration

1469

00:57:12,799 --> 00:57:10,500

everything you can have all the specific

1470

00:57:16,370 --> 00:57:12,809

details and they're online you go on and

1471

00:57:19,519 --> 00:57:16,380

check did you use hydrogen helium helium

1472

00:57:23,809 --> 00:57:19,529

okay is there a porosity factor do the

1473

00:57:26,779 --> 00:57:23,819

balloons leak acidic and Ziggler bid

1474

00:57:28,670 --> 00:57:26,789

that they have it all figure out so

1475

00:57:31,009 --> 00:57:28,680

basically in Montez it for example for

1476

00:57:32,359 --> 00:57:31,019

our case it has some ballast so I didn't

1477

00:57:34,339 --> 00:57:32,369

lose this pressure with the fly you can

1478

00:57:35,870 --> 00:57:34,349

you can maintain altitude drop in some

1479

00:57:38,509 --> 00:57:35,880

ballast but there are the balloons that

1480

00:57:39,769 --> 00:57:38,519

are a different different system that

1481

00:57:41,150 --> 00:57:39,779

they can maintain altitude and go

1482

00:57:44,029 --> 00:57:41,160

through the United cycles and NASA's

1483

00:57:46,819 --> 00:57:44,039

testing right now so used ballast rather

1484

00:57:49,569 --> 00:57:46,829

than bringing more helium along - yeah

1485

00:57:51,920 --> 00:57:49,579

for that is basic along we're using I

1486

00:57:53,900 --> 00:57:51,930

also mentioned that when I was at

1487

00:57:56,029 --> 00:57:53,910

Wallops I was looking at some of they

1488

00:57:58,339 --> 00:57:56,039

have balloon materials labs there and

1489

00:57:59,930 --> 00:57:58,349

they were working on prototype materials

1490

00:58:01,460 --> 00:57:59,940

for balloons for Venus because obviously

1491

00:58:02,569 --> 00:58:01,470

Venus is a very different environment

1492

00:58:03,710 --> 00:58:02,579

and you don't want to put a you know a

1493

00:58:05,749 --> 00:58:03,720

piece of plastic that's gonna just

1494

00:58:08,180 --> 00:58:05,759

disintegrate so they were actually

1495

00:58:10,430 --> 00:58:08,190

looking at a mylar laminate with Kevlar

1496

00:58:12,890 --> 00:58:10,440

on it I believe as one of the envelope

1497

00:58:19,730 --> 00:58:12,900

materials so it's gonna depend on where

1498

00:58:22,580 --> 00:58:19,740

you go interesting thank you I noticed

1499

00:58:25,220 --> 00:58:22,590

that you did use helium now I realized

1500

00:58:27,620 --> 00:58:25,230

that it won't explode like hydrogen will

1501

00:58:29,630 --> 00:58:27,630

but hydrogen seems to have a lot of

1502

00:58:36,400 --> 00:58:29,640

other advantages what was the main

1503

00:58:42,590 --> 00:58:39,560

for instance hydrogen gives you more

1504

00:58:49,100 --> 00:58:42,600

lift and I assume you can do things

1505

00:58:50,840 --> 00:58:49,110

safely so it won't explode you have

1506

00:58:52,640 --> 00:58:50,850

again to go to the balloon program

1507

00:58:55,790 --> 00:58:52,650

office and probably they have a lot of

1508

00:58:57,500 --> 00:58:55,800

information about how NASA is that we

1509

00:59:01,280 --> 00:58:57,510

were working mostly in the payload but

1510

00:59:02,840 --> 00:59:01,290

NASA the balloon office works on the

1511

00:59:05,540 --> 00:59:02,850

balloons and you know separate they have

1512

00:59:07,160 --> 00:59:05,550

all these different but one so I'm sure

1513

00:59:08,020 --> 00:59:07,170

that all the informations you can find

1514

00:59:10,820 --> 00:59:08,030

it online on there

1515

00:59:13,070 --> 00:59:10,830

thank you speculate they're trying to

1516

00:59:14,630 --> 00:59:13,080

get you know just his payload down to

1517

00:59:16,760 --> 00:59:14,640

Antarctica was quite a multi-step

1518

00:59:18,170 --> 00:59:16,770

journey with things on boats for a long

1519

00:59:21,109 --> 00:59:18,180

time so even if you can work with

1520

00:59:23,600 --> 00:59:21,119

hydrogen when you're out there you the

1521

00:59:25,220 --> 00:59:23,610

the cost of having an accident of some

1522

00:59:33,640 --> 00:59:25,230

kind is probably a lot higher so you

1523

00:59:40,160 --> 00:59:37,040

how do you control the flight the

1524

00:59:44,720 --> 00:59:40,170

elevation the position we saw it goes

1525

00:59:47,240 --> 00:59:44,730

around and related question why do you

1526

00:59:49,580 --> 00:59:47,250

bring it back do you have any

1527

00:59:52,420 --> 00:59:49,590

communication why don't you keep it

1528

00:59:58,670 --> 00:59:55,730

you don't want it to drift out continent

1529

01:00:00,680 --> 00:59:58,680

I mean if it falls in the water

1530

01:00:01,849 --> 01:00:00,690

that's fine you lose the payload but you

1531

01:00:03,740 --> 01:00:01,859

want to recover the tail of the

1532

01:00:05,180 --> 01:00:03,750

specially on these flies so you want to

1533

01:00:07,550 --> 01:00:05,190

make sure that it doesn't go off

1534

01:00:10,190 --> 01:00:07,560

continent so you terminate the mission

1535

01:00:11,870 --> 01:00:10,200

before it has happened at some point the

1536

01:00:14,840 --> 01:00:11,880

Antarctic vortex you can disappear and

1537

01:00:16,820 --> 01:00:14,850

it will vary for continent do you know

1538

01:00:18,410 --> 01:00:16,830

what it is because you have gps antennas

1539

01:00:20,210 --> 01:00:18,420

and all that you are in constant

1540

01:00:23,210 --> 01:00:20,220

communication through satellite with the

1541

01:00:26,090 --> 01:00:23,220

so you can you are operating the the

1542

01:00:28,580 --> 01:00:26,100

balloon up flight you have of course the

1543

01:00:31,190 --> 01:00:28,590

pointing system you can control the

1544

01:00:33,679 --> 01:00:31,200

elevation and the azimuth laura probably

1545

01:00:35,779 --> 01:00:33,689

can talk more about the Deponia system

1546

01:00:37,609 --> 01:00:35,789

but you have full-time communications

1547

01:00:39,349 --> 01:00:37,619

hey there there are a couple of random

1548

01:00:41,870 --> 01:00:39,359

systems so we are controlling the

1549

01:00:44,059 --> 01:00:41,880

balloon all the time in terms of

1550

01:00:46,489 --> 01:00:44,069

trajectory control you can control your

1551
01:00:48,739 --> 01:00:46,499
elevation by making sure you have the

1552
01:00:50,899 --> 01:00:48,749
right amount of lifting gas compared to

1553
01:00:53,209 --> 01:00:50,909
your weight and you actually do find

1554
01:00:55,699 --> 01:00:53,219
that you'll get diurnal variations you

1555
01:00:57,709 --> 01:00:55,709
kind of move around over night for

1556
01:01:00,199 --> 01:00:57,719
example and the way they manage that is

1557
01:01:01,489 --> 01:01:00,209
with ballast and so if you you know that

1558
01:01:03,109 --> 01:01:01,499
you're about to drop down you can drop

1559
01:01:04,969 --> 01:01:03,119
some ballast to try to maintain some of

1560
01:01:07,219 --> 01:01:04,979
that altitude but you don't really

1561
01:01:09,199 --> 01:01:07,229
control for most typical balloons you're

1562
01:01:10,459 --> 01:01:09,209
kind of XY coordinates as you go around

1563
01:01:12,559 --> 01:01:10,469

that's really dominated by the

1564

01:01:15,199 --> 01:01:12,569

prevailing winds Jose I mentioned that

1565

01:01:16,969 --> 01:01:15,209

you you have a kill switch so that if it

1566

01:01:18,799 --> 01:01:16,979

gets too far away you can actually take

1567

01:01:20,899 --> 01:01:18,809

it down before it goes se out into the

1568

01:01:23,449 --> 01:01:20,909

ocean or our flight was supposed to

1569

01:01:24,649 --> 01:01:23,459

happen up actually in Norway so if it

1570

01:01:27,889 --> 01:01:24,659

gets too close to Russian airspace you

1571

01:01:30,169 --> 01:01:27,899

want to take it down before they do but

1572

01:01:31,879 --> 01:01:30,179

but yeah so so that's the way you really

1573

01:01:33,439 --> 01:01:31,889

just you have to watch it you manage it

1574

01:01:34,849 --> 01:01:33,449

with GPS and it's it's more of a

1575

01:01:37,009 --> 01:01:34,859

knowledge thing than a control thing

1576

01:01:39,079 --> 01:01:37,019

there are some proposal ideas out there

1577

01:01:40,969 --> 01:01:39,089

about how to make it more of a shapes

1578

01:01:42,620 --> 01:01:40,979

form kind of a dirigible type thing

1579

01:01:45,319 --> 01:01:42,630

where you can actually manage its

1580

01:01:47,919 --> 01:01:45,329

trajectory and XY as well but those are

1581

01:01:50,569 --> 01:01:47,929

a little bit more involved

1582

01:01:52,459 --> 01:01:50,579

so you can do control the azimuth and

1583

01:01:53,989 --> 01:01:52,469

elevation but you don't control the path

1584

01:01:57,969 --> 01:01:53,999

it just gets the right with the wind

1585

01:02:01,339 --> 01:01:57,979

right and what's the maximum elevation

1586

01:02:04,539 --> 01:02:01,349

depends on the weight of your payload I

1587

01:02:07,969 --> 01:02:04,549

think it's around 40 kilometers around

1588

01:02:12,469 --> 01:02:07,979

140,000 feet something like that again

1589

01:02:20,479 --> 01:02:12,479

is the higher the heavier your payload

1590

01:02:21,949 --> 01:02:20,489

is the lower you go I mean I think you

1591

01:02:24,199 --> 01:02:21,959

both threw a wonderful lecture

1592

01:02:25,939 --> 01:02:24,209

Jose I wanted to ask you specifically

1593

01:02:28,639 --> 01:02:25,949

about the component you have on the

1594

01:02:32,659 --> 01:02:28,649

table and the difference or what changes

1595

01:02:34,039 --> 01:02:32,669

you made between that and the new Jen so

1596

01:02:37,999 --> 01:02:34,049

the one that we've recovered which is

1597

01:02:41,599 --> 01:02:38,009

the big one it has is it's one of the

1598

01:02:43,999 --> 01:02:41,609

drivers of the receiver so it has four

1599

01:02:45,190 --> 01:02:44,009

channels so basically like we have four

1600

01:02:48,460 --> 01:02:45,200

receivers right

1601
01:02:51,910 --> 01:02:48,470
- not the same mission or in this case

1602
01:02:53,710 --> 01:02:51,920
was carbon I have a nice carbon the

1603
01:02:56,289 --> 01:02:53,720
other one it was the next generation so

1604
01:02:57,640 --> 01:02:56,299
of course we will find that we're

1605
01:02:59,579 --> 01:02:57,650
planning to fly that but we are the same

1606
01:03:02,950 --> 01:02:59,589
time we're working on the next step

1607
01:03:05,079 --> 01:03:02,960
better designs had better packaging so

1608
01:03:08,280 --> 01:03:05,089
so that they won the small one that you

1609
01:03:10,120 --> 01:03:08,290
see there is actually 16 receivers or 16

1610
01:03:10,569 --> 01:03:10,130
transmitter in this case it's a

1611
01:03:14,980 --> 01:03:10,579
transmitter

1612
01:03:19,930 --> 01:03:14,990
type flexing are you multiplexing no no

1613
01:03:23,049 --> 01:03:19,940

yes 16 transmitter and the receiver part

1614

01:03:26,289 --> 01:03:23,059

would have system receiver but it

1615

01:03:27,099 --> 01:03:26,299

consumes less power than the other one

1616

01:03:29,740 --> 01:03:27,109

which is 4

1617

01:03:32,410 --> 01:03:29,750

this one has 16 of course it's much much

1618

01:03:35,170 --> 01:03:32,420

smaller we use less one learn from the

1619

01:03:38,349 --> 01:03:35,180

other one to implement the new one so in

1620

01:03:40,660 --> 01:03:38,359

the nest or fully belong flag we will

1621

01:03:43,359 --> 01:03:40,670

try to fry the a new generation it also

1622

01:03:47,049 --> 01:03:43,369

allow us to you know in the same form

1623

01:03:53,079 --> 01:03:47,059

factor add more channels more frequency

1624

01:03:54,460 --> 01:03:53,089

coverage thank you so we do have two

1625

01:03:55,780 --> 01:03:54,470

questions from we had a lot of questions

1626
01:03:57,430 --> 01:03:55,790
from the internet and there were great

1627
01:04:01,420 --> 01:03:57,440
questions but we have time for two of

1628
01:04:04,299 --> 01:04:01,430
them so I'm gonna start with question

1629
01:04:06,190 --> 01:04:04,309
from you two kind of on the design you

1630
01:04:08,799 --> 01:04:06,200
talk about with planetary could we

1631
01:04:10,539 --> 01:04:08,809
launch a Mars mission with a balloon to

1632
01:04:12,520 --> 01:04:10,549
be launched from the surface of Mars

1633
01:04:16,150 --> 01:04:12,530
rather than what we saw in the image

1634
01:04:18,640 --> 01:04:16,160
before yeah I mean there are a lot of

1635
01:04:20,260 --> 01:04:18,650
concepts I think that you know if you

1636
01:04:23,230 --> 01:04:20,270
give an engineer a difficult problem

1637
01:04:23,829 --> 01:04:23,240
they'll find a way to make it work we've

1638
01:04:26,289 --> 01:04:23,839

shown before

1639

01:04:28,510 --> 01:04:26,299

yeah the specific concepts that I was

1640

01:04:31,420 --> 01:04:28,520

studying as an intern was there are some

1641

01:04:33,039 --> 01:04:31,430

advantages to using the atmosphere that

1642

01:04:35,200 --> 01:04:33,049

you have rather than bringing it with

1643

01:04:37,690 --> 01:04:35,210

you and mostly you're a lot less prone

1644

01:04:38,829 --> 01:04:37,700

to leaks and so if you you know lose a

1645

01:04:40,030 --> 01:04:38,839

little bit of helium that you brought

1646

01:04:42,280 --> 01:04:40,040

with you then that's kind of the end of

1647

01:04:44,319 --> 01:04:42,290

it but if you can heat up and kind of

1648

01:04:46,450 --> 01:04:44,329

keep replenishing the atmosphere you

1649

01:04:47,890 --> 01:04:46,460

have then you might be able to stay up

1650

01:04:49,480 --> 01:04:47,900

longer was the idea but they're

1651

01:04:51,640 --> 01:04:49,490

definitely concepts for a lot of

1652

01:04:52,839 --> 01:04:51,650

different things I mean and launching

1653

01:04:55,420 --> 01:04:52,849

from the surface would be one of them

1654

01:04:57,730 --> 01:04:55,430

very cool and the last one from northern

1655

01:04:58,900 --> 01:04:57,740

astronomy what is the most interesting

1656

01:05:04,349 --> 01:04:58,910

thing you

1657

01:05:14,799 --> 01:05:10,779

science point of view well person I

1658

01:05:16,660 --> 01:05:14,809

would say that is the being exposed to

1659

01:05:18,400 --> 01:05:16,670

this end-to-end mission in such a short

1660

01:05:21,670 --> 01:05:18,410

period of time come compared to flight

1661

01:05:23,890 --> 01:05:21,680

is like a summer Club it'll be longer

1662

01:05:25,990 --> 01:05:23,900

than that but it's just an intensive

1663

01:05:27,940 --> 01:05:26,000

training so you get to do everything you

1664

01:05:30,160 --> 01:05:27,950

get to do design you fabricate it would

1665

01:05:32,680 --> 01:05:30,170

you have design you put it on a

1666

01:05:35,230 --> 01:05:32,690

telescope and make it work and you are

1667

01:05:37,630 --> 01:05:35,240

with all the team and at the end you

1668

01:05:39,099 --> 01:05:37,640

know everyone does what is needed to

1669

01:05:41,049 --> 01:05:39,109

help so everyone that's a bit of

1670

01:05:42,520 --> 01:05:41,059

everything so so you are with the

1671

01:05:44,200 --> 01:05:42,530

scientists so you will get to learn the

1672

01:05:47,049 --> 01:05:44,210

science even if you are an engineer the

1673

01:05:50,260 --> 01:05:47,059

scientists understand better than

1674

01:05:54,160 --> 01:05:50,270

engineers so everyone is there so also

1675

01:05:55,990 --> 01:05:54,170

this work teamwork spirit getting to

1676
01:05:59,859 --> 01:05:56,000
work with all these amazing people learn

1677
01:06:02,890 --> 01:05:59,869
from the best people in the world to to

1678
01:06:04,180 --> 01:06:02,900
build this kind of technology and of

1679
01:06:06,870 --> 01:06:04,190
course the best scientist in the world I

1680
01:06:09,190 --> 01:06:06,880
mean it's something that is really I

1681
01:06:10,809 --> 01:06:09,200
mean it's I once in a lifetime

1682
01:06:15,339 --> 01:06:10,819
opportunity especially being there in

1683
01:06:17,620 --> 01:06:15,349
Antartica amazing yeah it's really all

1684
01:06:19,150 --> 01:06:17,630
about the teaming I think that the thing

1685
01:06:21,400 --> 01:06:19,160
that I thought was most interesting is

1686
01:06:23,109 --> 01:06:21,410
as a systems engineer you think smaller

1687
01:06:24,460 --> 01:06:23,119
mission might have fewer functions or

1688
01:06:26,200 --> 01:06:24,470

fewer things you do but it's really you

1689

01:06:28,839 --> 01:06:26,210

have to do all of it you just have less

1690

01:06:30,970 --> 01:06:28,849

time and money to do it with and so you

1691

01:06:33,640 --> 01:06:30,980

have to have interfaces you have to have

1692

01:06:35,799 --> 01:06:33,650

risks like spelled out so you really

1693

01:06:37,960 --> 01:06:35,809

have to do everything in a small mission

1694

01:06:40,029 --> 01:06:37,970

is just it's how you manage them is a

1695

01:06:41,740 --> 01:06:40,039

little bit different so all the systems

1696

01:06:43,210 --> 01:06:41,750

engineering functions are there you just

1697

01:06:45,970 --> 01:06:43,220

got to do it and so it's interesting to

1698

01:06:48,730 --> 01:06:45,980

me is to see how that discipline really

1699

01:06:49,960 --> 01:06:48,740

just it it's required even at these tiny

1700

01:06:53,859 --> 01:06:49,970

scales all the way up to something like

1701

01:06:55,450 --> 01:06:53,869

clipper oh thank you very much that is

1702

01:06:57,190 --> 01:06:55,460

unfortunately all the time that we have

1703

01:07:04,730 --> 01:06:57,200

this evening I want to give a big thank

1704

01:07:08,180 --> 01:07:06,770

and thank you to all of you who joined

1705

01:07:10,070 --> 01:07:08,190

us whether it be here in person or

1706

01:07:12,200 --> 01:07:10,080

watching from your home wherever you are

1707

01:07:14,480 --> 01:07:12,210

today please join us in March for the

1708

01:07:16,280 --> 01:07:14,490

golden age of exoplanet exploration

1709

01:07:19,550 --> 01:07:16,290

details can be found on our website

1710

01:07:22,200 --> 01:07:19,560

JPL nasa.gov thank you for joining us

1711

01:07:47,450 --> 01:07:22,210

folks and have a great night