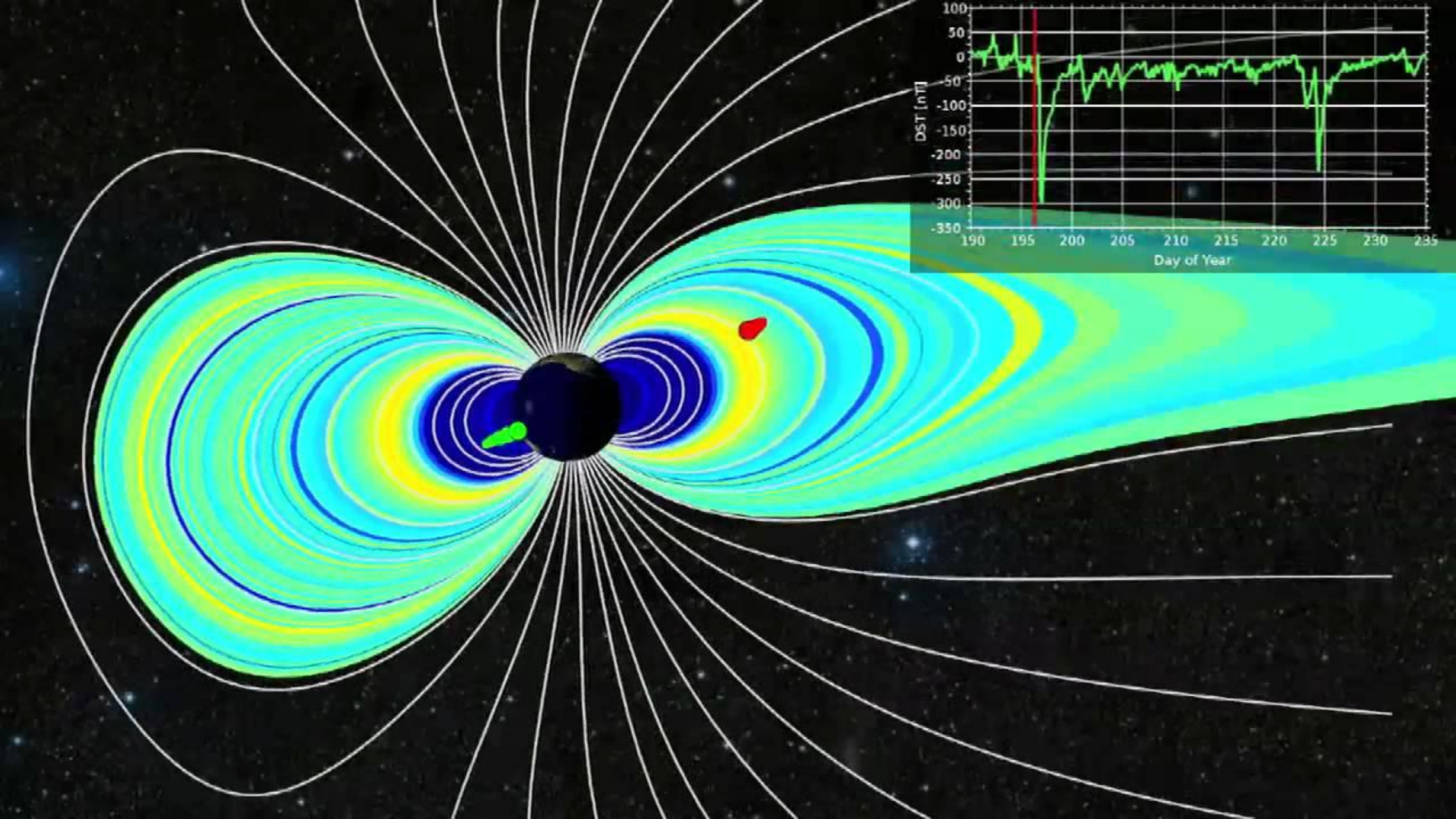
100
50
0
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-300
-350
DST [nT]
190
195
200
205
210
215
220
225
230
235
Day of Year

1
00:00:10,070 --> 00:00:08,549
hello i'm jd harrington public affairs

2
00:00:12,230 --> 00:00:10,080
officer for nasa's science mission

3
00:00:14,870 --> 00:00:12,240
directorate in washington dc

4
00:00:16,150 --> 00:00:14,880
i'd like to welcome you today to today's

5
00:00:18,630 --> 00:00:16,160
l14 media

6
00:00:20,950 --> 00:00:18,640
conference we will discuss the exciting

7
00:00:22,470 --> 00:00:20,960
launch of nasa's two radiation belt

8
00:00:25,109 --> 00:00:22,480
stone probes

9
00:00:26,870 --> 00:00:25,119
rbsp for short now this is going to

10
00:00:28,550 --> 00:00:26,880
happen on august 23rd from cape

11
00:00:30,630 --> 00:00:28,560
canaveral florida

12
00:00:32,630 --> 00:00:30,640
the two-year rbsp mission will help

13
00:00:35,350 --> 00:00:32,640

scientists develop an understanding

14
00:00:37,190 --> 00:00:35,360
of earth's van l and radiation belts in

15
00:00:37,830 --> 00:00:37,200
related regions that pose hazards to

16
00:00:40,630 --> 00:00:37,840
humans

17
00:00:42,069 --> 00:00:40,640
and exploration uh robotic exploration

18
00:00:43,750 --> 00:00:42,079
for explorers

19
00:00:45,750 --> 00:00:43,760
before we get started a few housekeeping

20
00:00:47,910 --> 00:00:45,760
duties we have four panelists

21
00:00:49,750 --> 00:00:47,920
joining us today each will give a short

22
00:00:51,270 --> 00:00:49,760
four to six minute briefing on their

23
00:00:52,790 --> 00:00:51,280
specific topic

24
00:00:54,470 --> 00:00:52,800
besides seeing their graphics here on

25
00:00:55,189 --> 00:00:54,480
television you can also see them on the

26
00:00:58,510 --> 00:00:55,199
website

27
00:01:01,990 --> 00:00:58,520
at www.nasa.gov

28
00:01:03,430 --> 00:01:02,000
rbsp after the panelist discussion

29
00:01:05,509 --> 00:01:03,440
we'll move to the question and answer

30
00:01:06,950 --> 00:01:05,519
session accepting questions from media

31
00:01:08,950 --> 00:01:06,960
here at nasa headquarters

32
00:01:11,190 --> 00:01:08,960
those at the centers and others from

33
00:01:13,109 --> 00:01:11,200
that dial into the telephone bridge

34
00:01:14,390 --> 00:01:13,119
you can also ask questions submitted via

35
00:01:17,510 --> 00:01:14,400
the twitter sphere

36
00:01:19,270 --> 00:01:17,520
by using the hashtag ask nasa

37
00:01:20,550 --> 00:01:19,280
this media conference will be limited to

38
00:01:23,350 --> 00:01:20,560

one hour

39
00:01:24,070 --> 00:01:23,360
today's panelists include lika gujarat

40
00:01:26,390 --> 00:01:24,080
curta

41
00:01:32,550 --> 00:01:26,400
the living with a star program scientist

42
00:01:36,230 --> 00:01:35,350
besides lika we have mona kessel the

43
00:01:38,830 --> 00:01:36,240
rbsp

44
00:01:41,590 --> 00:01:38,840
program scientist also from nasa

45
00:01:44,550 --> 00:01:41,600
headquarters

46
00:01:47,030 --> 00:01:44,560
barry mock the rbsp project scientist

47
00:01:51,749 --> 00:01:47,040
from johns hopkins universities applied

48
00:01:55,510 --> 00:01:54,710
and rick fitzgerald the rbsp project

49
00:01:58,789 --> 00:01:55,520
manager

50
00:02:00,870 --> 00:01:58,799
from also from apl laurel maryland

51
00:02:01,990 --> 00:02:00,880
and with that let's get started here's

52
00:02:05,270 --> 00:02:02,000
lika

53
00:02:07,910 --> 00:02:05,280
thank you jd good afternoon

54
00:02:10,469 --> 00:02:07,920
after the very successful landing of

55
00:02:14,070 --> 00:02:10,479
nasa's mars science laboratory with

56
00:02:16,550 --> 00:02:14,080
all lies focused on planet mars i think

57
00:02:18,550 --> 00:02:16,560
it's time to bring our attention back to

58
00:02:21,110 --> 00:02:18,560
planet earth once again

59
00:02:21,990 --> 00:02:21,120
not only do we live here but we are also

60
00:02:24,070 --> 00:02:22,000
launching the

61
00:02:26,470 --> 00:02:24,080
second mission of living with a star

62
00:02:27,350 --> 00:02:26,480
program called radiation build storm

63
00:02:31,030 --> 00:02:27,360

probes

64
00:02:31,830 --> 00:02:31,040
for short rbsp the radiation belts are

65
00:02:34,949 --> 00:02:31,840
the first

66
00:02:38,229 --> 00:02:34,959
and perhaps the oldest discovery of

67
00:02:40,309 --> 00:02:38,239
the space age yet they remain a mystery

68
00:02:41,350 --> 00:02:40,319
simply because this is a very harsh

69
00:02:43,910 --> 00:02:41,360
environment

70
00:02:45,509 --> 00:02:43,920
where satellites don't last for very

71
00:02:49,030 --> 00:02:45,519
long and we don't have

72
00:02:52,150 --> 00:02:49,040
a lot of data we still don't understand

73
00:02:53,190 --> 00:02:52,160
how the belts behave nor do we have the

74
00:02:55,990 --> 00:02:53,200
ability to make

75
00:02:56,790 --> 00:02:56,000
key predictions which is really very

76
00:02:58,630 --> 00:02:56,800
important

77
00:03:00,790 --> 00:02:58,640
and i hope with the launch of these two

78
00:03:02,710 --> 00:03:00,800
probes we will be answering many of

79
00:03:05,270 --> 00:03:02,720
these questions

80
00:03:06,790 --> 00:03:05,280
my esteemed colleagues to my left they

81
00:03:08,630 --> 00:03:06,800
are going to talk about the details of

82
00:03:10,869 --> 00:03:08,640
the mission and its signs

83
00:03:12,710 --> 00:03:10,879
and let me talk a little bit about the

84
00:03:14,550 --> 00:03:12,720
program itself living with the star

85
00:03:17,430 --> 00:03:14,560
program

86
00:03:18,869 --> 00:03:17,440
uh most of you know that we live in the

87
00:03:22,470 --> 00:03:18,879
outer atmosphere

88
00:03:24,630 --> 00:03:22,480

of our star the sun and it's not only

89
00:03:26,390 --> 00:03:24,640
our planet but every other planet

90
00:03:29,990 --> 00:03:26,400
everything in the solar system

91
00:03:32,789 --> 00:03:30,000
is immersed in the solar environment

92
00:03:33,750 --> 00:03:32,799
even though with our unaided eyes we

93
00:03:36,070 --> 00:03:33,760
just kind of

94
00:03:37,750 --> 00:03:36,080
look at the sun and it looks like a

95
00:03:40,470 --> 00:03:37,760
placid yellow ball

96
00:03:41,430 --> 00:03:40,480
when we look at the sun with um you know

97
00:03:43,350 --> 00:03:41,440
telescopes

98
00:03:45,509 --> 00:03:43,360
uh we find like solar dynamics

99
00:03:45,990 --> 00:03:45,519
observatory first mission of living with

100
00:03:48,949 --> 00:03:46,000
the star

101
00:03:51,190 --> 00:03:48,959
program what we find is a really

102
00:03:55,110 --> 00:03:51,200
seething boiling surface

103
00:03:59,910 --> 00:03:55,120
a very dynamic sun which has tremendous

104
00:04:00,630 --> 00:03:59,920
influence on the environment in geospace

105
00:04:03,509 --> 00:04:00,640
even

106
00:04:04,309 --> 00:04:03,519
as we search for life on mars that's why

107
00:04:07,750 --> 00:04:04,319
we launched

108
00:04:10,869 --> 00:04:07,760
msl it is kind of interesting to know

109
00:04:13,350 --> 00:04:10,879
that under the protective shield

110
00:04:14,869 --> 00:04:13,360
of earth's magnetosphere and and

111
00:04:18,069 --> 00:04:14,879
atmosphere

112
00:04:20,710 --> 00:04:18,079
earth still remains an island

113
00:04:21,509 --> 00:04:20,720

in the universe i would say in which

114
00:04:24,550 --> 00:04:21,519
life has

115
00:04:24,870 --> 00:04:24,560
evolved and flourished and the origins

116
00:04:28,070 --> 00:04:24,880
and

117
00:04:30,950 --> 00:04:28,080
fate of life here on earth is really

118
00:04:33,110 --> 00:04:30,960
intimately connected to the sun and

119
00:04:34,710 --> 00:04:33,120
solar variability and how the earth

120
00:04:37,270 --> 00:04:34,720
responds to that

121
00:04:39,430 --> 00:04:37,280
recognizing this importance between the

122
00:04:40,629 --> 00:04:39,440
connection between sun and earth sun and

123
00:04:43,990 --> 00:04:40,639
solar system

124
00:04:46,790 --> 00:04:44,000
in 2001 nasa initiated a program called

125
00:04:48,230 --> 00:04:46,800
living with a star program whose goal is

126
00:04:50,710 --> 00:04:48,240
to really go after

127
00:04:51,830 --> 00:04:50,720
the science of the connected sun earth

128
00:04:54,230 --> 00:04:51,840
system

129
00:04:55,510 --> 00:04:54,240
but the ones that have relevance to life

130
00:04:58,390 --> 00:04:55,520
and society so

131
00:05:00,390 --> 00:04:58,400
basic science with science uh with

132
00:05:02,790 --> 00:05:00,400
relevance to life and society

133
00:05:04,230 --> 00:05:02,800
kind of science in pasture mode and this

134
00:05:07,189 --> 00:05:04,240
becomes very clear

135
00:05:08,550 --> 00:05:07,199
with this um chart that i'm about to

136
00:05:11,830 --> 00:05:08,560
show you which kind of

137
00:05:14,230 --> 00:05:11,840
gives you on the top panel the aspects

138
00:05:16,310 --> 00:05:14,240

of basic science solar variability and

139
00:05:18,950 --> 00:05:16,320
its impact on our magnetosphere

140
00:05:20,550 --> 00:05:18,960
something we will be studying with rbsp

141
00:05:22,870 --> 00:05:20,560
solar variability and its

142
00:05:24,310 --> 00:05:22,880
impact on different kinds of planet

143
00:05:25,950 --> 00:05:24,320
planetary environments

144
00:05:27,670 --> 00:05:25,960
that might or might not have

145
00:05:29,670 --> 00:05:27,680
magnetosphere um

146
00:05:31,510 --> 00:05:29,680
solar variability and it's not

147
00:05:35,029 --> 00:05:31,520
necessarily solar variability

148
00:05:36,230 --> 00:05:35,039
but in general sort of variability of

149
00:05:39,510 --> 00:05:36,240
radiation

150
00:05:40,310 --> 00:05:39,520
in the magnetized uh universe uh the

151
00:05:42,710 --> 00:05:40,320
plasma

152
00:05:44,070 --> 00:05:42,720
that surrounds that most of our universe

153
00:05:46,390 --> 00:05:44,080
is actually filled with

154
00:05:47,909 --> 00:05:46,400
magnetized plasma so this mission is

155
00:05:51,110 --> 00:05:47,919
actually going to provide some

156
00:05:54,550 --> 00:05:51,120
critical insight into that as well

157
00:05:57,510 --> 00:05:54,560
when we go to the lower uh panel

158
00:05:59,029 --> 00:05:57,520
what you see is the relevant side of it

159
00:06:02,230 --> 00:05:59,039
essentially

160
00:06:05,990 --> 00:06:02,240
modern uh human technology has become

161
00:06:09,029 --> 00:06:06,000
very susceptible to solar storm solar

162
00:06:10,870 --> 00:06:09,039
coronal mass ejections solar wind what

163
00:06:13,029 --> 00:06:10,880

you're looking in that picture

164
00:06:14,629 --> 00:06:13,039
are these that solar storms can affect

165
00:06:16,309 --> 00:06:14,639
satellites in space

166
00:06:18,070 --> 00:06:16,319
astronauts doing extra vehicular

167
00:06:20,629 --> 00:06:18,080
activity power grids

168
00:06:22,150 --> 00:06:20,639
uh even smart power grids uh

169
00:06:25,350 --> 00:06:22,160
communication navigation

170
00:06:26,629 --> 00:06:25,360
system uh air traffic uh and even

171
00:06:28,469 --> 00:06:26,639
terrestrial climate

172
00:06:29,909 --> 00:06:28,479
so there's a deep connection between how

173
00:06:33,430 --> 00:06:29,919
the sun varies

174
00:06:37,029 --> 00:06:33,440
and its relevance to life and society

175
00:06:39,670 --> 00:06:37,039
now in addition to the sun producing

176
00:06:42,150 --> 00:06:39,680
radiation something that sun also

177
00:06:46,710 --> 00:06:42,160
produces is what's called a solar wind

178
00:06:49,189 --> 00:06:46,720
this is a hot million miles per hour

179
00:06:51,110 --> 00:06:49,199
wind which consists of electrons and

180
00:06:53,670 --> 00:06:51,120
protons and if i can get the

181
00:06:56,070 --> 00:06:53,680
next chart please and this is this kind

182
00:06:59,350 --> 00:06:56,080
of blows out continuously from

183
00:07:02,230 --> 00:06:59,360
the sun and um it's it's the

184
00:07:04,629 --> 00:07:02,240
next movie and and what what this shows

185
00:07:08,070 --> 00:07:04,639
is from the surface of the sun

186
00:07:11,830 --> 00:07:08,080
all the way 93 millions of miles away

187
00:07:15,110 --> 00:07:11,840
our home planet earth now this picture

188
00:07:16,469 --> 00:07:15,120

was taken by five digital cameras on one

189
00:07:19,830 --> 00:07:16,479
of our missions called

190
00:07:21,909 --> 00:07:19,840
stereo and we are able to see for the

191
00:07:25,029 --> 00:07:21,919
first time the entire picture

192
00:07:27,749 --> 00:07:25,039
of a solar storm 93 million miles

193
00:07:29,350 --> 00:07:27,759
in between what you see are cloud of

194
00:07:32,469 --> 00:07:29,360
plasma there's a billion

195
00:07:34,870 --> 00:07:32,479
tons of material electrons and protons

196
00:07:37,830 --> 00:07:34,880
traveling at tremendous speed

197
00:07:39,270 --> 00:07:37,840
impinging not only on our planet that

198
00:07:41,589 --> 00:07:39,280
really blue dot

199
00:07:44,230 --> 00:07:41,599
but also planet venus and any other

200
00:07:46,550 --> 00:07:44,240
planets in the solar system

201
00:07:48,070 --> 00:07:46,560
in the next movie what we have done is

202
00:07:50,950 --> 00:07:48,080
we have taken those

203
00:07:52,390 --> 00:07:50,960
images kind of distorted them into a

204
00:07:55,350 --> 00:07:52,400
radial coordinate

205
00:07:57,909 --> 00:07:55,360
so we can actually see the track of a

206
00:08:00,469 --> 00:07:57,919
coronal mass ejection or a solar storm

207
00:08:02,950 --> 00:08:00,479
in just one panel so you are seeing

208
00:08:03,589 --> 00:08:02,960
93 million miles captured in that one

209
00:08:06,550 --> 00:08:03,599
frame

210
00:08:08,869 --> 00:08:06,560
and you see that the solar storms are

211
00:08:09,990 --> 00:08:08,879
blowing out from the surface of the sun

212
00:08:11,990 --> 00:08:10,000
from the blue

213
00:08:13,510 --> 00:08:12,000

to the yellowish red and then the

214
00:08:16,710 --> 00:08:13,520
interplanetary medium

215
00:08:17,350 --> 00:08:16,720
this is billion tons of matter plowing

216
00:08:19,270 --> 00:08:17,360
through

217
00:08:20,469 --> 00:08:19,280
interplanetary medium and just look at

218
00:08:23,029 --> 00:08:20,479
the size scale

219
00:08:24,550 --> 00:08:23,039
uh it it's just overwhelming to tiny

220
00:08:27,670 --> 00:08:24,560
planets like ours

221
00:08:30,869 --> 00:08:27,680
mars venus and and so how does

222
00:08:34,230 --> 00:08:30,879
our planet then respond to that

223
00:08:34,870 --> 00:08:34,240
kind of dynamic pressure if you look at

224
00:08:38,149 --> 00:08:34,880
the next

225
00:08:41,750 --> 00:08:38,159
movie that shows that earth

226
00:08:43,990 --> 00:08:41,760
actually has its own magnetosphere we

227
00:08:45,750 --> 00:08:44,000
call it almost like a cocoon

228
00:08:47,430 --> 00:08:45,760
that protects us from this harmful

229
00:08:49,750 --> 00:08:47,440
radiation of the sun

230
00:08:51,430 --> 00:08:49,760
so the solar wind provides the dynamic

231
00:08:53,670 --> 00:08:51,440
pressure and you're seeing that

232
00:08:55,030 --> 00:08:53,680
from the left it impinges on the

233
00:08:57,829 --> 00:08:55,040
magnetosphere

234
00:08:58,790 --> 00:08:57,839
and when the storm is really strong you

235
00:09:00,949 --> 00:08:58,800
can see

236
00:09:03,269 --> 00:09:00,959
that the magnetosphere is not only

237
00:09:05,269 --> 00:09:03,279
shimmering it's get gets squished

238
00:09:07,269 --> 00:09:05,279

distorted all different kinds of

239
00:09:10,949 --> 00:09:07,279
phenomena but this is happening

240
00:09:14,470 --> 00:09:10,959
constantly and inside the magnetosphere

241
00:09:17,509 --> 00:09:14,480
what we have are the radiation belts

242
00:09:21,190 --> 00:09:17,519
and these radiation belts are really

243
00:09:24,310 --> 00:09:21,200
important for us for a couple of reasons

244
00:09:26,790 --> 00:09:24,320
for satellites in that environment

245
00:09:28,710 --> 00:09:26,800
as well as for astronauts astronauts for

246
00:09:30,630 --> 00:09:28,720
them to leave low earth orbit

247
00:09:33,030 --> 00:09:30,640
they have to punch through the radiation

248
00:09:33,750 --> 00:09:33,040
bills and satellites many of our key

249
00:09:35,990 --> 00:09:33,760
satellites

250
00:09:36,949 --> 00:09:36,000
actually go skimming through this uh

251
00:09:38,870 --> 00:09:36,959
environment

252
00:09:40,470 --> 00:09:38,880
and they spent spend their entire

253
00:09:44,070 --> 00:09:40,480
lifetime in this environment

254
00:09:44,550 --> 00:09:44,080
and this is not a pleasant environment

255
00:09:47,829 --> 00:09:44,560
it's a

256
00:09:49,829 --> 00:09:47,839
harmful harsh uh environment

257
00:09:51,829 --> 00:09:49,839
as i mentioned before you know we still

258
00:09:52,550 --> 00:09:51,839
don't understand how the radiation belts

259
00:09:55,430 --> 00:09:52,560
behave

260
00:09:57,269 --> 00:09:55,440
neither can we make uh key predictions

261
00:09:59,509 --> 00:09:57,279
for the radiation bills

262
00:10:01,509 --> 00:09:59,519
what are those key predictions you know

263
00:10:04,069 --> 00:10:01,519

we don't know for example

264
00:10:04,949 --> 00:10:04,079
where highly charged relativistic

265
00:10:07,590 --> 00:10:04,959
electrons

266
00:10:08,710 --> 00:10:07,600
will appear or disappear these are

267
00:10:11,990 --> 00:10:08,720
really lethal

268
00:10:14,150 --> 00:10:12,000
for example to spacecraft charging

269
00:10:16,230 --> 00:10:14,160
we for example don't know how the

270
00:10:18,310 --> 00:10:16,240
radiation belts will respond to any

271
00:10:20,710 --> 00:10:18,320
given coronal mass ejection

272
00:10:21,829 --> 00:10:20,720
will the bells shrink will the belts

273
00:10:24,310 --> 00:10:21,839
expand

274
00:10:26,389 --> 00:10:24,320
will the belts merge i mean you know

275
00:10:28,630 --> 00:10:26,399
these three orthogonal questions

276
00:10:30,630 --> 00:10:28,640
we don't have a good answer for that

277
00:10:31,990 --> 00:10:30,640
today but with the launch of these two

278
00:10:34,230 --> 00:10:32,000
missions we certainly think

279
00:10:36,949 --> 00:10:34,240
that we will have a much better

280
00:10:38,630 --> 00:10:36,959
understanding of what's going on there

281
00:10:40,550 --> 00:10:38,640
now i want to show you the last slide

282
00:10:42,310 --> 00:10:40,560
and in the last slide i want to draw

283
00:10:45,590 --> 00:10:42,320
your attention

284
00:10:46,870 --> 00:10:45,600
to the solar cycle the various phases of

285
00:10:49,670 --> 00:10:46,880
the solar cycle

286
00:10:51,509 --> 00:10:49,680
and how our geospace environment and

287
00:10:52,389 --> 00:10:51,519
radiation builds respond to that

288
00:10:54,550 --> 00:10:52,399

environment

289
00:10:56,310 --> 00:10:54,560
so on the top panel what you're seeing

290
00:10:57,190 --> 00:10:56,320
is the red plot i mean that's your

291
00:11:00,230 --> 00:10:57,200
traditional

292
00:11:03,430 --> 00:11:00,240
solar cycle variability plot sun

293
00:11:05,110 --> 00:11:03,440
varies every 11 years the sunspots go up

294
00:11:06,710 --> 00:11:05,120
and then go down and we are kind of on

295
00:11:09,990 --> 00:11:06,720
the rising phase of that

296
00:11:13,030 --> 00:11:10,000
cycle the blue plot superposed

297
00:11:14,389 --> 00:11:13,040
on that top panel essentially shows the

298
00:11:16,389 --> 00:11:14,399
response of

299
00:11:18,790 --> 00:11:16,399
the geospace environment or in other

300
00:11:21,269 --> 00:11:18,800
words you know how the radiation belts

301
00:11:22,389 --> 00:11:21,279
would uh respond to solar variability

302
00:11:24,630 --> 00:11:22,399
and what you find

303
00:11:27,110 --> 00:11:24,640
there isn't a one-to-one correspondence

304
00:11:29,829 --> 00:11:27,120
they are not following the same pattern

305
00:11:31,750 --> 00:11:29,839
or what goes on the radiation bells and

306
00:11:33,430 --> 00:11:31,760
our geospace environment

307
00:11:35,829 --> 00:11:33,440
not only responds to the solar

308
00:11:36,790 --> 00:11:35,839
variability but it also responds to the

309
00:11:39,509 --> 00:11:36,800
solar wind

310
00:11:41,670 --> 00:11:39,519
that we just showed you in the movie the

311
00:11:44,470 --> 00:11:41,680
high-speed solar wind in blue

312
00:11:45,030 --> 00:11:44,480
in the lower panel the slow speed solar

313
00:11:48,230 --> 00:11:45,040

vein

314
00:11:49,990 --> 00:11:48,240
in green the coronal mass ejections and

315
00:11:52,470 --> 00:11:50,000
other transients in red

316
00:11:54,150 --> 00:11:52,480
in the lower panel they have all

317
00:11:57,110 --> 00:11:54,160
different variability

318
00:11:58,230 --> 00:11:57,120
all of them together along with the

319
00:12:01,269 --> 00:11:58,240
sunspot cycle

320
00:12:01,870 --> 00:12:01,279
really contributes to what the radiation

321
00:12:04,230 --> 00:12:01,880
belt

322
00:12:05,750 --> 00:12:04,240
experiences and this is what we are

323
00:12:07,910 --> 00:12:05,760
trying to understand

324
00:12:09,350 --> 00:12:07,920
and going back to the basic points we

325
00:12:12,790 --> 00:12:09,360
need to understand this

326
00:12:15,750 --> 00:12:12,800
because the weather in these belts

327
00:12:16,550 --> 00:12:15,760
is very important for us much like the

328
00:12:19,110 --> 00:12:16,560
weather

329
00:12:20,150 --> 00:12:19,120
on surface of our planet you know like

330
00:12:22,550 --> 00:12:20,160
the tornadoes

331
00:12:24,470 --> 00:12:22,560
the hurricanes and we want to understand

332
00:12:27,430 --> 00:12:24,480
the weather in the radiation bills

333
00:12:29,509 --> 00:12:27,440
and its variation with solar cycle so

334
00:12:33,030 --> 00:12:29,519
that we can be better prepared for

335
00:12:35,430 --> 00:12:33,040
making better satellite designs for our

336
00:12:38,629 --> 00:12:35,440
astronauts for communications

337
00:12:40,230 --> 00:12:38,639
all of those and with that i'm going to

338
00:12:42,389 --> 00:12:40,240

pass it on to mona who will give you

339
00:12:43,670 --> 00:12:42,399
some history and more signs on the

340
00:12:45,670 --> 00:12:43,680
radiation belts

341
00:12:47,190 --> 00:12:45,680
okay thank you lika for setting the

342
00:12:49,910 --> 00:12:47,200
stage that

343
00:12:50,629 --> 00:12:49,920
really puts this into perspective i want

344
00:12:52,310 --> 00:12:50,639
to start

345
00:12:53,990 --> 00:12:52,320
by answering a couple of simple

346
00:12:56,230 --> 00:12:54,000
questions starting with

347
00:12:57,590 --> 00:12:56,240
what are the radiation belts and then

348
00:12:59,750 --> 00:12:57,600
where are they

349
00:13:00,629 --> 00:12:59,760
so if we can look at the first slide

350
00:13:03,430 --> 00:13:00,639
that i have

351
00:13:05,750 --> 00:13:03,440
you can see a cutaway model of the

352
00:13:07,509 --> 00:13:05,760
earth's radiation belt you see the earth

353
00:13:10,230 --> 00:13:07,519
and you see there's an inner belt

354
00:13:13,350 --> 00:13:10,240
and then outer belt and within these

355
00:13:15,750 --> 00:13:13,360
belts are captured or trapped actually

356
00:13:17,430 --> 00:13:15,760
high energy particles primarily

357
00:13:19,190 --> 00:13:17,440
electrons and ions

358
00:13:21,110 --> 00:13:19,200
they're trapped by earth's magnetic

359
00:13:24,150 --> 00:13:21,120
field you can also see the

360
00:13:25,750 --> 00:13:24,160
two satellites from rbsp that are

361
00:13:28,389 --> 00:13:25,760
pictured there as well

362
00:13:29,110 --> 00:13:28,399
so the inner belt really begins about a

363
00:13:31,030 --> 00:13:29,120

thousand

364
00:13:33,430 --> 00:13:31,040
miles up from earth's surface and

365
00:13:35,670 --> 00:13:33,440
extends to about 8 000 miles

366
00:13:37,030 --> 00:13:35,680
then there's a gap and the outer belt

367
00:13:40,470 --> 00:13:37,040
begins and that's about

368
00:13:43,670 --> 00:13:40,480
12 000 to about 25 000 miles

369
00:13:45,670 --> 00:13:43,680
so those belts that's kind of a

370
00:13:48,150 --> 00:13:45,680
picture that you see when they're

371
00:13:50,230 --> 00:13:48,160
nominal when there's not a lot going on

372
00:13:51,750 --> 00:13:50,240
but during solar storms which we could

373
00:13:54,949 --> 00:13:51,760
just discussed

374
00:13:57,990 --> 00:13:54,959
lots of things happen the belts can

375
00:13:58,870 --> 00:13:58,000
expand greatly so they fill in much

376
00:14:00,790 --> 00:13:58,880
closer to earth

377
00:14:02,310 --> 00:14:00,800
they can even fill in the region between

378
00:14:05,590 --> 00:14:02,320
the belts and expand

379
00:14:08,629 --> 00:14:05,600
out so when they expand in they get to

380
00:14:09,269 --> 00:14:08,639
about 125 miles above the surface of the

381
00:14:11,430 --> 00:14:09,279
earth

382
00:14:14,150 --> 00:14:11,440
that means that the international space

383
00:14:15,990 --> 00:14:14,160
station and low orbiting satellites

384
00:14:18,150 --> 00:14:16,000
pass through that region so they're

385
00:14:19,430 --> 00:14:18,160
susceptible to the energetic particles

386
00:14:21,590 --> 00:14:19,440
that are trapped there

387
00:14:23,110 --> 00:14:21,600
the same thing happens on the outside

388
00:14:24,389 --> 00:14:23,120

that's where our geosynchronous

389
00:14:27,509 --> 00:14:24,399
satellites are

390
00:14:28,629 --> 00:14:27,519
and as the belts expand those satellites

391
00:14:30,870 --> 00:14:28,639
come within

392
00:14:32,150 --> 00:14:30,880
that region and they're also then

393
00:14:35,829 --> 00:14:32,160
susceptible to

394
00:14:38,790 --> 00:14:35,839
the possible damage from the particles

395
00:14:40,069 --> 00:14:38,800
so let's stop about solar storms for a

396
00:14:40,949 --> 00:14:40,079
little bit because i want to step back

397
00:14:43,590 --> 00:14:40,959
in time

398
00:14:45,430 --> 00:14:43,600
for a little bit back to the 1950s when

399
00:14:47,990 --> 00:14:45,440
the space age began

400
00:14:49,670 --> 00:14:48,000
as like has already mentioned one of the

401
00:14:51,990 --> 00:14:49,680
first discoveries

402
00:14:52,710 --> 00:14:52,000
the first satellite that went into space

403
00:14:55,670 --> 00:14:52,720
discovered

404
00:14:57,030 --> 00:14:55,680
the inner belt of what we now know as

405
00:14:59,189 --> 00:14:57,040
the radiation belts

406
00:15:00,150 --> 00:14:59,199
so if we can look at the next slide that

407
00:15:03,110 --> 00:15:00,160
i have

408
00:15:05,750 --> 00:15:03,120
what i show here is a picture of four of

409
00:15:08,710 --> 00:15:05,760
the early pioneering scientists

410
00:15:10,230 --> 00:15:08,720
from left to right they're carl mcelwain

411
00:15:13,750 --> 00:15:10,240
james van allen

412
00:15:14,470 --> 00:15:13,760
george ludwig and ernie ray all four of

413
00:15:16,629 --> 00:15:14,480

these men

414
00:15:17,910 --> 00:15:16,639
were very important to these early

415
00:15:21,110 --> 00:15:17,920
discoveries

416
00:15:22,470 --> 00:15:21,120
van allen particularly was lecturing all

417
00:15:24,230 --> 00:15:22,480
around the country

418
00:15:26,710 --> 00:15:24,240
he was trying to get people interested

419
00:15:28,949 --> 00:15:26,720
in doing science in space

420
00:15:30,310 --> 00:15:28,959
so what he really wanted to study was

421
00:15:32,870 --> 00:15:30,320
cosmic rays

422
00:15:34,790 --> 00:15:32,880
and you need to go above the atmosphere

423
00:15:36,069 --> 00:15:34,800
to study cosmic rays

424
00:15:37,910 --> 00:15:36,079
because that's where you're going to get

425
00:15:40,069 --> 00:15:37,920
the best view and

426
00:15:42,310 --> 00:15:40,079
the the rockets the suborbital rockets

427
00:15:44,310 --> 00:15:42,320
that he'd been sending up for some years

428
00:15:45,990 --> 00:15:44,320
those are only up for a few minutes and

429
00:15:48,389 --> 00:15:46,000
then come right back down so he was very

430
00:15:51,749 --> 00:15:48,399
anxious to get a satellite in space

431
00:15:53,749 --> 00:15:51,759
so in addition to to uh

432
00:15:55,269 --> 00:15:53,759
pushing this idea of doing cosmic rays

433
00:15:57,829 --> 00:15:55,279
in space he was

434
00:15:59,350 --> 00:15:57,839
conversing with verna werner von braun

435
00:16:01,350 --> 00:15:59,360
and william pickering

436
00:16:03,030 --> 00:16:01,360
both of whom were very important in

437
00:16:05,749 --> 00:16:03,040
getting that first rocket

438
00:16:06,550 --> 00:16:05,759

to go up into space the first u.s rocket

439
00:16:09,670 --> 00:16:06,560
in space

440
00:16:12,389 --> 00:16:09,680
so he together with george ludwig

441
00:16:14,069 --> 00:16:12,399
designed the first instrument and that

442
00:16:14,949 --> 00:16:14,079
instrument was just a simple geiger

443
00:16:17,749 --> 00:16:14,959
counter

444
00:16:19,350 --> 00:16:17,759
and that was to go up on explorer one so

445
00:16:21,910 --> 00:16:19,360
if we can show the next

446
00:16:24,069 --> 00:16:21,920
slide that i have this is a very famous

447
00:16:26,550 --> 00:16:24,079
picture showing pickering

448
00:16:28,710 --> 00:16:26,560
van allen and von braun holding up a

449
00:16:30,870 --> 00:16:28,720
model of explorer one

450
00:16:31,829 --> 00:16:30,880
this is this was a press conference that

451
00:16:35,350 --> 00:16:31,839
was held

452
00:16:37,990 --> 00:16:35,360
soon after um the launch of the rocket

453
00:16:39,829 --> 00:16:38,000
and it was really important because it

454
00:16:42,069 --> 00:16:39,839
had not only national but also

455
00:16:44,550 --> 00:16:42,079
international significance

456
00:16:47,509 --> 00:16:44,560
so soon after that ben allen and his

457
00:16:49,430 --> 00:16:47,519
team got very busy analyzing the data

458
00:16:51,030 --> 00:16:49,440
and simultaneously getting ready for

459
00:16:52,870 --> 00:16:51,040
explore two and three which we're going

460
00:16:55,189 --> 00:16:52,880
to launch in the next few months

461
00:16:57,110 --> 00:16:55,199
but the data was perplexing because

462
00:17:00,470 --> 00:16:57,120
there were times when the count rates

463
00:17:02,470 --> 00:17:00,480

went very very low and it didn't make

464
00:17:03,670 --> 00:17:02,480
any sense that the cosmic rays in space

465
00:17:07,110 --> 00:17:03,680
would be zero

466
00:17:10,150 --> 00:17:07,120
so then explorer three confirmed that

467
00:17:12,470 --> 00:17:10,160
so now mcelwain he went into the lab he

468
00:17:14,870 --> 00:17:12,480
took their prototype geiger counter

469
00:17:16,789 --> 00:17:14,880
did a series of tests and he was able to

470
00:17:18,230 --> 00:17:16,799
demonstrate that when the count rates

471
00:17:21,270 --> 00:17:18,240
got really high

472
00:17:21,909 --> 00:17:21,280
like 25 000 counts per second then the

473
00:17:25,029 --> 00:17:21,919
geiger

474
00:17:28,470 --> 00:17:25,039
counter would actually respond with zero

475
00:17:30,870 --> 00:17:28,480
so what they've got now is count rates

476
00:17:31,669 --> 00:17:30,880
that are a thousand times the cosmic

477
00:17:34,710 --> 00:17:31,679
rays

478
00:17:36,950 --> 00:17:34,720
so that was that was really interesting

479
00:17:39,029 --> 00:17:36,960
they got very very busy then trying to

480
00:17:40,789 --> 00:17:39,039
piece that together and say okay what

481
00:17:43,510 --> 00:17:40,799
are we really looking at here

482
00:17:45,430 --> 00:17:43,520
so they put together a map and if we can

483
00:17:47,830 --> 00:17:45,440
look at the next slide

484
00:17:48,630 --> 00:17:47,840
they they did an analysis by latitude

485
00:17:51,750 --> 00:17:48,640
and longitude

486
00:17:53,990 --> 00:17:51,760
and altitude and then they hand drew

487
00:17:55,430 --> 00:17:54,000
and in fact all of this was done without

488
00:17:57,990 --> 00:17:55,440

computers so it was really

489
00:17:58,870 --> 00:17:58,000
quite an effort back at that time they

490
00:18:01,029 --> 00:17:58,880
drew

491
00:18:03,029 --> 00:18:01,039
a version of the radiation belt because

492
00:18:05,909 --> 00:18:03,039
van allen deduced

493
00:18:07,669 --> 00:18:05,919
that there must be trapped radiation and

494
00:18:08,390 --> 00:18:07,679
this was the picture that he came up

495
00:18:10,150 --> 00:18:08,400
with

496
00:18:11,669 --> 00:18:10,160
then later he was giving a press

497
00:18:15,110 --> 00:18:11,679
conference on this

498
00:18:17,590 --> 00:18:15,120
and he was describing these belts as

499
00:18:19,350 --> 00:18:17,600
encircling the earth and so there was a

500
00:18:21,350 --> 00:18:19,360
reporter in the audience who asked him a

501
00:18:24,230 --> 00:18:21,360
question he said do you mean like a belt

502
00:18:26,630 --> 00:18:24,240
he said yeah like a belt so that's where

503
00:18:27,990 --> 00:18:26,640
the term radiation belts came from was a

504
00:18:30,230 --> 00:18:28,000
reporter asking a question

505
00:18:32,470 --> 00:18:30,240
at a press conference and and this

506
00:18:34,070 --> 00:18:32,480
discovery this discovery of these

507
00:18:36,390 --> 00:18:34,080
radiation belts with the trapped

508
00:18:38,390 --> 00:18:36,400
radiation landed van allen on the cover

509
00:18:40,310 --> 00:18:38,400
at time magazine if we go to the next

510
00:18:41,990 --> 00:18:40,320
picture which again shows the map but

511
00:18:46,470 --> 00:18:42,000
now it shows van allen on the cover

512
00:18:48,549 --> 00:18:46,480
of time magazine this was in may 1959

513
00:18:50,470 --> 00:18:48,559

but at that time we thought that they

514
00:18:51,750 --> 00:18:50,480
were static belts that they were fixed

515
00:18:54,789 --> 00:18:51,760
in location

516
00:18:57,350 --> 00:18:54,799
later satellites cress and sampecs

517
00:18:59,190 --> 00:18:57,360
painted an entirely different picture so

518
00:19:01,590 --> 00:18:59,200
if we can go to the movie now

519
00:19:04,150 --> 00:19:01,600
i want to show you with sampek's data

520
00:19:06,470 --> 00:19:04,160
starting in about 1998

521
00:19:07,750 --> 00:19:06,480
pictures of the dynamic nature of the

522
00:19:10,230 --> 00:19:07,760
belts you can see

523
00:19:11,430 --> 00:19:10,240
red areas those correspond to the belts

524
00:19:14,470 --> 00:19:11,440
getting really pumped up

525
00:19:17,190 --> 00:19:14,480
lots of charged particles sometimes

526
00:19:18,710 --> 00:19:17,200
the belts the red areas extend all the

527
00:19:20,710 --> 00:19:18,720
way through the region sometimes the

528
00:19:22,789 --> 00:19:20,720
outer one almost disappears

529
00:19:24,470 --> 00:19:22,799
and then other times you can see them as

530
00:19:26,710 --> 00:19:24,480
two distinct belts

531
00:19:28,070 --> 00:19:26,720
but one thing you definitely can see is

532
00:19:31,909 --> 00:19:28,080
that it's a highly

533
00:19:33,830 --> 00:19:31,919
dynamic region so one satellite

534
00:19:35,270 --> 00:19:33,840
unfortunately could not unravel this

535
00:19:38,470 --> 00:19:35,280
complicated nature

536
00:19:40,870 --> 00:19:38,480
this is a job for rbsp but it also

537
00:19:43,110 --> 00:19:40,880
demonstrates a kind of weather in space

538
00:19:45,669 --> 00:19:43,120

that lika has already mentioned

539
00:19:48,390 --> 00:19:45,679
this is all driven by the sun by the

540
00:19:51,669 --> 00:19:48,400
changing energy coming from the sun

541
00:19:52,310 --> 00:19:51,679
and it actually affects the performance

542
00:19:54,630 --> 00:19:52,320
and the

543
00:19:56,549 --> 00:19:54,640
reliability of technologies that we have

544
00:19:59,190 --> 00:19:56,559
here both in space and

545
00:20:00,549 --> 00:19:59,200
on the ground now in particular if you

546
00:20:03,590 --> 00:20:00,559
look at the next slide

547
00:20:06,710 --> 00:20:03,600
what rbsp will be able to do is

548
00:20:07,669 --> 00:20:06,720
give us information about spacecraft

549
00:20:11,110 --> 00:20:07,679
charging

550
00:20:13,909 --> 00:20:11,120
upsets

551
00:20:15,510 --> 00:20:13,919
sometimes the solar panels will degrade

552
00:20:17,350 --> 00:20:15,520
because of the charges that are

553
00:20:18,630 --> 00:20:17,360
that are that that come and they hit the

554
00:20:20,070 --> 00:20:18,640
panels so

555
00:20:21,909 --> 00:20:20,080
this is something that rick is going to

556
00:20:24,950 --> 00:20:21,919
talk about a little bit more later

557
00:20:26,710 --> 00:20:24,960
but this aspect this solar

558
00:20:28,070 --> 00:20:26,720
the space weather is what we're

559
00:20:30,470 --> 00:20:28,080
concerned about and

560
00:20:32,070 --> 00:20:30,480
in particular when we have astronauts

561
00:20:33,510 --> 00:20:32,080
that fly through the area they can get a

562
00:20:36,470 --> 00:20:33,520
dose of radiation

563
00:20:37,270 --> 00:20:36,480

we know that prolonged exposure to

564
00:20:40,470 --> 00:20:37,280
radiation

565
00:20:42,950 --> 00:20:40,480
can cause cancer so rbsp

566
00:20:44,070 --> 00:20:42,960
is what it will do for us is en enable

567
00:20:46,950 --> 00:20:44,080
the prediction

568
00:20:48,310 --> 00:20:46,960
of extreme and dynamic space weather

569
00:20:51,430 --> 00:20:48,320
conditions

570
00:20:54,630 --> 00:20:51,440
we have broadcasting both satellites

571
00:20:55,830 --> 00:20:54,640
24 7 space weather this is going to get

572
00:20:58,070 --> 00:20:55,840
picked up by

573
00:21:00,149 --> 00:20:58,080
ground stations around the world if we

574
00:21:01,029 --> 00:21:00,159
go to my final slide we can see a

575
00:21:03,590 --> 00:21:01,039
picture

576
00:21:06,310 --> 00:21:03,600
of a ground station this is the korea

577
00:21:09,430 --> 00:21:06,320
astronomy and space science institute

578
00:21:12,549 --> 00:21:09,440
they built a special dish just to to

579
00:21:14,070 --> 00:21:12,559
capture the rbsp space weather data

580
00:21:15,909 --> 00:21:14,080
we're also working with the czech

581
00:21:18,950 --> 00:21:15,919
republic they have a ground

582
00:21:20,870 --> 00:21:18,960
station and other sites around the world

583
00:21:22,470 --> 00:21:20,880
so as soon as that data becomes

584
00:21:24,710 --> 00:21:22,480
available it will be

585
00:21:26,310 --> 00:21:24,720
broadcast out to the public and this

586
00:21:29,430 --> 00:21:26,320
will support our efforts

587
00:21:30,470 --> 00:21:29,440
of analyzing space weather data around

588
00:21:32,870 --> 00:21:30,480

the world

589
00:21:34,470 --> 00:21:32,880
so now i want to turn it over to barry

590
00:21:35,190 --> 00:21:34,480
who's going to talk about the mission in

591
00:21:36,950 --> 00:21:35,200
more detail

592
00:21:38,470 --> 00:21:36,960
thank you very much mona i want to

593
00:21:40,549 --> 00:21:38,480
answer the most important question

594
00:21:42,789 --> 00:21:40,559
as cool as mars is it does not have a

595
00:21:44,630 --> 00:21:42,799
radiation belt so i won't be

596
00:21:47,110 --> 00:21:44,640
i won't be talking about mars here i

597
00:21:49,029 --> 00:21:47,120
wanted to start by showing a movie

598
00:21:51,350 --> 00:21:49,039
that illustrates the point that mona was

599
00:21:53,029 --> 00:21:51,360
making in lika that the um

600
00:21:55,029 --> 00:21:53,039
uh the radiation belts are highly

601
00:21:57,510 --> 00:21:55,039
dynamic but what this movie also

602
00:21:59,350 --> 00:21:57,520
shows is that that dynamics is highly

603
00:22:01,510 --> 00:21:59,360
unpredictable based on what we know

604
00:22:03,750 --> 00:22:01,520
about the radiation belts right now

605
00:22:05,990 --> 00:22:03,760
we know that variations in the sun cause

606
00:22:07,830 --> 00:22:06,000
what are called geomagnetic storms

607
00:22:09,190 --> 00:22:07,840
those storms are actually observable on

608
00:22:11,270 --> 00:22:09,200
the ground by mag

609
00:22:12,470 --> 00:22:11,280
by magnetometer measurements and they

610
00:22:14,470 --> 00:22:12,480
show up as these strong

611
00:22:16,630 --> 00:22:14,480
dips that you see in the green curve in

612
00:22:18,870 --> 00:22:16,640
the upper right of this uh

613
00:22:19,909 --> 00:22:18,880

of this movie what we've learned is the

614
00:22:22,149 --> 00:22:19,919
response

615
00:22:23,510 --> 00:22:22,159
of the radiation bells to those storms

616
00:22:25,830 --> 00:22:23,520
to those green dips

617
00:22:27,750 --> 00:22:25,840
is highly variable sometimes it's big

618
00:22:29,830 --> 00:22:27,760
sometimes it's small and we just do not

619
00:22:32,230 --> 00:22:29,840
understand why that uh

620
00:22:33,590 --> 00:22:32,240
why that occurs this movie by the way

621
00:22:35,430 --> 00:22:33,600
will be on the rbsb

622
00:22:36,789 --> 00:22:35,440
and nasa website and you can study it

623
00:22:38,549 --> 00:22:36,799
yourself and you can look at the

624
00:22:40,549 --> 00:22:38,559
response to those two different storms

625
00:22:42,549 --> 00:22:40,559
and you'll see that it is very different

626
00:22:43,750 --> 00:22:42,559
and it is just a mystery as to why that

627
00:22:47,029 --> 00:22:43,760
happens

628
00:22:49,110 --> 00:22:47,039
on the next slide i wanted to talk about

629
00:22:50,789 --> 00:22:49,120
the fact that since 1958 when the

630
00:22:52,149 --> 00:22:50,799
radiation belts were discovered

631
00:22:54,230 --> 00:22:52,159
we've learned that when it comes to

632
00:22:55,270 --> 00:22:54,240
radiation regions in space we are not

633
00:22:58,390 --> 00:22:55,280
alone

634
00:23:00,549 --> 00:22:58,400
at all radiation is created near the sun

635
00:23:02,310 --> 00:23:00,559
radiation is uh created between the

636
00:23:04,149 --> 00:23:02,320
planets it's strongly

637
00:23:06,470 --> 00:23:04,159
uh created at all of the strongly

638
00:23:09,029 --> 00:23:06,480

magnetized planets here we show earth

639
00:23:11,029 --> 00:23:09,039
and jupiter radio image of jupiter but

640
00:23:11,909 --> 00:23:11,039
it also occurs at saturn uranus and

641
00:23:14,870 --> 00:23:11,919
neptune so

642
00:23:15,430 --> 00:23:14,880
radiation belts are are common they also

643
00:23:17,590 --> 00:23:15,440
occur in

644
00:23:18,870 --> 00:23:17,600
distant regions of the of the universe

645
00:23:21,750 --> 00:23:18,880
here is an image of

646
00:23:23,750 --> 00:23:21,760
of x-ray image of the crab nebula which

647
00:23:24,310 --> 00:23:23,760
is an image of the radiation belts of

648
00:23:29,029 --> 00:23:24,320
that

649
00:23:31,590 --> 00:23:29,039
important parts of the radiation

650
00:23:33,110 --> 00:23:31,600
about storm pro's mission is to use

651
00:23:35,669 --> 00:23:33,120
earth's radiation belt

652
00:23:36,950 --> 00:23:35,679
as a natural laboratory for studying how

653
00:23:39,110 --> 00:23:36,960
radiation

654
00:23:40,549 --> 00:23:39,120
is created in space how it varies in

655
00:23:42,870 --> 00:23:40,559
space

656
00:23:45,669 --> 00:23:42,880
and why the creation of radiation in

657
00:23:47,830 --> 00:23:45,679
space is so common

658
00:23:49,350 --> 00:23:47,840
i'd like to go back to the my first

659
00:23:51,830 --> 00:23:49,360
movie if i may

660
00:23:52,630 --> 00:23:51,840
i'd like to talk about another aspect of

661
00:23:58,390 --> 00:23:52,640
uh

662
00:24:00,149 --> 00:23:58,400
wanted to describe why it is so unique

663
00:24:02,549 --> 00:24:00,159

in terms of its ability

664
00:24:04,789 --> 00:24:02,559
to resolve the mysteries of the van

665
00:24:05,750 --> 00:24:04,799
allen radiation belts the first and most

666
00:24:07,110 --> 00:24:05,760
obvious point

667
00:24:10,070 --> 00:24:07,120
is the fact that there are two

668
00:24:13,350 --> 00:24:10,080
spacecraft closely coordinated with

669
00:24:15,269 --> 00:24:13,360
with each other two spacecraft allow

670
00:24:17,350 --> 00:24:15,279
you to determine the difference between

671
00:24:18,950 --> 00:24:17,360
a spacecraft variations that occur

672
00:24:20,710 --> 00:24:18,960
because the spacecraft moves from one

673
00:24:22,950 --> 00:24:20,720
region to another region

674
00:24:24,710 --> 00:24:22,960
and variations that occur because of

675
00:24:25,750 --> 00:24:24,720
explicit time variations in the

676
00:24:28,070 --> 00:24:25,760
radiation belts

677
00:24:29,909 --> 00:24:28,080
and as simple as that seems that has

678
00:24:32,390 --> 00:24:29,919
been a fundamental impediment in our

679
00:24:35,110 --> 00:24:32,400
ability to understand the physics of

680
00:24:36,789 --> 00:24:35,120
space environment things like the

681
00:24:40,950 --> 00:24:36,799
radiation belts

682
00:24:42,789 --> 00:24:40,960
this movie shows the rbsp spacecraft

683
00:24:44,710 --> 00:24:42,799
with these red and green balls

684
00:24:46,789 --> 00:24:44,720
and if you study it carefully you'll see

685
00:24:49,510 --> 00:24:46,799
how the two spacecraft

686
00:24:50,470 --> 00:24:49,520
look at any one structure twice and that

687
00:24:53,430 --> 00:24:50,480
looking at

688
00:24:54,630 --> 00:24:53,440

at structures twice for any for any

689
00:24:56,630 --> 00:24:54,640
feature that you see

690
00:24:58,789 --> 00:24:56,640
allows us to make that separation

691
00:25:00,549 --> 00:24:58,799
between space and time

692
00:25:01,830 --> 00:25:00,559
on my next slide i show a little bit

693
00:25:04,310 --> 00:25:01,840
more about

694
00:25:05,590 --> 00:25:04,320
uh the orbit the orbits are highly

695
00:25:08,230 --> 00:25:05,600
elliptical they cut

696
00:25:09,590 --> 00:25:08,240
and they are that way be because they're

697
00:25:11,269 --> 00:25:09,600
designed to cut through all of the

698
00:25:12,390 --> 00:25:11,279
different radiation structures of the

699
00:25:14,630 --> 00:25:12,400
radiation belt

700
00:25:16,950 --> 00:25:14,640
the two spacecraft follow almost

701
00:25:17,510 --> 00:25:16,960
identical orbits but not quite in fact

702
00:25:19,909 --> 00:25:17,520
one

703
00:25:21,669 --> 00:25:19,919
is a little faster than the other and so

704
00:25:22,789 --> 00:25:21,679
sometimes these spacecraft are very

705
00:25:25,430 --> 00:25:22,799
close together

706
00:25:27,430 --> 00:25:25,440
sometimes they're very very far apart as

707
00:25:29,669 --> 00:25:27,440
as far as the entire orbit

708
00:25:30,470 --> 00:25:29,679
and that allows us to study small scale

709
00:25:35,990 --> 00:25:30,480
structures

710
00:25:39,269 --> 00:25:36,000
do all that we can to understand the

711
00:25:41,830 --> 00:25:39,279
various parts of how this radiation belt

712
00:25:42,549 --> 00:25:41,840
responds there is another aspect of the

713
00:25:44,390 --> 00:25:42,559

rbsb

714
00:25:46,310 --> 00:25:44,400
mission that also makes it uniquely

715
00:25:46,789 --> 00:25:46,320
capable of resolving the mysteries of

716
00:25:53,190 --> 00:25:46,799
the

717
00:25:54,310 --> 00:25:53,200
highest quality instruments that have

718
00:25:57,510 --> 00:25:54,320
ever been used

719
00:26:00,549 --> 00:25:57,520
to study radiation regions in space

720
00:26:01,909 --> 00:26:00,559
it is exceedingly difficult to make

721
00:26:03,750 --> 00:26:01,919
measurements in the heart of the

722
00:26:05,110 --> 00:26:03,760
radiation belt because the particles

723
00:26:06,870 --> 00:26:05,120
penetrate your instruments and

724
00:26:09,669 --> 00:26:06,880
contaminate the measurements

725
00:26:11,029 --> 00:26:09,679
and rbsp has technologies that allow it

726
00:26:13,110 --> 00:26:11,039
to make the cleanest

727
00:26:16,230 --> 00:26:13,120
measurements that have ever been done in

728
00:26:19,350 --> 00:26:16,240
this the heart of the radiation

729
00:26:20,549 --> 00:26:19,360
belt i'd like to talk now with my next

730
00:26:22,230 --> 00:26:20,559
slide

731
00:26:24,470 --> 00:26:22,240
the different classes of instruments

732
00:26:27,590 --> 00:26:24,480
that are on rbsb and there are two

733
00:26:28,789 --> 00:26:27,600
classes one class measures the particles

734
00:26:32,070 --> 00:26:28,799
themselves

735
00:26:34,070 --> 00:26:32,080
and on the next slide if i can have that

736
00:26:35,590 --> 00:26:34,080
this highlights the various components

737
00:26:38,630 --> 00:26:35,600
that are actually measuring

738
00:26:40,310 --> 00:26:38,640

the particles these these instruments

739
00:26:42,549 --> 00:26:40,320
measure particles from the lowest

740
00:26:44,549 --> 00:26:42,559
energies about one electron volt

741
00:26:46,310 --> 00:26:44,559
all the way to the highest energies that

742
00:26:49,430 --> 00:26:46,320
we need about two billion

743
00:26:50,870 --> 00:26:49,440
electron volts these these measurements

744
00:26:53,430 --> 00:26:50,880
are made by six different

745
00:26:55,830 --> 00:26:53,440
instruments that are delivered by three

746
00:26:58,310 --> 00:26:55,840
different investigations it's the ect

747
00:26:59,510 --> 00:26:58,320
investigation the rb spice investigation

748
00:27:01,909 --> 00:26:59,520
and the rps

749
00:27:03,909 --> 00:27:01,919
investigation these instruments measure

750
00:27:05,350 --> 00:27:03,919
not only the radiation particles that

751
00:27:09,029 --> 00:27:05,360
we're very interested in

752
00:27:10,870 --> 00:27:09,039
but it also measures the ionized gases

753
00:27:12,950 --> 00:27:10,880
or plasmas that constitute the

754
00:27:13,990 --> 00:27:12,960
environment within which the radiation

755
00:27:16,630 --> 00:27:14,000
belts

756
00:27:17,909 --> 00:27:16,640
reside the other class of instruments

757
00:27:21,590 --> 00:27:17,919
that we have

758
00:27:26,149 --> 00:27:21,600
shown on the next slide are the

759
00:27:28,070 --> 00:27:26,159
magnetic and electric fields experiments

760
00:27:30,230 --> 00:27:28,080
the magnetic and electric fields in the

761
00:27:32,230 --> 00:27:30,240
radiation belts control the behaviors of

762
00:27:35,990 --> 00:27:32,240
the particles it causes the particles to

763
00:27:39,269 --> 00:27:36,000

be energized and to be lost

764
00:27:40,710 --> 00:27:39,279
rbsp instruments measure electric and

765
00:27:43,430 --> 00:27:40,720
magnetic fields that are

766
00:27:45,350 --> 00:27:43,440
changing very slowly over many hours and

767
00:27:47,190 --> 00:27:45,360
those that are changing very rapidly in

768
00:27:48,070 --> 00:27:47,200
the form of waves that propagate with

769
00:27:51,750 --> 00:27:48,080
frequencies

770
00:27:54,149 --> 00:27:51,760
as high as 400 000 cycles

771
00:27:55,110 --> 00:27:54,159
per second and again these electric and

772
00:27:57,430 --> 00:27:55,120
magnetic fields

773
00:27:59,029 --> 00:27:57,440
essentially control the behavior of the

774
00:28:02,230 --> 00:27:59,039
of the particle instrument

775
00:28:04,950 --> 00:28:02,240
and these measurements are made by

776
00:28:06,230 --> 00:28:04,960
four different sensor types that are

777
00:28:08,230 --> 00:28:06,240
delivered by two different

778
00:28:10,310 --> 00:28:08,240
investigations and that is the emphasis

779
00:28:13,510 --> 00:28:10,320
investigation and the efw

780
00:28:15,190 --> 00:28:13,520
investigation all of these instruments

781
00:28:17,190 --> 00:28:15,200
can only make their measurements by

782
00:28:18,149 --> 00:28:17,200
being integrated on a very capable

783
00:28:22,950 --> 00:28:18,159
spacecraft

784
00:28:23,990 --> 00:28:22,960
harsh environments they have to be very

785
00:28:30,549 --> 00:28:24,000
quiet

786
00:28:31,269 --> 00:28:30,559
so that the fields and particles uh the

787
00:28:33,350 --> 00:28:31,279
fields

788
00:28:35,110 --> 00:28:33,360

measurements can be made and i forgot to

789
00:28:35,990 --> 00:28:35,120
show my last movie which i'd like to

790
00:28:38,070 --> 00:28:36,000
show now

791
00:28:41,750 --> 00:28:38,080
which shows one of the ways that we keep

792
00:28:43,750 --> 00:28:41,760
these uh electric and magnetic field uh

793
00:28:45,350 --> 00:28:43,760
measurements very quiet by putting them

794
00:28:47,110 --> 00:28:45,360
out on boom

795
00:28:49,110 --> 00:28:47,120
like structures and this movie for

796
00:28:51,430 --> 00:28:49,120
example shows the deployment

797
00:28:53,510 --> 00:28:51,440
of the magnetometer booms that are

798
00:28:56,149 --> 00:28:53,520
mounted on the end of the

799
00:28:58,070 --> 00:28:56,159
of the solar solar panels and we do that

800
00:28:59,909 --> 00:28:58,080
to keep these sensors far away from the

801
00:29:00,710 --> 00:28:59,919
spacecraft which can contaminate the

802
00:29:02,710 --> 00:29:00,720
measurements

803
00:29:04,710 --> 00:29:02,720
the electric field instruments are even

804
00:29:05,750 --> 00:29:04,720
more sensitive and they are put on wire

805
00:29:09,350 --> 00:29:05,760
booms that extend

806
00:29:11,029 --> 00:29:09,360
50 meters um away from the spacecraft so

807
00:29:12,149 --> 00:29:11,039
that from tip to tip you're measuring

808
00:29:14,630 --> 00:29:12,159
the size of a

809
00:29:16,549 --> 00:29:14,640
of a football field so again as i was

810
00:29:18,310 --> 00:29:16,559
saying before uh these instruments have

811
00:29:20,389 --> 00:29:18,320
to be put on a very

812
00:29:22,470 --> 00:29:20,399
uh robust spacecraft they have to be

813
00:29:24,870 --> 00:29:22,480

very quiet and they have to be capable

814
00:29:25,830 --> 00:29:24,880
to keep themselves oriented with respect

815
00:29:27,430 --> 00:29:25,840
to this

816
00:29:29,269 --> 00:29:27,440
to the space that they're supposed to be

817
00:29:32,470 --> 00:29:29,279
oriented and this task fell

818
00:29:35,190 --> 00:29:32,480
to rick fitzgerald to my left who is the

819
00:29:37,750 --> 00:29:35,200
program manager and his engineering team

820
00:29:39,669 --> 00:29:37,760
and i'll let you take it from there okay

821
00:29:41,510 --> 00:29:39,679
thank you barry

822
00:29:43,510 --> 00:29:41,520
i'm very pleased and happy and proud to

823
00:29:47,110 --> 00:29:43,520
be here today representing the entire

824
00:29:50,070 --> 00:29:47,120
rbsp team which includes apl

825
00:29:50,710 --> 00:29:50,080
and all of our instrument teams that

826
00:29:53,029 --> 00:29:50,720
design

827
00:29:54,070 --> 00:29:53,039
built tested about to launch and will

828
00:29:56,230 --> 00:29:54,080
operate

829
00:29:57,590 --> 00:29:56,240
these two satellites for the next two

830
00:29:59,510 --> 00:29:57,600
years

831
00:30:01,430 --> 00:29:59,520
so you've you've heard in great detail

832
00:30:02,149 --> 00:30:01,440
about the difficult environment that

833
00:30:05,269 --> 00:30:02,159
we're going to

834
00:30:07,110 --> 00:30:05,279
into and so

835
00:30:08,389 --> 00:30:07,120
i'm going to talk a little bit about the

836
00:30:10,630 --> 00:30:08,399
design aspects

837
00:30:12,389 --> 00:30:10,640
of how do we how do we possibly live in

838
00:30:14,950 --> 00:30:12,399

that environment so

839
00:30:15,830 --> 00:30:14,960
the first slide that i have here uh

840
00:30:19,110 --> 00:30:15,840
shows our

841
00:30:19,909 --> 00:30:19,120
electronics that um really we we did two

842
00:30:21,590 --> 00:30:19,919
things

843
00:30:23,590 --> 00:30:21,600
to be able to live in this radiation

844
00:30:27,430 --> 00:30:23,600
environment the first is we picked

845
00:30:30,389 --> 00:30:27,440
radiation hardened parts so electronic

846
00:30:32,789 --> 00:30:30,399
and electrical parts are very sensitive

847
00:30:35,190 --> 00:30:32,799
to these highly charged particles so

848
00:30:38,389 --> 00:30:35,200
you can actually buy some parts that are

849
00:30:40,230 --> 00:30:38,399
tested to higher levels of uh radiation

850
00:30:42,710 --> 00:30:40,240
and uh and so that that's the first

851
00:30:44,950 --> 00:30:42,720
place we started the second thing we did

852
00:30:47,669 --> 00:30:44,960
was uh to shield all these critical

853
00:30:47,990 --> 00:30:47,679
electronics both spacecraft subsystems

854
00:30:51,350 --> 00:30:48,000
and

855
00:30:52,549 --> 00:30:51,360
science instruments in 350 mils thick

856
00:30:55,269 --> 00:30:52,559
aluminum boxes

857
00:30:55,909 --> 00:30:55,279
uh so that's approximately a third of an

858
00:30:58,549 --> 00:30:55,919
inch thick

859
00:30:59,350 --> 00:30:58,559
or some thinly sliced bread as it gives

860
00:31:02,389 --> 00:30:59,360
you an idea

861
00:31:04,149 --> 00:31:02,399
of the thickness and so essentially the

862
00:31:06,310 --> 00:31:04,159
the primary way that we're overcoming

863
00:31:08,070 --> 00:31:06,320

this difficult environment is to is to

864
00:31:09,590 --> 00:31:08,080
go there in a suit of armor

865
00:31:11,750 --> 00:31:09,600
and and that makes us one of the

866
00:31:13,430 --> 00:31:11,760
toughest missions um

867
00:31:15,509 --> 00:31:13,440
tough in the sense that we can survive

868
00:31:17,350 --> 00:31:15,519
this this environment that nasa's ever

869
00:31:18,710 --> 00:31:17,360
put together

870
00:31:20,470 --> 00:31:18,720
and you can see the text there

871
00:31:22,149 --> 00:31:20,480
installing some of those boxes and what

872
00:31:29,190 --> 00:31:22,159
we call the dog houses so the

873
00:31:34,630 --> 00:31:32,789
so what we want to talk about next is

874
00:31:36,710 --> 00:31:34,640
the mission itself so we've said there's

875
00:31:38,870 --> 00:31:36,720
two satellites and you can see here

876
00:31:40,549 --> 00:31:38,880
the satellites are separating from the

877
00:31:43,430 --> 00:31:40,559
the launch vehicle

878
00:31:46,389 --> 00:31:43,440
that separation will happen over hawaii

879
00:31:50,310 --> 00:31:46,399
approximately 78 minutes after launch

880
00:31:52,070 --> 00:31:50,320
we'll see that separation happen and um

881
00:31:54,149 --> 00:31:52,080
the the satellites are injected into

882
00:31:56,389 --> 00:31:54,159
slightly different orbits and that that

883
00:31:57,909 --> 00:31:56,399
is uh part of the mission design that

884
00:32:00,630 --> 00:31:57,919
barry talked about

885
00:32:02,549 --> 00:32:00,640
where we are able to make these

886
00:32:05,190 --> 00:32:02,559
measurements throughout the structure

887
00:32:06,950 --> 00:32:05,200
of the radiation belts um with them

888
00:32:09,430 --> 00:32:06,960

separated in different ways sometimes

889
00:32:11,430 --> 00:32:09,440
close together sometimes further apart

890
00:32:15,750 --> 00:32:11,440
and the injection of the orbit is

891
00:32:18,789 --> 00:32:15,760
critical to being able to do that

892
00:32:21,750 --> 00:32:18,799
the next thing that i want to talk about

893
00:32:22,310 --> 00:32:21,760
is the deployment itself so so barry

894
00:32:24,230 --> 00:32:22,320
showed you

895
00:32:26,470 --> 00:32:24,240
an animation and you can see it there

896
00:32:27,990 --> 00:32:26,480
where the magnetometer booms are

897
00:32:30,389 --> 00:32:28,000
deployed and you can see these wire

898
00:32:32,549 --> 00:32:30,399
booms coming out at you right there

899
00:32:35,029 --> 00:32:32,559
that's not in real time

900
00:32:36,710 --> 00:32:35,039
so these wire booms actually take a

901
00:32:38,710 --> 00:32:36,720
couple of weeks to deploy

902
00:32:40,789 --> 00:32:38,720
and they are they're essentially on

903
00:32:41,750 --> 00:32:40,799
reels inside the spacecraft kind of like

904
00:32:45,269 --> 00:32:41,760
a fishing reel

905
00:32:46,389 --> 00:32:45,279
and they get played out over a period of

906
00:32:48,549 --> 00:32:46,399
two weeks

907
00:32:50,149 --> 00:32:48,559
and and that's all part of our 60-day

908
00:32:53,590 --> 00:32:50,159
commissioning timeline

909
00:32:55,509 --> 00:32:53,600
so in a very carefully choreographed

910
00:32:57,350 --> 00:32:55,519
series of turn-ons of the various

911
00:32:58,549 --> 00:32:57,360
instruments and and subsystems on the

912
00:33:02,310 --> 00:32:58,559
spacecraft

913
00:33:04,310 --> 00:33:02,320

um we uh we decide which

914
00:33:06,149 --> 00:33:04,320
instruments with with the science team

915
00:33:08,389 --> 00:33:06,159
will get turned on in which order

916
00:33:11,190 --> 00:33:08,399
and when these deployments will happen

917
00:33:11,750 --> 00:33:11,200
and so um the the animations that you

918
00:33:13,990 --> 00:33:11,760
saw

919
00:33:15,350 --> 00:33:14,000
are um pointing to some of the uh the

920
00:33:16,149 --> 00:33:15,360
fields measurements that are going to be

921
00:33:18,310 --> 00:33:16,159
made

922
00:33:19,830 --> 00:33:18,320
and um and and showing you those

923
00:33:21,990 --> 00:33:19,840
deployments

924
00:33:24,789 --> 00:33:22,000
um i did also want to talk about some of

925
00:33:26,470 --> 00:33:24,799
the integration and test activities

926
00:33:28,149 --> 00:33:26,480
that we've had on the program so i have

927
00:33:30,389 --> 00:33:28,159
a series of video clips

928
00:33:31,750 --> 00:33:30,399
to show some of the key events and talk

929
00:33:34,870 --> 00:33:31,760
a little bit about

930
00:33:36,950 --> 00:33:34,880
what it is that they um that

931
00:33:38,710 --> 00:33:36,960
that we've done with this mission that

932
00:33:41,430 --> 00:33:38,720
that are somewhat unique

933
00:33:43,110 --> 00:33:41,440
so if we can roll that first video the

934
00:33:43,750 --> 00:33:43,120
first thing we have here are the solar

935
00:33:45,909 --> 00:33:43,760
panels

936
00:33:47,669 --> 00:33:45,919
and there's a deployment test here to

937
00:33:49,509 --> 00:33:47,679
make sure the mechanisms work

938
00:33:51,430 --> 00:33:49,519

in a gene gated environment for the

939
00:33:53,830 --> 00:33:51,440
solar panels to pop open

940
00:33:55,269 --> 00:33:53,840
and then for those booms to deploy the

941
00:33:57,430 --> 00:33:55,279
solar panels i will mention

942
00:33:59,350 --> 00:33:57,440
are specially designed to dissipate

943
00:34:00,710 --> 00:33:59,360
surface charge which is one of the

944
00:34:02,389 --> 00:34:00,720
things that we're concerned about with

945
00:34:05,029 --> 00:34:02,399
this mission so

946
00:34:05,990 --> 00:34:05,039
those were key tests i'm showing here a

947
00:34:07,990 --> 00:34:06,000
stack vibration

948
00:34:09,669 --> 00:34:08,000
test so with any any satellite mission

949
00:34:10,950 --> 00:34:09,679
this is one of the toughest environments

950
00:34:12,550 --> 00:34:10,960
to survive and that's the launch

951
00:34:14,069 --> 00:34:12,560
environment with the ride that you get

952
00:34:16,470 --> 00:34:14,079
from the launch vehicle

953
00:34:18,149 --> 00:34:16,480
and so we we test as we fly in a stacked

954
00:34:20,869 --> 00:34:18,159
configuration

955
00:34:23,349 --> 00:34:20,879
and then we have a magnetic swing test

956
00:34:25,349 --> 00:34:23,359
this is critically important because

957
00:34:27,109 --> 00:34:25,359
the spacecraft has to be magnetically

958
00:34:28,790 --> 00:34:27,119
silent in order to make these sensitive

959
00:34:30,389 --> 00:34:28,800
magnetic fields measurements and this

960
00:34:32,550 --> 00:34:30,399
test essentially is like walking through

961
00:34:34,550 --> 00:34:32,560
a magnetometer at the airport

962
00:34:36,149 --> 00:34:34,560
fortunately we're very quiet in that

963
00:34:39,030 --> 00:34:36,159

sense

964
00:34:41,109 --> 00:34:39,040
the next you will see here is a a test

965
00:34:43,349 --> 00:34:41,119
of our separation mechanism from the

966
00:34:44,869 --> 00:34:43,359
launch vehicle and the clamp band and

967
00:34:46,629 --> 00:34:44,879
we have to make sure obviously that

968
00:34:47,990 --> 00:34:46,639
separates successfully and you can see

969
00:34:49,829 --> 00:34:48,000
there the deployment we did

970
00:34:51,270 --> 00:34:49,839
together with our launch vehicle

971
00:34:54,470 --> 00:34:51,280
provider

972
00:34:58,550 --> 00:34:57,589
we next have a test that would show here

973
00:35:00,310 --> 00:34:58,560
with the electric

974
00:35:01,670 --> 00:35:00,320
fields measurement so there's also some

975
00:35:03,510 --> 00:35:01,680
antennas top and bottom on the

976
00:35:06,150 --> 00:35:03,520
spacecraft and this is the first motion

977
00:35:07,750 --> 00:35:06,160
test of one of those antennas

978
00:35:09,190 --> 00:35:07,760
and then we move to the thermal vacuum

979
00:35:11,030 --> 00:35:09,200
test which is a

980
00:35:12,790 --> 00:35:11,040
pretty standard in the industry you want

981
00:35:13,589 --> 00:35:12,800
to test in the in thermal environment

982
00:35:16,870 --> 00:35:13,599
you're going to live in

983
00:35:17,270 --> 00:35:16,880
and under vacuum conditions this is all

984
00:35:21,829 --> 00:35:17,280
done

985
00:35:22,710 --> 00:35:21,839
chambers that we have at apl are

986
00:35:25,270 --> 00:35:22,720
somewhat unique

987
00:35:27,430 --> 00:35:25,280
in that they open from the bottom and

988
00:35:30,470 --> 00:35:27,440

the spacecraft are actually deployed

989
00:35:31,910 --> 00:35:30,480
from bottom to top and pushed up into

990
00:35:33,829 --> 00:35:31,920
the second floor

991
00:35:35,829 --> 00:35:33,839
bolted down and then we run the test for

992
00:35:37,589 --> 00:35:35,839
about 30 days

993
00:35:39,670 --> 00:35:37,599
the final test that i'm showing you here

994
00:35:42,790 --> 00:35:39,680
is our

995
00:35:45,430 --> 00:35:42,800
spin test and we do this because the

996
00:35:46,390 --> 00:35:45,440
spacecraft spin at about 5 rpm nominally

997
00:35:47,829 --> 00:35:46,400
on orbit

998
00:35:50,310 --> 00:35:47,839
and we need to make sure they're well

999
00:35:52,310 --> 00:35:50,320
balanced so this test is a lot like

1000
00:35:54,069 --> 00:35:52,320
taking car tires and getting them

1001
00:35:58,230 --> 00:35:54,079
balanced at the garage

1002
00:35:59,670 --> 00:35:58,240
and as you well know you can put some

1003
00:36:01,270 --> 00:35:59,680
various weights of different parts on

1004
00:36:02,550 --> 00:36:01,280
the wheel to make sure that they

1005
00:36:04,710 --> 00:36:02,560
that they're all balanced and we do the

1006
00:36:07,349 --> 00:36:04,720
same thing with the spacecraft

1007
00:36:07,750 --> 00:36:07,359
on orbit um we do have a period where we

1008
00:36:09,349 --> 00:36:07,760
spin

1009
00:36:10,870 --> 00:36:09,359
a little bit faster than nominal in

1010
00:36:12,310 --> 00:36:10,880
order to make those deployments of the

1011
00:36:13,990 --> 00:36:12,320
wire booms

1012
00:36:17,589 --> 00:36:14,000
but once we're in a nominal condition

1013
00:36:19,750 --> 00:36:17,599

we'll spin at about 5 rpm

1014
00:36:21,349 --> 00:36:19,760
the final slide that i want to show you

1015
00:36:22,550 --> 00:36:21,359
is the spacecraft in the stacked

1016
00:36:24,630 --> 00:36:22,560
configuration

1017
00:36:25,910 --> 00:36:24,640
down at the cape so this was just taken

1018
00:36:27,589 --> 00:36:25,920
a few days ago

1019
00:36:28,950 --> 00:36:27,599
inside the fairing you can see there

1020
00:36:30,870 --> 00:36:28,960
we're stacked on top of the launch

1021
00:36:34,310 --> 00:36:30,880
vehicle adapter

1022
00:36:35,430 --> 00:36:34,320
and and so the the team has been working

1023
00:36:37,349 --> 00:36:35,440
very hard over the

1024
00:36:39,510 --> 00:36:37,359
period of about five years to get to

1025
00:36:40,470 --> 00:36:39,520
this point uh we're very proud of the

1026
00:36:43,670 --> 00:36:40,480
mission

1027
00:36:45,109 --> 00:36:43,680
and um as a runner uh there's a slogan

1028
00:36:45,990 --> 00:36:45,119
that you see occasionally written on

1029
00:36:49,750 --> 00:36:46,000
t-shirts

1030
00:36:50,470 --> 00:36:49,760
which says uh uh my sport is your sports

1031
00:36:51,829 --> 00:36:50,480
punishment

1032
00:36:53,910 --> 00:36:51,839
and that's how we feel about this

1033
00:36:55,829 --> 00:36:53,920
mission so our mission is other missions

1034
00:36:57,510 --> 00:36:55,839
punishment nobody really wants to live

1035
00:37:00,470 --> 00:36:57,520
in the environment that we're going to

1036
00:37:01,829 --> 00:37:00,480
live in for two years and so it's taken

1037
00:37:03,589 --> 00:37:01,839
a lot of effort

1038
00:37:05,990 --> 00:37:03,599

to overcome some of the challenges that

1039
00:37:08,230 --> 00:37:06,000
i just spoke about to get to this point

1040
00:37:09,430 --> 00:37:08,240
and we're very pleased and happy to be

1041
00:37:12,150 --> 00:37:09,440
uh uh

1042
00:37:14,470 --> 00:37:12,160
at this point um just uh less than uh a

1043
00:37:16,790 --> 00:37:14,480
couple of weeks away from launch so

1044
00:37:18,550 --> 00:37:16,800
um with that i'd like to wrap it up and

1045
00:37:19,829 --> 00:37:18,560
uh i want to say a special thank you to

1046
00:37:22,069 --> 00:37:19,839
the team

1047
00:37:25,109 --> 00:37:22,079
that we've assembled this fantastic rbsp

1048
00:37:26,790 --> 00:37:25,119
team that's pulled this mission together

1049
00:37:28,630 --> 00:37:26,800
thanks rick and with that we'll start

1050
00:37:30,710 --> 00:37:28,640
the question and answer session

1051
00:37:32,790 --> 00:37:30,720
we have a number of people joining us

1052
00:37:33,829 --> 00:37:32,800
today from a variety of locations so we

1053
00:37:35,829 --> 00:37:33,839
ask that reporters

1054
00:37:36,870 --> 00:37:35,839
limit themselves to one question and one

1055
00:37:38,870 --> 00:37:36,880
follow-up

1056
00:37:41,829 --> 00:37:38,880
we will go around a second time if time

1057
00:37:44,150 --> 00:37:41,839
permits also we'd like to have you

1058
00:37:45,510 --> 00:37:44,160
identify yourself your media affiliation

1059
00:37:47,430 --> 00:37:45,520
and then direct your question to a

1060
00:37:49,829 --> 00:37:47,440
specific panelist if at all possible

1061
00:37:51,109 --> 00:37:49,839
to avoid any confusion for those on the

1062
00:37:52,630 --> 00:37:51,119
telephone bridge

1063
00:37:54,710 --> 00:37:52,640

who would like to ask a question push

1064
00:37:57,109 --> 00:37:54,720
the star one keys on your telephone

1065
00:37:57,910 --> 00:37:57,119
to be placed in the queue and once again

1066
00:38:01,349 --> 00:37:57,920
on twitter

1067
00:38:03,510 --> 00:38:01,359
you can send your questions to ask nasa

1068
00:38:04,550 --> 00:38:03,520
and we do have one question already in

1069
00:38:07,910 --> 00:38:04,560
the queue from the

1070
00:38:09,109 --> 00:38:07,920
twitter twitter spear um

1071
00:38:11,109 --> 00:38:09,119
this question i'm not sure who it's

1072
00:38:13,430 --> 00:38:11,119
gonna go to but what's the impact of

1073
00:38:16,390 --> 00:38:13,440
on the mission if for whatever reason

1074
00:38:19,750 --> 00:38:16,400
one of the probes doesn't work

1075
00:38:23,589 --> 00:38:19,760
okay i'll take that uh question

1076
00:38:26,069 --> 00:38:23,599
the answer is first of all we anticipate

1077
00:38:26,870 --> 00:38:26,079
that they're both going to work they're

1078
00:38:28,710 --> 00:38:26,880
have the

1079
00:38:30,950 --> 00:38:28,720
as you have just heard from rick they

1080
00:38:32,310 --> 00:38:30,960
have been well designed well tested

1081
00:38:34,069 --> 00:38:32,320
thoroughly tested

1082
00:38:35,430 --> 00:38:34,079
and so our anticipation is that they

1083
00:38:37,910 --> 00:38:35,440
will work however

1084
00:38:38,710 --> 00:38:37,920
if they don't work if one of them

1085
00:38:41,270 --> 00:38:38,720
doesn't work

1086
00:38:42,470 --> 00:38:41,280
then we still have these very

1087
00:38:45,190 --> 00:38:42,480
sophisticated

1088
00:38:45,670 --> 00:38:45,200

instruments out there that are capable

1089
00:38:50,230 --> 00:38:45,680
of

1090
00:38:52,310 --> 00:38:50,240
the radiation belts

1091
00:38:54,390 --> 00:38:52,320
and so that we think that we can achieve

1092
00:38:57,589 --> 00:38:54,400
some really stunning science

1093
00:38:59,589 --> 00:38:57,599
even if we only have one spacecraft and

1094
00:39:00,630 --> 00:38:59,599
i think i'll add to that i think we have

1095
00:39:02,390 --> 00:39:00,640
a situation

1096
00:39:05,030 --> 00:39:02,400
because this is part of living with a

1097
00:39:05,910 --> 00:39:05,040
star we are actually going to be able to

1098
00:39:07,990 --> 00:39:05,920
study

1099
00:39:10,790 --> 00:39:08,000
sort of the causes and consequences that

1100
00:39:14,710 --> 00:39:10,800
causes solar variability and its impact

1101
00:39:16,150 --> 00:39:14,720
uh even with one spacecraft

1102
00:39:18,630 --> 00:39:16,160
thank you i believe we have someone on

1103
00:39:22,870 --> 00:39:18,640
the radio right on the telephone rather

1104
00:39:27,510 --> 00:39:25,910
um hi this is lisa i'm wondering why

1105
00:39:28,390 --> 00:39:27,520
these questions have gone unanswered for

1106
00:39:32,790 --> 00:39:28,400
so long

1107
00:39:36,150 --> 00:39:34,710
i didn't hear the question i'm afraid

1108
00:39:38,470 --> 00:39:36,160
the question was how come

1109
00:39:39,750 --> 00:39:38,480
the uh these questions have gone on and

1110
00:39:42,630 --> 00:39:39,760
unanswered for so long

1111
00:39:44,790 --> 00:39:42,640
well it i let me take a take a stab at

1112
00:39:48,150 --> 00:39:44,800
that uh it's not for lack of trying

1113
00:39:50,950 --> 00:39:48,160

uh one of the greatest advances uh

1114
00:39:52,150 --> 00:39:50,960
in understanding the new dynamics of the

1115
00:39:54,390 --> 00:39:52,160
radiation belts was the

1116
00:39:56,069 --> 00:39:54,400
was the air force cress mission that

1117
00:40:00,390 --> 00:39:56,079
flew in the early 90s

1118
00:40:02,230 --> 00:40:00,400
and then nasa flew the sampex mission

1119
00:40:04,470 --> 00:40:02,240
which is a low altitude mission but

1120
00:40:05,349 --> 00:40:04,480
could monitor the radiation belt over

1121
00:40:07,990 --> 00:40:05,359
long

1122
00:40:09,190 --> 00:40:08,000
periods of time but these were single

1123
00:40:12,069 --> 00:40:09,200
spacecraft

1124
00:40:14,150 --> 00:40:12,079
and they the fundamental issue of being

1125
00:40:16,870 --> 00:40:14,160
able to separate spatial

1126
00:40:18,870 --> 00:40:16,880
variations from temporal variations they

1127
00:40:20,870 --> 00:40:18,880
just could not uh were not able to do

1128
00:40:24,630 --> 00:40:20,880
that and that's so fundamental

1129
00:40:26,230 --> 00:40:24,640
uh that that we really can't resolve

1130
00:40:28,550 --> 00:40:26,240
the mysteries that are there without

1131
00:40:30,069 --> 00:40:28,560
that capability i also wanted to point

1132
00:40:32,069 --> 00:40:30,079
out that there are

1133
00:40:34,069 --> 00:40:32,079
more recent technologies instrument

1134
00:40:35,030 --> 00:40:34,079
technologies that really allow us to

1135
00:40:37,430 --> 00:40:35,040
make

1136
00:40:39,349 --> 00:40:37,440
much much cleaner measurements in the

1137
00:40:40,230 --> 00:40:39,359
radiation belt than we've ever been able

1138
00:40:43,430 --> 00:40:40,240

to do

1139
00:40:45,190 --> 00:40:43,440
uh before this these penetrating

1140
00:40:46,870 --> 00:40:45,200
particles get into the ear instruments

1141
00:40:49,109 --> 00:40:46,880
they contaminate the measurements

1142
00:40:50,710 --> 00:40:49,119
it's just a very hard thing to do and

1143
00:40:51,990 --> 00:40:50,720
more recent technologies have

1144
00:40:55,190 --> 00:40:52,000
allowed us to make much better

1145
00:40:55,510 --> 00:40:55,200
measurements and if i may add to that i

1146
00:40:58,069 --> 00:40:55,520
think

1147
00:40:59,109 --> 00:40:58,079
we are studying the radiation belt for

1148
00:41:01,829 --> 00:40:59,119
its signs sake

1149
00:41:04,069 --> 00:41:01,839
intrinsic signs as it applies to the

1150
00:41:06,309 --> 00:41:04,079
bells and elsewhere in the universe

1151
00:41:08,790 --> 00:41:06,319
but it's also for its relevance to life

1152
00:41:11,750 --> 00:41:08,800
and society and i think space weather

1153
00:41:13,030 --> 00:41:11,760
is a really emerging area where we are

1154
00:41:15,190 --> 00:41:13,040
beginning to

1155
00:41:16,390 --> 00:41:15,200
understand the impact of solar

1156
00:41:19,430 --> 00:41:16,400
variability

1157
00:41:20,150 --> 00:41:19,440
on our technology uh whether it's in the

1158
00:41:23,270 --> 00:41:20,160
radiation

1159
00:41:23,589 --> 00:41:23,280
belts elsewhere and and so recognizing

1160
00:41:27,109 --> 00:41:23,599
that

1161
00:41:28,630 --> 00:41:27,119
importance i think we are uh making sure

1162
00:41:30,230 --> 00:41:28,640
that we have the appropriate

1163
00:41:34,550 --> 00:41:30,240

observations and measurements

1164
00:41:37,030 --> 00:41:34,560
to really understand uh these systems

1165
00:41:38,309 --> 00:41:37,040
and now i'm just sorry one last thing to

1166
00:41:40,790 --> 00:41:38,319
that which is that

1167
00:41:43,510 --> 00:41:40,800
we are becoming very dependent on our

1168
00:41:45,430 --> 00:41:43,520
space assets we have more than 300

1169
00:41:47,510 --> 00:41:45,440
satellites in geosynchronous

1170
00:41:49,349 --> 00:41:47,520
orbit i don't know how many we have in

1171
00:41:51,430 --> 00:41:49,359
low earth orbit we also have the space

1172
00:41:53,670 --> 00:41:51,440
station up there so

1173
00:41:54,790 --> 00:41:53,680
these assets are very important we have

1174
00:41:57,270 --> 00:41:54,800
to understand

1175
00:41:59,270 --> 00:41:57,280
this space environment and that's what

1176
00:42:01,589 --> 00:41:59,280
we're setting out to do

1177
00:42:03,109 --> 00:42:01,599
sounds good we're also going back to our

1178
00:42:04,150 --> 00:42:03,119
telephone bridge once again with clara

1179
00:42:07,750 --> 00:42:04,160
moskowitz

1180
00:42:11,190 --> 00:42:10,069
yes hi my question i think it's ramona

1181
00:42:13,670 --> 00:42:11,200
uh you mentioned

1182
00:42:14,470 --> 00:42:13,680
that the iss sometimes passes through

1183
00:42:17,510 --> 00:42:14,480
these belts

1184
00:42:21,030 --> 00:42:17,520
if they expand down lower um

1185
00:42:22,870 --> 00:42:21,040
can you say whether the iss has recently

1186
00:42:24,550 --> 00:42:22,880
made a pass through the belts and just

1187
00:42:25,910 --> 00:42:24,560
how high how much higher is the

1188
00:42:28,550 --> 00:42:25,920

radiation dose

1189
00:42:30,150 --> 00:42:28,560
they experience than the normal iss

1190
00:42:33,430 --> 00:42:30,160
radiation dose

1191
00:42:35,510 --> 00:42:33,440
we have been going through a time where

1192
00:42:37,990 --> 00:42:35,520
the sun has been very quiet

1193
00:42:39,190 --> 00:42:38,000
actually so most of the time that the

1194
00:42:41,030 --> 00:42:39,200
space station

1195
00:42:42,950 --> 00:42:41,040
recently has been a time where we

1196
00:42:46,069 --> 00:42:42,960
haven't had that much activity

1197
00:42:47,750 --> 00:42:46,079
and we haven't had any any recent times

1198
00:42:49,349 --> 00:42:47,760
where the space station has

1199
00:42:52,470 --> 00:42:49,359
has been going through the radiation

1200
00:42:55,589 --> 00:42:52,480
belts the dosage that you might get

1201
00:42:57,990 --> 00:42:55,599
on a quick pass-through is is much less

1202
00:43:01,109 --> 00:42:58,000
than you would get from a ct scan

1203
00:43:02,870 --> 00:43:01,119
so it's really only prolonged over the

1204
00:43:04,150 --> 00:43:02,880
course of quite some time

1205
00:43:07,030 --> 00:43:04,160
that you're going to get anything

1206
00:43:11,589 --> 00:43:09,190
thanks mona we have another twitter

1207
00:43:12,230 --> 00:43:11,599
question here how will rbsp improve

1208
00:43:16,870 --> 00:43:12,240
space

1209
00:43:22,470 --> 00:43:20,069
i mean one of the ways we we generate

1210
00:43:24,630 --> 00:43:22,480
predictions is by generating

1211
00:43:25,510 --> 00:43:24,640
models simulations and models of the

1212
00:43:29,670 --> 00:43:25,520
space

1213
00:43:33,030 --> 00:43:29,680

preliminary simulations

1214
00:43:36,069 --> 00:43:33,040
they do they are able to predict

1215
00:43:36,790 --> 00:43:36,079
space weather to limited degrees what we

1216
00:43:39,990 --> 00:43:36,800
need to do

1217
00:43:42,309 --> 00:43:40,000
is to solve the fundamental science of

1218
00:43:43,030 --> 00:43:42,319
the radiation so that we can improve

1219
00:43:45,270 --> 00:43:43,040
those uh

1220
00:43:46,150 --> 00:43:45,280
those basic models many of those models

1221
00:43:48,069 --> 00:43:46,160
are driven

1222
00:43:50,150 --> 00:43:48,079
by the interplanetary environment the

1223
00:43:52,470 --> 00:43:50,160
the solar wind comes at uh

1224
00:43:53,270 --> 00:43:52,480
at the earth's magnetosphere it has a

1225
00:43:55,829 --> 00:43:53,280
density

1226
00:43:56,470 --> 00:43:55,839
it has a velocity it contains a magnetic

1227
00:43:59,430 --> 00:43:56,480
field

1228
00:44:01,270 --> 00:43:59,440
and these simulation models do have some

1229
00:44:02,309 --> 00:44:01,280
preliminary predictions of what the

1230
00:44:05,030 --> 00:44:02,319
consequences

1231
00:44:06,470 --> 00:44:05,040
of those inputs are to the space

1232
00:44:09,030 --> 00:44:06,480
environment around earth

1233
00:44:10,790 --> 00:44:09,040
we do not those models do not contain

1234
00:44:11,750 --> 00:44:10,800
enough of the fundamental physics that

1235
00:44:14,069 --> 00:44:11,760
we need to find

1236
00:44:15,430 --> 00:44:14,079
out in order for those models to give a

1237
00:44:18,069 --> 00:44:15,440
high fidelity

1238
00:44:19,829 --> 00:44:18,079

prediction and by improving the our

1239
00:44:20,790 --> 00:44:19,839
understanding of the fundamental physics

1240
00:44:22,870 --> 00:44:20,800
in this region

1241
00:44:24,950 --> 00:44:22,880
those models will become higher and

1242
00:44:26,550 --> 00:44:24,960
higher in fidelity and will improve our

1243
00:44:29,190 --> 00:44:26,560
predictions

1244
00:44:31,430 --> 00:44:29,200
and and also add that some of the models

1245
00:44:32,390 --> 00:44:31,440
are empirical models which means that

1246
00:44:35,910 --> 00:44:32,400
they actually

1247
00:44:38,069 --> 00:44:35,920
take data that exists in that region and

1248
00:44:40,230 --> 00:44:38,079
assimilate it into the model

1249
00:44:41,589 --> 00:44:40,240
and when we once we have the rbsp

1250
00:44:43,990 --> 00:44:41,599
satellites up there there'll be

1251
00:44:45,910 --> 00:44:44,000
additional data that can be assimilated

1252
00:44:49,430 --> 00:44:45,920
into the models and as barry said we're

1253
00:44:51,109 --> 00:44:49,440
going to have much higher fidelity

1254
00:44:53,109 --> 00:44:51,119
we'll go back to the telephone bridge

1255
00:44:56,710 --> 00:44:53,119
now with al staller from

1256
00:45:02,309 --> 00:45:00,069
house dollar kvmr question for barry

1257
00:45:03,829 --> 00:45:02,319
despite the radiation hardening do you

1258
00:45:06,470 --> 00:45:03,839
envision there might be a scenario when

1259
00:45:09,990 --> 00:45:06,480
you would have to go into safe mode

1260
00:45:11,030 --> 00:45:10,000
um one of the um one of the fundamental

1261
00:45:14,630 --> 00:45:11,040
requirements

1262
00:45:14,950 --> 00:45:14,640
of the radiation belt uh storm probes is

1263
00:45:17,349 --> 00:45:14,960

it

1264
00:45:18,710 --> 00:45:17,359
had to be designed to what we call

1265
00:45:20,550 --> 00:45:18,720
operate through

1266
00:45:21,750 --> 00:45:20,560
the radiation belt storm probes are

1267
00:45:23,910 --> 00:45:21,760
designed with an

1268
00:45:24,950 --> 00:45:23,920
operate through requirement which means

1269
00:45:27,190 --> 00:45:24,960
that it has to

1270
00:45:27,990 --> 00:45:27,200
take quality measurements during the

1271
00:45:31,190 --> 00:45:28,000
worst

1272
00:45:32,710 --> 00:45:31,200
of the uh the highest intensity

1273
00:45:34,710 --> 00:45:32,720
radiation belt events

1274
00:45:35,750 --> 00:45:34,720
we've characterized that worst case

1275
00:45:39,510 --> 00:45:35,760
environment

1276
00:45:40,550 --> 00:45:39,520
were made over the last couple of

1277
00:45:43,750 --> 00:45:40,560
decades

1278
00:45:45,510 --> 00:45:43,760
and so the the spacecraft and its

1279
00:45:47,510 --> 00:45:45,520
interior and all the instrument was

1280
00:45:50,790 --> 00:45:47,520
designed with that worst case

1281
00:45:53,430 --> 00:45:50,800
radiation environment in mind and so we

1282
00:45:55,510 --> 00:45:53,440
absolutely do not anticipate that rbsp

1283
00:45:59,109 --> 00:45:55,520
will go into safe mode because of high

1284
00:46:00,470 --> 00:45:59,119
radiation once again if you would like

1285
00:46:02,309 --> 00:46:00,480
to ask a question on the telephone

1286
00:46:04,069 --> 00:46:02,319
bridge push the star one keys on your

1287
00:46:06,550 --> 00:46:04,079
telephone to be placed in the queue

1288
00:46:08,630 --> 00:46:06,560

and you can send your questions to ask

1289
00:46:10,390 --> 00:46:08,640
nasa on the twitter sphere

1290
00:46:12,069 --> 00:46:10,400
another question here which i think is

1291
00:46:14,470 --> 00:46:12,079
pretty interesting is there any chance

1292
00:46:16,230 --> 00:46:14,480
of harnessing the energy in the in the

1293
00:46:20,230 --> 00:46:16,240
belt since the flow is constant

1294
00:46:20,240 --> 00:46:24,470
i can dive in there

1295
00:46:29,349 --> 00:46:26,790
the answer is probably not there's a

1296
00:46:31,190 --> 00:46:29,359
tremendous amount of energy

1297
00:46:32,790 --> 00:46:31,200
within the radiation belts but the

1298
00:46:34,710 --> 00:46:32,800
energy density

1299
00:46:36,950 --> 00:46:34,720
within the radiation belts that means

1300
00:46:40,150 --> 00:46:36,960
the energy per cubic meter

1301
00:46:42,630 --> 00:46:40,160
if you will is in fact very very low and

1302
00:46:44,710 --> 00:46:42,640
in order to harness an energy source

1303
00:46:47,030 --> 00:46:44,720
not only do you need a lot of energy but

1304
00:46:48,630 --> 00:46:47,040
you need a lot of energy density

1305
00:46:51,190 --> 00:46:48,640
in order for it to be an efficient

1306
00:46:52,790 --> 00:46:51,200
source of energy so no despite the fact

1307
00:46:53,829 --> 00:46:52,800
that the radiation belt are very

1308
00:46:56,550 --> 00:46:53,839
dangerous

1309
00:46:58,790 --> 00:46:56,560
very high energy in total the energy

1310
00:47:02,230 --> 00:46:58,800
density is in fact too small to be a

1311
00:47:03,990 --> 00:47:02,240
practical source of energy

1312
00:47:05,589 --> 00:47:04,000
all right back to the twitter sphere

1313
00:47:08,829 --> 00:47:05,599

when do you expect the first science

1314
00:47:15,910 --> 00:47:12,470
um we have a commissioning phase

1315
00:47:18,390 --> 00:47:15,920
that's going to last about 60 days

1316
00:47:20,309 --> 00:47:18,400
and after that we are going to be

1317
00:47:20,790 --> 00:47:20,319
getting results out very quickly we've

1318
00:47:23,750 --> 00:47:20,800
actually

1319
00:47:24,309 --> 00:47:23,760
targeted the american geophysical union

1320
00:47:26,230 --> 00:47:24,319
meeting

1321
00:47:27,349 --> 00:47:26,240
which will be in december in san

1322
00:47:29,430 --> 00:47:27,359
francisco

1323
00:47:31,030 --> 00:47:29,440
and we have a special session there and

1324
00:47:31,829 --> 00:47:31,040
we're going to show some of our early

1325
00:47:33,190 --> 00:47:31,839
results

1326
00:47:35,349 --> 00:47:33,200
we've got to give the scientists a

1327
00:47:36,870 --> 00:47:35,359
little bit of time to look at the data

1328
00:47:38,950 --> 00:47:36,880
once we've gone through commissioning

1329
00:47:39,510 --> 00:47:38,960
but but we're expecting that that

1330
00:47:41,190 --> 00:47:39,520
meeting

1331
00:47:45,190 --> 00:47:41,200
is going to be the first time that we're

1332
00:47:49,510 --> 00:47:47,349
okay one more question here and this

1333
00:47:51,349 --> 00:47:49,520
involves the educational component

1334
00:47:52,790 --> 00:47:51,359
how are students participating in this

1335
00:47:56,630 --> 00:47:52,800
mission

1336
00:47:58,470 --> 00:47:56,640
i can start we actually have

1337
00:48:00,870 --> 00:47:58,480
like some of our flight controllers our

1338
00:48:02,549 --> 00:48:00,880

college students from area universities

1339
00:48:03,510 --> 00:48:02,559
who have been trained over the summer

1340
00:48:06,069 --> 00:48:03,520
and

1341
00:48:07,990 --> 00:48:06,079
an intense period to be able to operate

1342
00:48:12,470 --> 00:48:08,000
the satellites

1343
00:48:17,190 --> 00:48:12,480
we also have a very robust epo program

1344
00:48:19,430 --> 00:48:17,200
that involves k through 12 and also

1345
00:48:20,950 --> 00:48:19,440
college students as well and barrier

1346
00:48:23,589 --> 00:48:20,960
money might have more details to talk

1347
00:48:25,829 --> 00:48:23,599
about i just want to point out that the

1348
00:48:26,390 --> 00:48:25,839
principal investigators of the various

1349
00:48:28,309 --> 00:48:26,400
uh

1350
00:48:29,430 --> 00:48:28,319
investigations all come from major

1351
00:48:31,510 --> 00:48:29,440
universities

1352
00:48:33,430 --> 00:48:31,520
they all have student involvement in the

1353
00:48:35,190 --> 00:48:33,440
fundamental science that they are

1354
00:48:37,270 --> 00:48:35,200
they're doing they had student

1355
00:48:39,750 --> 00:48:37,280
involvement in the construction

1356
00:48:40,870 --> 00:48:39,760
and design of the instruments at some

1357
00:48:43,670 --> 00:48:40,880
always at some

1358
00:48:45,109 --> 00:48:43,680
relatively low level but uh but but

1359
00:48:46,630 --> 00:48:45,119
involvement as well

1360
00:48:49,030 --> 00:48:46,640
and those students again will be

1361
00:48:49,829 --> 00:48:49,040
involved in get pulling the science out

1362
00:48:52,870 --> 00:48:49,839
of the uh

1363
00:48:55,270 --> 00:48:52,880

out of the data this is a our our leads

1364
00:48:57,510 --> 00:48:55,280
are uh major participants in their

1365
00:49:00,309 --> 00:48:57,520
university education programs

1366
00:49:01,829 --> 00:49:00,319
and and i'll say a final note to that

1367
00:49:03,990 --> 00:49:01,839
because i've been

1368
00:49:05,829 --> 00:49:04,000
going around the country several places

1369
00:49:08,549 --> 00:49:05,839
i've been doing some lectures on

1370
00:49:10,230 --> 00:49:08,559
upcoming science of rbsp and there are

1371
00:49:12,390 --> 00:49:10,240
always lots of students there the

1372
00:49:14,150 --> 00:49:12,400
students are very excited and very

1373
00:49:16,069 --> 00:49:14,160
interested sometimes the students make

1374
00:49:17,910 --> 00:49:16,079
up a quarter of the audience

1375
00:49:19,670 --> 00:49:17,920
so i can tell you that there are a lot

1376
00:49:20,390 --> 00:49:19,680
of students interested and they'll be

1377
00:49:22,390 --> 00:49:20,400
engaged

1378
00:49:24,390 --> 00:49:22,400
in the analysis as soon as we get that

1379
00:49:26,710 --> 00:49:24,400
data flowing

1380
00:49:28,790 --> 00:49:26,720
i think living with the star program

1381
00:49:30,549 --> 00:49:28,800
also has a summer school called

1382
00:49:31,990 --> 00:49:30,559
heliophysics summer school where we

1383
00:49:34,549 --> 00:49:32,000
actually train

1384
00:49:35,750 --> 00:49:34,559
the next generation of who we call

1385
00:49:37,630 --> 00:49:35,760
heliophysicists

1386
00:49:39,270 --> 00:49:37,640
who actually look at this broad

1387
00:49:41,910 --> 00:49:39,280
interdisciplinary signs

1388
00:49:42,390 --> 00:49:41,920

not only just radiation built signs but

1389
00:49:45,510 --> 00:49:42,400
how

1390
00:49:47,109 --> 00:49:45,520
does the sun relate to what goes on in

1391
00:49:50,150 --> 00:49:47,119
the radiation bill

1392
00:49:52,870 --> 00:49:50,160
we get about 40 students each year we

1393
00:49:53,589 --> 00:49:52,880
support undergraduate students post docs

1394
00:49:56,470 --> 00:49:53,599
so there

1395
00:49:59,829 --> 00:49:56,480
are a number of ways we are trying to

1396
00:50:01,990 --> 00:49:59,839
educate the next generation

1397
00:50:03,030 --> 00:50:02,000
thank you i believe we have space.com's

1398
00:50:06,549 --> 00:50:03,040
clara moskowitz

1399
00:50:08,870 --> 00:50:06,559
on the line again yes thank you

1400
00:50:09,750 --> 00:50:08,880
um just a quick question and a slightly

1401
00:50:10,950 --> 00:50:09,760
longer one

1402
00:50:13,349 --> 00:50:10,960
first of all i'm wondering what the

1403
00:50:15,910 --> 00:50:13,359
total cost of the mission is

1404
00:50:17,510 --> 00:50:15,920
and then secondly i have a question that

1405
00:50:20,630 --> 00:50:17,520
maybe is a dumb question but

1406
00:50:22,309 --> 00:50:20,640
if you have such um rigorous shielding

1407
00:50:23,990 --> 00:50:22,319
on the spacecraft then how are the

1408
00:50:25,510 --> 00:50:24,000
instruments going to be able to

1409
00:50:27,270 --> 00:50:25,520
measure all this radiation they're being

1410
00:50:29,030 --> 00:50:27,280
exposed to

1411
00:50:31,349 --> 00:50:29,040
i'll answer the first question to let

1412
00:50:32,470 --> 00:50:31,359
rick answer the second question the cost

1413
00:50:36,069 --> 00:50:32,480

of this mission

1414
00:50:37,349 --> 00:50:36,079
is about 670 million dollars and that

1415
00:50:40,470 --> 00:50:37,359
includes the launch

1416
00:50:40,950 --> 00:50:40,480
vehicle you want me to answer the answer

1417
00:50:42,790 --> 00:50:40,960
sure

1418
00:50:44,390 --> 00:50:42,800
okay that's an interesting question you

1419
00:50:46,069 --> 00:50:44,400
know one of the problems with measuring

1420
00:50:47,430 --> 00:50:46,079
these radiation particles that to

1421
00:50:48,710 --> 00:50:47,440
measure them you actually have to let

1422
00:50:51,430 --> 00:50:48,720
them into the sensor

1423
00:50:52,309 --> 00:50:51,440
and so uh you're uh you can't shield

1424
00:50:54,870 --> 00:50:52,319
everything out

1425
00:50:57,109 --> 00:50:54,880
you do you have a lot of shielding over

1426
00:50:59,510 --> 00:50:57,119
most of the instrument you control

1427
00:51:00,950 --> 00:50:59,520
the those particles that can ca come

1428
00:51:01,430 --> 00:51:00,960
into the instrument there are very there

1429
00:51:04,470 --> 00:51:01,440
are

1430
00:51:04,950 --> 00:51:04,480
orifices openings that allow it in one

1431
00:51:07,670 --> 00:51:04,960
of the

1432
00:51:09,349 --> 00:51:07,680
the new technologies that allows us to

1433
00:51:11,670 --> 00:51:09,359
make these measurements in a fashion

1434
00:51:13,910 --> 00:51:11,680
that we have not been able to do before

1435
00:51:16,470 --> 00:51:13,920
is the use of coincident measurements

1436
00:51:19,510 --> 00:51:16,480
and what that means is a particle come

1437
00:51:21,430 --> 00:51:19,520
it comes in it makes a measurement in

1438
00:51:23,670 --> 00:51:21,440

it makes a signal in one part of the

1439
00:51:25,589 --> 00:51:23,680
instrument if it goes further into the

1440
00:51:27,030 --> 00:51:25,599
instrument and makes a signal in another

1441
00:51:30,230 --> 00:51:27,040
part of the instrument

1442
00:51:33,510 --> 00:51:30,240
and and the timing between those two uh

1443
00:51:36,870 --> 00:51:33,520
signals is very very short and by using

1444
00:51:37,510 --> 00:51:36,880
very fast circuitry you can discriminate

1445
00:51:39,109 --> 00:51:37,520
between

1446
00:51:41,109 --> 00:51:39,119
those particles that you're trying to

1447
00:51:42,950 --> 00:51:41,119
measure we call it the foreground

1448
00:51:44,549 --> 00:51:42,960
from those particles that penetrate

1449
00:51:47,349 --> 00:51:44,559
through the sides of the boxes

1450
00:51:49,510 --> 00:51:47,359
or come in some other way and so these

1451
00:51:50,470 --> 00:51:49,520
it's very sophisticated technology that

1452
00:51:52,549 --> 00:51:50,480
allows you to

1453
00:51:53,990 --> 00:51:52,559
separate out the good stuff from the bad

1454
00:51:56,150 --> 00:51:54,000
stuff

1455
00:51:57,750 --> 00:51:56,160
and so that's a very good question and

1456
00:52:01,030 --> 00:51:57,760
it's a very hard one

1457
00:52:01,349 --> 00:52:01,040
to achieve but but recent technologies

1458
00:52:04,710 --> 00:52:01,359
have

1459
00:52:06,630 --> 00:52:04,720
allowed us to do that

1460
00:52:07,990 --> 00:52:06,640
all right question here you mentioned a

1461
00:52:09,349 --> 00:52:08,000
dish being built in south korea in

1462
00:52:11,589 --> 00:52:09,359
another country is

1463
00:52:12,549 --> 00:52:11,599

nasa actually downloading the data here

1464
00:52:14,069 --> 00:52:12,559
in the u.s

1465
00:52:16,630 --> 00:52:14,079
or just relying on foreign partners oh

1466
00:52:19,349 --> 00:52:16,640
absolutely i was talking about the space

1467
00:52:20,150 --> 00:52:19,359
weather data that's our broadcast that's

1468
00:52:23,670 --> 00:52:20,160
that's out

1469
00:52:26,630 --> 00:52:23,680
24 7. but absolutely apl

1470
00:52:27,510 --> 00:52:26,640
is the is is the site that is

1471
00:52:30,390 --> 00:52:27,520
downloading

1472
00:52:32,230 --> 00:52:30,400
the science data there's a recorder on

1473
00:52:35,190 --> 00:52:32,240
board and so

1474
00:52:35,589 --> 00:52:35,200
that data will be downloaded every day

1475
00:52:38,950 --> 00:52:35,599
well

1476
00:52:39,829 --> 00:52:38,960
maybe once a day i think uh from that

1477
00:52:42,230 --> 00:52:39,839
recorder

1478
00:52:43,750 --> 00:52:42,240
and it will be downloaded here in the us

1479
00:52:45,670 --> 00:52:43,760
and processed and it will be

1480
00:52:47,349 --> 00:52:45,680
sent out to all of the operating center

1481
00:52:48,710 --> 00:52:47,359
each of the instruments has their own

1482
00:52:50,950 --> 00:52:48,720
operating center

1483
00:52:53,990 --> 00:52:50,960
right so the primary ground station is

1484
00:52:56,630 --> 00:52:54,000
at apl we have an 18 meter dish at apl

1485
00:52:57,190 --> 00:52:56,640
our mission operations center is there

1486
00:53:01,190 --> 00:52:57,200
and

1487
00:53:04,230 --> 00:53:01,200
half gigabits of data a day

1488
00:53:04,790 --> 00:53:04,240

so it's it's kind of like uh a dvd movie

1489
00:53:08,150 --> 00:53:04,800
and a half

1490
00:53:09,990 --> 00:53:08,160
every day that we download and and the

1491
00:53:12,870 --> 00:53:10,000
the science data itself

1492
00:53:14,309 --> 00:53:12,880
um is what we call bent pipe transmitted

1493
00:53:16,230 --> 00:53:14,319
to science operations centers

1494
00:53:19,190 --> 00:53:16,240
distributed across the country

1495
00:53:22,150 --> 00:53:19,200
for the various um science instrument

1496
00:53:26,829 --> 00:53:25,190
thanks uh this question here relates to

1497
00:53:29,430 --> 00:53:26,839
that uh what will the data actually look

1498
00:53:33,430 --> 00:53:29,440
like

1499
00:53:36,150 --> 00:53:33,440
well i'll i'll start with that one

1500
00:53:36,710 --> 00:53:36,160
it won't be pictures because what what

1501
00:53:39,670 --> 00:53:36,720
we'll get

1502
00:53:41,109 --> 00:53:39,680
are counts of particles and we will turn

1503
00:53:43,349 --> 00:53:41,119
those into something we call

1504
00:53:45,510 --> 00:53:43,359
phase-based density which will give us a

1505
00:53:48,069 --> 00:53:45,520
a bigger picture of of

1506
00:53:49,670 --> 00:53:48,079
what the distribution is around the

1507
00:53:51,190 --> 00:53:49,680
environment which we will put into

1508
00:53:53,030 --> 00:53:51,200
pictures at some point

1509
00:53:54,950 --> 00:53:53,040
and we'll get some squiggly lines that

1510
00:53:56,390 --> 00:53:54,960
are that are magnetic field data and

1511
00:53:58,870 --> 00:53:56,400
electric field data that

1512
00:54:01,030 --> 00:53:58,880
and the squiggliness is what tells us

1513
00:54:03,589 --> 00:54:01,040

what the characteristics of the wave

1514
00:54:04,390 --> 00:54:03,599
are and so those will be the primary

1515
00:54:06,630 --> 00:54:04,400
data that come

1516
00:54:07,670 --> 00:54:06,640
in but we will take those data and we

1517
00:54:10,790 --> 00:54:07,680
will make them more

1518
00:54:13,109 --> 00:54:10,800
accessible and i mean that's what we use

1519
00:54:14,630 --> 00:54:13,119
to in order to interpret because it's

1520
00:54:16,309 --> 00:54:14,640
actually the interactions between the

1521
00:54:18,790 --> 00:54:16,319
particles and the waves

1522
00:54:20,710 --> 00:54:18,800
which gives us the science i wanted to

1523
00:54:23,750 --> 00:54:20,720
add that in fact we

1524
00:54:23,990 --> 00:54:23,760
that is the low level science products

1525
00:54:26,150 --> 00:54:24,000
but

1526
00:54:27,109 --> 00:54:26,160
in fact one can make pictures the movie

1527
00:54:29,109 --> 00:54:27,119
that uh

1528
00:54:31,190 --> 00:54:29,119
that mona showed and the movie that i

1529
00:54:33,990 --> 00:54:31,200
showed were actually real data

1530
00:54:36,309 --> 00:54:34,000
they were taken from the sampex mission

1531
00:54:38,230 --> 00:54:36,319
they were interpreted and put into a

1532
00:54:40,390 --> 00:54:38,240
three-dimensional context

1533
00:54:42,950 --> 00:54:40,400
and i am absolutely confident we will be

1534
00:54:43,670 --> 00:54:42,960
doing exactly the same thing on the rbsb

1535
00:54:46,069 --> 00:54:43,680
mission

1536
00:54:47,910 --> 00:54:46,079
once we understand we have to make

1537
00:54:49,030 --> 00:54:47,920
certain assumptions in order to turn it

1538
00:54:51,430 --> 00:54:49,040

into line plots

1539
00:54:53,270 --> 00:54:51,440
into a three-dimensional movie but once

1540
00:54:53,990 --> 00:54:53,280
we understand the physics we can make

1541
00:54:56,309 --> 00:54:54,000
those

1542
00:54:58,309 --> 00:54:56,319
uh though we can put that into the data

1543
00:54:59,270 --> 00:54:58,319
and we can actually display the data in

1544
00:55:00,950 --> 00:54:59,280
that movie

1545
00:55:03,030 --> 00:55:00,960
form and i'm like i said i'm sure we

1546
00:55:03,829 --> 00:55:03,040
will be doing that yeah because that's

1547
00:55:06,230 --> 00:55:03,839
actually very

1548
00:55:07,510 --> 00:55:06,240
useful for the scientists as well as for

1549
00:55:10,069 --> 00:55:07,520
the public because

1550
00:55:10,549 --> 00:55:10,079
pictures tell stories very well and you

1551
00:55:12,230 --> 00:55:10,559
can see

1552
00:55:13,910 --> 00:55:12,240
as you were watching those movies you

1553
00:55:15,990 --> 00:55:13,920
got a really good sense of what was

1554
00:55:18,309 --> 00:55:16,000
happening in the radiation belts

1555
00:55:20,150 --> 00:55:18,319
so we will use that and and barry is

1556
00:55:21,270 --> 00:55:20,160
right we will we will achieve these

1557
00:55:25,510 --> 00:55:21,280
kinds of movies

1558
00:55:26,950 --> 00:55:25,520
at some point but it won't be immediate

1559
00:55:31,109 --> 00:55:26,960
thanks we're going back to the telephone

1560
00:55:35,109 --> 00:55:33,589
hey i had a follow-up question they're

1561
00:55:37,670 --> 00:55:35,119
following up on clara's question

1562
00:55:38,870 --> 00:55:37,680
um rick you were talking about um

1563
00:55:40,950 --> 00:55:38,880

shielding the

1564
00:55:42,390 --> 00:55:40,960
the space the instruments from the

1565
00:55:43,990 --> 00:55:42,400
background particles the particles you

1566
00:55:45,430 --> 00:55:44,000
don't want and then letting in certain

1567
00:55:47,349 --> 00:55:45,440
particles but if they're all the same

1568
00:55:49,589 --> 00:55:47,359
particles in the radiation belt

1569
00:55:50,789 --> 00:55:49,599
how do you decide which ones you want as

1570
00:55:52,549 --> 00:55:50,799
background and which ones you want to

1571
00:55:54,870 --> 00:55:52,559
let in

1572
00:55:56,630 --> 00:55:54,880
that's actually a better one for barry i

1573
00:55:58,230 --> 00:55:56,640
can give a simplistic answer but barry

1574
00:55:59,589 --> 00:55:58,240
can give a very detailed answer do you

1575
00:56:02,630 --> 00:55:59,599
want to field that one barry

1576
00:56:04,549 --> 00:56:02,640
well as i said in a previous answer you

1577
00:56:07,270 --> 00:56:04,559
do shield most of the instrument very

1578
00:56:09,910 --> 00:56:07,280
very robustly but you do have to have

1579
00:56:11,030 --> 00:56:09,920
an aperture that allows some particles

1580
00:56:12,950 --> 00:56:11,040
to come in

1581
00:56:14,549 --> 00:56:12,960
uh the particles come through that

1582
00:56:16,549 --> 00:56:14,559
aperture and they're more or less coming

1583
00:56:17,430 --> 00:56:16,559
all from the same from the same

1584
00:56:19,829 --> 00:56:17,440
direction

1585
00:56:21,510 --> 00:56:19,839
and they will hit a uh they will hit

1586
00:56:24,710 --> 00:56:21,520
some kind of detector

1587
00:56:26,710 --> 00:56:24,720
but that detector can also be hit by

1588
00:56:27,589 --> 00:56:26,720

particles coming from other directions

1589
00:56:29,670 --> 00:56:27,599
and that's when this

1590
00:56:31,190 --> 00:56:29,680
where this coincident circuitry

1591
00:56:33,030 --> 00:56:31,200
coincidence measurement because that

1592
00:56:35,510 --> 00:56:33,040
particle coming in a straight line

1593
00:56:36,789 --> 00:56:35,520
will hit one detector and then proceed

1594
00:56:39,270 --> 00:56:36,799
into the

1595
00:56:40,549 --> 00:56:39,280
volume of the of the sensor and hit

1596
00:56:43,349 --> 00:56:40,559
another detector

1597
00:56:45,910 --> 00:56:43,359
and by demanding that when i get hit by

1598
00:56:46,789 --> 00:56:45,920
one detector i also get hit on the other

1599
00:56:49,349 --> 00:56:46,799
detector

1600
00:56:49,910 --> 00:56:49,359
i can tell what direction that particle

1601
00:56:51,910 --> 00:56:49,920
came from

1602
00:56:53,190 --> 00:56:51,920
i can tell that it came through the

1603
00:56:54,950 --> 00:56:53,200
proper aperture

1604
00:56:56,829 --> 00:56:54,960
and that it did not come through some

1605
00:56:58,950 --> 00:56:56,839
other direction so it's a very

1606
00:57:01,910 --> 00:56:58,960
sophisticated set of detectors

1607
00:57:03,670 --> 00:57:01,920
inside the inside the box that allows

1608
00:57:05,349 --> 00:57:03,680
you to discriminate from those particles

1609
00:57:06,870 --> 00:57:05,359
coming from the wrong direction

1610
00:57:09,270 --> 00:57:06,880
from those particles coming from the

1611
00:57:10,470 --> 00:57:09,280
right direction but maybe maybe to add

1612
00:57:12,549 --> 00:57:10,480
to that barry

1613
00:57:13,670 --> 00:57:12,559

the question is we are actually going to

1614
00:57:15,990 --> 00:57:13,680
be sampling

1615
00:57:17,990 --> 00:57:16,000
from lots of different directions

1616
00:57:20,549 --> 00:57:18,000
because we really do want to know

1617
00:57:21,910 --> 00:57:20,559
which direction in general or the

1618
00:57:24,069 --> 00:57:21,920
particles are coming from

1619
00:57:25,030 --> 00:57:24,079
and there are times when they come from

1620
00:57:27,349 --> 00:57:25,040
one direction

1621
00:57:29,109 --> 00:57:27,359
primarily and our instrument will be

1622
00:57:30,710 --> 00:57:29,119
able to tell us that because we'll be

1623
00:57:33,670 --> 00:57:30,720
sampling from a larger

1624
00:57:33,990 --> 00:57:33,680
set of directions but we will see that

1625
00:57:35,910 --> 00:57:34,000
oh

1626
00:57:37,349 --> 00:57:35,920
they're all coming from this direction

1627
00:57:39,030 --> 00:57:37,359
and we'll continue with that

1628
00:57:40,870 --> 00:57:39,040
and that's going to be in in three

1629
00:57:42,150 --> 00:57:40,880
dimensions so that we will really be

1630
00:57:43,750 --> 00:57:42,160
able to tell

1631
00:57:45,430 --> 00:57:43,760
where these particles are coming from

1632
00:57:46,950 --> 00:57:45,440
let me add that one of the important

1633
00:57:48,950 --> 00:57:46,960
aspect that this is a spinning

1634
00:57:50,309 --> 00:57:48,960
spacecraft so sometimes the detector

1635
00:57:51,670 --> 00:57:50,319
looks in one direction and then it's

1636
00:57:54,150 --> 00:57:51,680
spinning around so

1637
00:57:55,670 --> 00:57:54,160
at different times in the spin it is

1638
00:57:56,309 --> 00:57:55,680

looking in different directions and

1639
00:57:57,829 --> 00:57:56,319
that's how

1640
00:57:59,750 --> 00:57:57,839
that's one of the more important ways

1641
00:58:01,589 --> 00:57:59,760
that we get the directionality

1642
00:58:03,109 --> 00:58:01,599
of the particles that are coming uh

1643
00:58:04,870 --> 00:58:03,119
coming to the spacecraft

1644
00:58:06,829 --> 00:58:04,880
and one final point and this is the

1645
00:58:08,150 --> 00:58:06,839
simplistic part um that i could

1646
00:58:10,150 --> 00:58:08,160
summarize uh

1647
00:58:11,990 --> 00:58:10,160
the detecting part of the instruments is

1648
00:58:13,349 --> 00:58:12,000
specifically made to withstand

1649
00:58:14,870 --> 00:58:13,359
that that's what they're there for to

1650
00:58:15,910 --> 00:58:14,880
measure these these high-energy

1651
00:58:17,510 --> 00:58:15,920
particles

1652
00:58:19,109 --> 00:58:17,520
uh the other parts of the instrument are

1653
00:58:20,549 --> 00:58:19,119
the electronics that support these

1654
00:58:22,309 --> 00:58:20,559
detector circuits

1655
00:58:24,549 --> 00:58:22,319
and and those are the ones we want to

1656
00:58:25,109 --> 00:58:24,559
protect so the design of the instrument

1657
00:58:27,510 --> 00:58:25,119
itself

1658
00:58:29,510 --> 00:58:27,520
is made to to detect what we want to and

1659
00:58:32,470 --> 00:58:29,520
screen out uh the things that we don't

1660
00:58:33,829 --> 00:58:32,480
want to harm the instrument

1661
00:58:36,630 --> 00:58:33,839
thank you unfortunately we're going to

1662
00:58:37,990 --> 00:58:36,640
run out of time here but we'd like to

1663
00:58:39,670 --> 00:58:38,000

say thanks to our panelists for an

1664
00:58:41,349 --> 00:58:39,680
outstanding job today for more

1665
00:58:43,030 --> 00:58:41,359
information about this exciting mission

1666
00:58:46,230 --> 00:58:43,040
when it launches two weeks from now

1667
00:58:49,030 --> 00:58:46,240
visit us at www.nasa.gov

1668
00:58:51,109 --> 00:58:49,040
rbsp and for more information about nasa

1669
00:58:53,829 --> 00:58:51,119
or any of its many projects visit us on

1670
00:58:56,150 --> 00:58:53,839
the web at www.nasa.gov

1671
00:58:57,750 --> 00:58:56,160
or go to any of our many social media

1672
00:59:00,549 --> 00:58:57,760
venues such as facebook

1673
00:59:02,069 --> 00:59:00,559
google plus twitter and youtube that's