
TST-1
Van Allen Probes
15:37

1
00:00:05,360 --> 00:00:03,830
hello and welcome to this NASA briefing

2
00:00:07,820 --> 00:00:05,370
about an exciting new discovery

3
00:00:10,129 --> 00:00:07,830
scientists made around Earth's radiation

4
00:00:11,780 --> 00:00:10,139
belts I'm Steve Cole from NASA

5
00:00:14,030 --> 00:00:11,790
headquarters Office of Communications

6
00:00:16,070 --> 00:00:14,040
we're bringing you this briefing today

7
00:00:17,750 --> 00:00:16,080
from the Johns Hopkins University

8
00:00:20,630 --> 00:00:17,760
Applied Physics Laboratory in Laurel

9
00:00:22,250 --> 00:00:20,640
Maryland our panel today is going to

10
00:00:24,859 --> 00:00:22,260
talk to you about a new finding that's

11
00:00:26,509 --> 00:00:24,869
just been released today that is using

12
00:00:28,580 --> 00:00:26,519
data from NASA's Van Allen probes

13
00:00:31,339 --> 00:00:28,590

mission which was just launched last

14
00:00:32,959 --> 00:00:31,349
year our panel today we have four

15
00:00:35,959 --> 00:00:32,969
panelists let me introduce you to them

16
00:00:37,880 --> 00:00:35,969
first is Mona Kessel Van Allen probes

17
00:00:41,000 --> 00:00:37,890
program scientists from NASA

18
00:00:42,830 --> 00:00:41,010
headquarters in Washington dan Baker

19
00:00:44,930 --> 00:00:42,840
director of the laboratory for

20
00:00:48,229 --> 00:00:44,940
atmospheric and space physics at the

21
00:00:50,990 --> 00:00:48,239
University of Colorado in Boulder Nicky

22
00:00:53,209 --> 00:00:51,000
Fox Van Allen probes deputy project

23
00:00:54,889 --> 00:00:53,219
scientist from the Johns Hopkins

24
00:00:58,279 --> 00:00:54,899
University Applied Physics Laboratory

25
00:01:00,619 --> 00:00:58,289
and Joe conches space scientists at

26
00:01:03,619 --> 00:01:00,629
NOAA's Space Weather Prediction Center

27
00:01:05,509 --> 00:01:03,629
in Boulder Colorado after our four

28
00:01:07,730 --> 00:01:05,519
panelists have given opening remarks

29
00:01:10,429 --> 00:01:07,740
we'll open it up to questions here in

30
00:01:13,340 --> 00:01:10,439
the audience people watching on NASA

31
00:01:15,740 --> 00:01:13,350
television and our media on the phone

32
00:01:18,200 --> 00:01:15,750
lines if you're watching on NASA TV you

33
00:01:22,969 --> 00:01:18,210
can ask a question through twitter by

34
00:01:27,020 --> 00:01:22,979
using the hashtag ask nasa okay

35
00:01:29,990 --> 00:01:27,030
we'll begin with Mona thank you Steve

36
00:01:32,810 --> 00:01:30,000
so NASA's radiation belt storm probes

37
00:01:36,200 --> 00:01:32,820
launched last year as Steve said in

38
00:01:38,450 --> 00:01:36,210

August 2012 and right away we went into

39
00:01:41,270 --> 00:01:38,460
two-month time period of we call

40
00:01:43,999 --> 00:01:41,280
commissioning where the doors open the

41
00:01:46,249 --> 00:01:44,009
booms deploy the instruments turn on and

42
00:01:48,499 --> 00:01:46,259
we start ramping up the high voltage

43
00:01:50,060 --> 00:01:48,509
what we're trying to do is check out all

44
00:01:52,969 --> 00:01:50,070
the instruments make sure everything's

45
00:01:55,160 --> 00:01:52,979
operational so that was two months as

46
00:01:58,010 --> 00:01:55,170
soon as that period was over then NASA

47
00:02:00,980 --> 00:01:58,020
renamed the mission the Van Allen probes

48
00:02:03,280 --> 00:02:00,990
that was in honor of James Van Allen who

49
00:02:06,440 --> 00:02:03,290
launched the Explorer 1 satellite in

50
00:02:08,779 --> 00:02:06,450
1958 that discovered the radiation belts

51
00:02:11,630 --> 00:02:08,789
so if we go to the first graphic thank

52
00:02:13,130 --> 00:02:11,640
you that shows the famous picture of

53
00:02:14,930 --> 00:02:13,140
Pickering then

54
00:02:17,150 --> 00:02:14,940
allan and von braun holding up the

55
00:02:19,550 --> 00:02:17,160
Explorer 1 satellite right after their

56
00:02:22,820 --> 00:02:19,560
successful launch and on the right side

57
00:02:26,300 --> 00:02:22,830
is a picture of James Van Alen from Time

58
00:02:29,420 --> 00:02:26,310
magazine and that was because after that

59
00:02:31,310 --> 00:02:29,430
mission went and the subsequent missions

60
00:02:34,880 --> 00:02:31,320
he and his team pieced together the

61
00:02:37,160 --> 00:02:34,890
information that let us know or that

62
00:02:39,350 --> 00:02:37,170
deduced that the there was tracked

63
00:02:42,290 --> 00:02:39,360

radiation in the Earth's magnetic field

64
00:02:44,660 --> 00:02:42,300
and so that trapped radiation is now

65
00:02:47,330 --> 00:02:44,670
called the Van Allen belts and so this

66
00:02:49,250 --> 00:02:47,340
mission is and named in honor of him but

67
00:02:51,590 --> 00:02:49,260
what are they what are these radiation

68
00:02:53,750 --> 00:02:51,600
belts and where are they if we go the

69
00:02:55,910 --> 00:02:53,760
next thank you then you can see this is

70
00:02:58,729 --> 00:02:55,920
a schematic you see earth in the center

71
00:03:01,040 --> 00:02:58,739
you see the Sun off to your left and you

72
00:03:03,350 --> 00:03:01,050
see two red regions this is a cutaway

73
00:03:05,509 --> 00:03:03,360
view so these are doughnut shaped

74
00:03:07,250 --> 00:03:05,519
regions that wrap around the earth

75
00:03:09,110 --> 00:03:07,260
there's an inner belt and there's an

76
00:03:11,390 --> 00:03:09,120
outer belt at least as far as we have

77
00:03:14,509 --> 00:03:11,400
understood from from the beginning of

78
00:03:17,300 --> 00:03:14,519
any explorers so what happens is there's

79
00:03:19,580 --> 00:03:17,310
trapped radiation in those two areas the

80
00:03:21,890 --> 00:03:19,590
inner belt runs from about 1,000 to

81
00:03:24,910 --> 00:03:21,900
8,000 miles above the surface of the

82
00:03:28,729 --> 00:03:24,920
earth and the outer belt is from about

83
00:03:33,199 --> 00:03:28,739
25,000 to about excuse me 12,000 to

84
00:03:35,000 --> 00:03:33,209
about 25,000 so this these satellites

85
00:03:36,319 --> 00:03:35,010
travel through these belts all of the

86
00:03:37,759 --> 00:03:36,329
time and you can see some of them

87
00:03:41,180 --> 00:03:37,769
pictured up there you can see the two

88
00:03:43,100 --> 00:03:41,190

Van Allen probes you can see GPS GPS

89
00:03:45,259 --> 00:03:43,110
travels through those regions all the

90
00:03:47,810 --> 00:03:45,269
time even in a quiet solar conditions

91
00:03:49,910 --> 00:03:47,820
but when we have disturbed conditions

92
00:03:53,509 --> 00:03:49,920
when there are solar storms then the

93
00:03:55,910 --> 00:03:53,519
belts expand the inner belt will will

94
00:03:57,710 --> 00:03:55,920
actually come down into the region where

95
00:04:01,670 --> 00:03:57,720
the International Space Station flies

96
00:04:04,310 --> 00:04:01,680
and other low orbiting orbiting

97
00:04:07,460 --> 00:04:04,320
satellites and the outer belt expands

98
00:04:09,650 --> 00:04:07,470
outward and so it encompasses the area

99
00:04:11,479 --> 00:04:09,660
that we call geosynchronous orbit where

100
00:04:14,120 --> 00:04:11,489
a lot of our communication satellites

101
00:04:16,849 --> 00:04:14,130
are and there's about 300 satellites out

102
00:04:19,190 --> 00:04:16,859
there so these these satellites then are

103
00:04:20,960 --> 00:04:19,200
in a way of potentially harmful

104
00:04:23,089 --> 00:04:20,970
radiation it can affect their

105
00:04:25,580 --> 00:04:23,099
electronics and it can pose a threat to

106
00:04:26,070 --> 00:04:25,590
astronauts and and all of our satellites

107
00:04:30,240 --> 00:04:26,080
that are

108
00:04:32,640 --> 00:04:30,250
there so the radiation belt storm probes

109
00:04:34,469 --> 00:04:32,650
now the Van Allen probes was a second

110
00:04:35,189 --> 00:04:34,479
mission with the living with the Star

111
00:04:36,899 --> 00:04:35,199
program

112
00:04:39,600 --> 00:04:36,909
pictured here this is just a couple of

113
00:04:41,550 --> 00:04:39,610

images to give the sense of what the

114
00:04:44,159 --> 00:04:41,560
living with a star program is about

115
00:04:46,320 --> 00:04:44,169
it's that making the connections between

116
00:04:49,499 --> 00:04:46,330
the assets from the Sun to the earth

117
00:04:51,209 --> 00:04:49,509
that affect life in society so you can

118
00:04:53,520 --> 00:04:51,219
see there astronauts you can see

119
00:04:55,200 --> 00:04:53,530
greenery for for plants you can see

120
00:04:57,629 --> 00:04:55,210
there are fisheries there there are

121
00:05:01,260 --> 00:04:57,639
power systems all of these things are

122
00:05:04,529 --> 00:05:01,270
affected by space weather as we call it

123
00:05:06,540 --> 00:05:04,539
affected by these radiation belts so Joe

124
00:05:07,860 --> 00:05:06,550
country's later in this presentation is

125
00:05:10,110 --> 00:05:07,870
going to talk about that a little bit

126
00:05:12,270 --> 00:05:10,120
more and the only thing I still want to

127
00:05:14,820 --> 00:05:12,280
tell you now is about the Solar Dynamics

128
00:05:16,529 --> 00:05:14,830
Observatory which was the first mission

129
00:05:19,019 --> 00:05:16,539
with the living with the Star program

130
00:05:23,519 --> 00:05:19,029
I'm going to show you a video this is

131
00:05:26,399 --> 00:05:23,529
right after launch where a filament from

132
00:05:29,100 --> 00:05:26,409
the Sun erupts from the atmosphere of

133
00:05:30,920 --> 00:05:29,110
the Sun out into space it carries with

134
00:05:33,689 --> 00:05:30,930
it it's a it's a coronal mass ejection

135
00:05:35,550 --> 00:05:33,699
that's actually headed towards the earth

136
00:05:37,379 --> 00:05:35,560
and you can see another picture of it

137
00:05:40,379 --> 00:05:37,389
here with Soho which is a note one of

138
00:05:42,329 --> 00:05:40,389

our older satellite assets and this will

139
00:05:44,939 --> 00:05:42,339
show come back to sto and show you that

140
00:05:48,360 --> 00:05:44,949
again this filament that bursts out into

141
00:05:49,980 --> 00:05:48,370
space so those happen all the time on

142
00:05:53,100 --> 00:05:49,990
the Sun but they're not always directed

143
00:05:55,680 --> 00:05:53,110
at Earth this one was at least as a

144
00:05:59,219 --> 00:05:55,690
glancing blow and it came to the earth

145
00:06:01,260 --> 00:05:59,229
and our radiation belts exploded with

146
00:06:02,670 --> 00:06:01,270
with things that were happening and so

147
00:06:04,680 --> 00:06:02,680
now I'm going to turn this over to Dan

148
00:06:08,700 --> 00:06:04,690
Baker and let him tell you about this

149
00:06:09,749 --> 00:06:08,710
remarkable discovery Thank You Mona yes

150
00:06:11,459 --> 00:06:09,759
I'm going to talk to you today about

151
00:06:15,839 --> 00:06:11,469
science paper that's being published

152
00:06:18,450 --> 00:06:15,849
today in the journal Science actually

153
00:06:20,519 --> 00:06:18,460
online science express I'm going to talk

154
00:06:22,110 --> 00:06:20,529
to you about the confinement of these

155
00:06:26,309 --> 00:06:22,120
very high-energy particles in Earth's

156
00:06:29,640 --> 00:06:26,319
magnetic field as moana noted for the

157
00:06:31,529 --> 00:06:29,650
last five decades we've been told in the

158
00:06:34,290 --> 00:06:31,539
textbooks that their Van Allen belts

159
00:06:37,889 --> 00:06:34,300
consists of two regions of trapped

160
00:06:39,660 --> 00:06:37,899
radiation the inner stable zone slot

161
00:06:41,820 --> 00:06:39,670
region and outer zone

162
00:06:43,820 --> 00:06:41,830
what we found rather remarkable is just

163
00:06:46,670 --> 00:06:43,830

a couple of days after turning on our

164
00:06:49,380 --> 00:06:46,680
high energy electron detection

165
00:06:52,380 --> 00:06:49,390
instrumentation that we really saw that

166
00:06:54,510 --> 00:06:52,390
there was a three belt structure and

167
00:06:56,130 --> 00:06:54,520
this persisted for four weeks and then

168
00:06:58,800 --> 00:06:56,140
really turned off if I could have the

169
00:07:00,480 --> 00:06:58,810
first graphic please this is several

170
00:07:02,730 --> 00:07:00,490
different energy channels displayed

171
00:07:05,760 --> 00:07:02,740
across in time the vertical axis is

172
00:07:09,810 --> 00:07:05,770
essentially distance measured out from

173
00:07:12,240 --> 00:07:09,820
the earth in Earth radii and if you do

174
00:07:14,780 --> 00:07:12,250
the next graphic click here you'll see

175
00:07:17,370 --> 00:07:14,790
that we saw the inner belt we saw the

176
00:07:21,120 --> 00:07:17,380
expected slot region and then we saw

177
00:07:24,420 --> 00:07:21,130
this new emergence of a third belt and a

178
00:07:26,760 --> 00:07:24,430
gap a second gap region a second slot we

179
00:07:28,860 --> 00:07:26,770
go on to the next slide or the next

180
00:07:31,050 --> 00:07:28,870
animation really I just like to tell you

181
00:07:33,540 --> 00:07:31,060
that the relativistic electron proton

182
00:07:36,000 --> 00:07:33,550
telescope was put on to the spacecraft

183
00:07:39,030 --> 00:07:36,010
you see the integration process here it

184
00:07:41,550 --> 00:07:39,040
was really geared toward measuring the

185
00:07:44,160 --> 00:07:41,560
highest energy particles a confined in

186
00:07:45,660 --> 00:07:44,170
the Earth's magnetic field and what our

187
00:07:47,640 --> 00:07:45,670
goal was was to really be able to

188
00:07:49,260 --> 00:07:47,650

measure to higher energies with better

189
00:07:51,090 --> 00:07:49,270
energy resolution better temporal

190
00:07:54,090 --> 00:07:51,100
resolution better spatial resolution in

191
00:07:55,890 --> 00:07:54,100
order to address these very

192
00:07:57,870 --> 00:07:55,900
long-standing questions about how

193
00:08:00,420 --> 00:07:57,880
particles are accelerated and lost from

194
00:08:04,230 --> 00:08:00,430
the Van Allen belts if we could have the

195
00:08:07,230 --> 00:08:04,240
next graphic please further motivation

196
00:08:09,390 --> 00:08:07,240
for us was the long run of data that we

197
00:08:11,130 --> 00:08:09,400
had from another NASA mission called the

198
00:08:13,590 --> 00:08:11,140
solar anomalous magnetic particle

199
00:08:16,920 --> 00:08:13,600
Explorer samp X this was launched in

200
00:08:19,020 --> 00:08:16,930
1992 it made measurements in low-earth

201
00:08:21,780 --> 00:08:19,030
orbit it wasn't really not and operating

202
00:08:24,270 --> 00:08:21,790
in the throat of the cosmic accelerator

203
00:08:27,510 --> 00:08:24,280
that operates in our neighborhood but it

204
00:08:29,700 --> 00:08:27,520
was really revealing the inner belt the

205
00:08:32,190 --> 00:08:29,710
outer belt the slot region over the long

206
00:08:36,300 --> 00:08:32,200
period of time we learned early in the

207
00:08:38,250 --> 00:08:36,310
summer of 2012 that the sample is going

208
00:08:39,960 --> 00:08:38,260
to come to an end atmospheric drag was

209
00:08:42,510 --> 00:08:39,970
going to bring the spacecraft down and

210
00:08:45,450 --> 00:08:42,520
cause its demise sometime in the fall of

211
00:08:47,610 --> 00:08:45,460
2012 and so what we really we went on a

212
00:08:49,800 --> 00:08:47,620
campaign to try to turn on our

213
00:08:51,650 --> 00:08:49,810

instrument of the repped instrument as

214
00:08:53,250 --> 00:08:51,660
early as we possibly could after launch

215
00:08:54,630 --> 00:08:53,260
in the normal

216
00:08:55,830 --> 00:08:54,640
floo of commissioning that I'm only

217
00:08:58,590 --> 00:08:55,840
talked about we would have turned on

218
00:09:01,350 --> 00:08:58,600
about 34 days after launch we really

219
00:09:04,050 --> 00:09:01,360
were able to turn on two days after

220
00:09:05,760 --> 00:09:04,060
launch and we were very fortunate that

221
00:09:08,580 --> 00:09:05,770
we did because if we go to the next

222
00:09:12,000 --> 00:09:08,590
slide what we saw when we first turned

223
00:09:13,980 --> 00:09:12,010
on was that the belt had the two belt

224
00:09:16,290 --> 00:09:13,990
structure as we expected and then as

225
00:09:17,970 --> 00:09:16,300
time marched on we saw this emergence of

226
00:09:20,940 --> 00:09:17,980
three belts and the lower panel really

227
00:09:22,980 --> 00:09:20,950
shows here the kind of collapse of all

228
00:09:26,130 --> 00:09:22,990
the orbits onto a single Meridiana plane

229
00:09:28,440 --> 00:09:26,140
and as you watch this you can see that

230
00:09:30,750 --> 00:09:28,450
this third belt emerges pretty clearly

231
00:09:33,390 --> 00:09:30,760
and then like a knife-edge the entire

232
00:09:35,220 --> 00:09:33,400
outer Van Allen belt is ripped away and

233
00:09:37,110 --> 00:09:35,230
then there's a new emergence of this and

234
00:09:39,870 --> 00:09:37,120
I'll just ask that we go through this

235
00:09:42,000 --> 00:09:39,880
again so you can see that sequence again

236
00:09:43,770 --> 00:09:42,010
here we are seeing the single storage

237
00:09:46,560 --> 00:09:43,780
ring feature as we call it and then we

238
00:09:48,300 --> 00:09:46,570

see the entire outer belt outside that

239
00:09:51,330 --> 00:09:48,310
storage ring undergoing all kinds of

240
00:09:52,770 --> 00:09:51,340
dynamics but these this storage ring or

241
00:09:55,290 --> 00:09:52,780
Taurus is just there for very

242
00:09:57,210 --> 00:09:55,300
persistently and unchanging for the

243
00:09:58,890 --> 00:09:57,220
better part of four weeks we first

244
00:10:00,930 --> 00:09:58,900
foolishly thought the instruments we're

245
00:10:02,820 --> 00:10:00,940
not working correctly but we quickly

246
00:10:04,740 --> 00:10:02,830
realized that that couldn't be true it

247
00:10:06,720 --> 00:10:04,750
had to be a real phenomenon we've been

248
00:10:10,740 --> 00:10:06,730
studying that now if I could have the

249
00:10:13,230 --> 00:10:10,750
next slide I just like to show you then

250
00:10:15,600 --> 00:10:13,240
an animation that's been put together by

251
00:10:17,670 --> 00:10:15,610
scientists here at the Applied Physics

252
00:10:21,360 --> 00:10:17,680
Laboratory that in which we've

253
00:11:30,489 --> 00:10:21,370
assimilated the data into the models and

254
00:11:34,329 --> 00:11:32,139
many mysteries still in the radiation

255
00:11:36,999 --> 00:11:34,339
belts is because they are home to a host

256
00:11:39,479 --> 00:11:37,009
of fundamental physics processes that

257
00:11:43,059 --> 00:11:39,489
are occurring throughout our universe

258
00:11:44,529 --> 00:11:43,069
the same physics that causes the

259
00:11:46,959 --> 00:11:44,539
particles to be accelerated in the

260
00:11:49,629 --> 00:11:46,969
Earth's radiation belts also causes

261
00:11:51,999 --> 00:11:49,639
radiation belts to occur at all of the

262
00:11:52,869 --> 00:11:52,009
large magnetized planets in our solar

263
00:11:55,239 --> 00:11:52,879

system

264
00:11:57,069 --> 00:11:55,249
so Neptune Jupiter Saturn Uranus all

265
00:12:00,009 --> 00:11:57,079
have radiation belt structures very

266
00:12:02,979 --> 00:12:00,019
similar to the earth even outside our

267
00:12:05,439 --> 00:12:02,989
solar system particle acceleration is

268
00:12:08,769 --> 00:12:05,449
also causing distant nebulae to glow in

269
00:12:10,209 --> 00:12:08,779
x-rays so as we say you know it's just

270
00:12:11,769 --> 00:12:10,219
rocket science it's just particle

271
00:12:14,439 --> 00:12:11,779
acceleration it's the same thing that's

272
00:12:16,869 --> 00:12:14,449
happening here is is happening

273
00:12:19,209 --> 00:12:16,879
everywhere and we're very lucky that we

274
00:12:21,129 --> 00:12:19,219
have this region of interest just a few

275
00:12:22,689 --> 00:12:21,139
thousand kilometers above our head it's

276
00:12:25,499 --> 00:12:22,699
really rather like having your very own

277
00:12:29,259 --> 00:12:25,509
particle accelerator in the backyard

278
00:12:31,989 --> 00:12:29,269
what also for me makes this event even

279
00:12:36,219 --> 00:12:31,999
more interesting is as mona spoke of

280
00:12:38,649 --> 00:12:36,229
initially the Sun drove that large storm

281
00:12:41,739 --> 00:12:38,659
that actually caused the beautiful event

282
00:12:45,249 --> 00:12:41,749
to be kicked off and as we show here

283
00:12:47,469 --> 00:12:45,259
SDO also can't cook the event that it

284
00:12:49,749 --> 00:12:47,479
actually caused the annihilation of the

285
00:12:51,849 --> 00:12:49,759
radiation belt so that knife edge that

286
00:12:54,609 --> 00:12:51,859
Dan showed where you see the outer belt

287
00:12:58,449 --> 00:12:54,619
almost disappearing was also driven by

288
00:13:00,909 --> 00:12:58,459

our star the Sun always the star of the

289
00:13:03,279 --> 00:13:00,919
show so the the Sun give a fan the Sun

290
00:13:05,559 --> 00:13:03,289
taketh away and one of the central

291
00:13:08,439 --> 00:13:05,569
themes of the radiation belt storm

292
00:13:10,599 --> 00:13:08,449
probes mission is to really see why the

293
00:13:12,669 --> 00:13:10,609
radiation belts respond in such

294
00:13:15,429 --> 00:13:12,679
different ways to seemingly similar

295
00:13:17,529 --> 00:13:15,439
events coming from the Sun and the only

296
00:13:20,529 --> 00:13:17,539
way that we can really do that is to

297
00:13:23,619 --> 00:13:20,539
really take a system approach and look

298
00:13:26,799 --> 00:13:23,629
at the everything coming from the Sun -

299
00:13:29,049 --> 00:13:26,809
to our earth space and so this animation

300
00:13:30,639 --> 00:13:29,059
shows nicely how the radiation belt

301
00:13:33,279 --> 00:13:30,649
storm probes or the Van Allen probes

302
00:13:35,529 --> 00:13:33,289
have now taken their place in the

303
00:13:38,139 --> 00:13:35,539
heliophysics Observatory so you're

304
00:13:41,529 --> 00:13:38,149
seeing a fleet of spacecraft in all the

305
00:13:42,549 --> 00:13:41,539
key locations between the Sun and all

306
00:13:44,290 --> 00:13:42,559
the way to earth

307
00:13:47,260 --> 00:13:44,300
what makes the radiation

308
00:13:49,540 --> 00:13:47,270
storm probes so important is that they

309
00:13:51,970 --> 00:13:49,550
really have taken their place here they

310
00:13:54,010 --> 00:13:51,980
are designed and developed to go after

311
00:13:56,110 --> 00:13:54,020
the physics that is occurring in the

312
00:13:59,410 --> 00:13:56,120
radiation belts so they will really be

313
00:14:03,100 --> 00:13:59,420

providing those much-needed observations

314
00:14:07,480 --> 00:14:03,110
so we can decide what's really happening

315
00:14:10,240 --> 00:14:07,490
in the radiation belts also on board the

316
00:14:11,860 --> 00:14:10,250
spacecraft we have a full complement of

317
00:14:13,870 --> 00:14:11,870
instruments so in addition to the

318
00:14:16,150 --> 00:14:13,880
highest quality particle measurements

319
00:14:18,550 --> 00:14:16,160
that have ever been made that Dan has

320
00:14:21,580 --> 00:14:18,560
already showed we also have filled some

321
00:14:24,100 --> 00:14:21,590
waves instruments so we're now going to

322
00:14:26,350 --> 00:14:24,110
study all of the wave structures that

323
00:14:29,170 --> 00:14:26,360
are maybe responsible for causing that

324
00:14:31,150 --> 00:14:29,180
third belt and eroding that center part

325
00:14:33,670 --> 00:14:31,160
in the outer radiation belt which we've

326
00:14:35,800 --> 00:14:33,680
termed the second slot region so we're

327
00:14:38,050 --> 00:14:35,810
very you know looking forward to these

328
00:14:40,480 --> 00:14:38,060
great new capabilities we have not only

329
00:14:42,880 --> 00:14:40,490
providing discoveries but also providing

330
00:14:46,120 --> 00:14:42,890
explanation as to why these phenomena

331
00:14:49,600 --> 00:14:46,130
are occurring and also as Mona said the

332
00:14:52,840 --> 00:14:49,610
the practical nature of the the effect

333
00:14:55,030 --> 00:14:52,850
here at Earth they are causing dramatic

334
00:14:58,030 --> 00:14:55,040
changes in our near-earth space which

335
00:14:59,680 --> 00:14:58,040
have effects on life in society we live

336
00:15:01,980 --> 00:14:59,690
and work in the radiation belts and all

337
00:15:04,000 --> 00:15:01,990
our technology is based there so

338
00:15:06,990 --> 00:15:04,010

understanding how the radiation belts

339
00:15:10,240 --> 00:15:07,000
change is extremely critical for our

340
00:15:12,190 --> 00:15:10,250
technological infrastructure so in

341
00:15:14,560 --> 00:15:12,200
addition to the the wonderful science

342
00:15:17,470 --> 00:15:14,570
that we we have with the storm probes

343
00:15:19,870 --> 00:15:17,480
we're also sending down real-time data

344
00:15:21,670 --> 00:15:19,880
real-time space weather data that comes

345
00:15:24,850 --> 00:15:21,680
down and is captured through a network

346
00:15:27,610 --> 00:15:24,860
of ground stations and then is available

347
00:15:29,470 --> 00:15:27,620
within about 30 minutes on the web and

348
00:15:31,660 --> 00:15:29,480
obviously scientists are very excited

349
00:15:33,430 --> 00:15:31,670
about these raw data but we understand

350
00:15:36,310 --> 00:15:33,440
that they're not always accessible to

351
00:15:38,920 --> 00:15:36,320
the general public so we actually feed

352
00:15:41,110 --> 00:15:38,930
them into two models one really good

353
00:15:43,200 --> 00:15:41,120
example is the dream model which is run

354
00:15:46,420 --> 00:15:43,210
out of Los Alamos National Laboratory

355
00:15:48,700 --> 00:15:46,430
and we are in the process now of feeding

356
00:15:50,770 --> 00:15:48,710
our real-time data into this model and

357
00:15:53,320 --> 00:15:50,780
within the next three months we will be

358
00:15:55,510 --> 00:15:53,330
delivering that to the NOAA Space

359
00:15:56,850 --> 00:15:55,520
Weather Prediction Center where they'll

360
00:15:59,070 --> 00:15:56,860
be using it

361
00:16:02,100 --> 00:15:59,080
to better forecast space weather and

362
00:16:04,110 --> 00:16:02,110
that's a good segue to pass on to to Joe

363
00:16:05,460 --> 00:16:04,120

countries from the Space Weather

364
00:16:07,730 --> 00:16:05,470
Prediction Center to tell us all about

365
00:16:09,900 --> 00:16:07,740
space weather Thank You Nikki

366
00:16:12,270 --> 00:16:09,910
discoveries from missions such as the

367
00:16:14,220 --> 00:16:12,280
Van Allen probes are really the

368
00:16:16,350 --> 00:16:14,230
wellspring from which improvements to

369
00:16:19,020 --> 00:16:16,360
operational space weather services come

370
00:16:20,640 --> 00:16:19,030
and let me take you into the the

371
00:16:22,470 --> 00:16:20,650
forecast office of the Space Weather

372
00:16:24,390 --> 00:16:22,480
Prediction Center here in a minute and

373
00:16:26,610 --> 00:16:24,400
show you what it's like to do

374
00:16:29,070 --> 00:16:26,620
operational space weather forecasting

375
00:16:30,570 --> 00:16:29,080
this is the forecast office from NOAA's

376
00:16:33,210 --> 00:16:30,580
Space Weather Prediction Center we

377
00:16:35,610 --> 00:16:33,220
operate 24 hours a day seven days a week

378
00:16:37,860 --> 00:16:35,620
we monitor space weather and we make the

379
00:16:40,920 --> 00:16:37,870
predictions that people want to to plan

380
00:16:42,360 --> 00:16:40,930
from we coordinate our activities with

381
00:16:44,550 --> 00:16:42,370
the US Air Force they have their own

382
00:16:47,100 --> 00:16:44,560
Center at Offutt Air Force Base and

383
00:16:48,690 --> 00:16:47,110
we're the world warning agency for 14

384
00:16:51,210 --> 00:16:48,700
countries the international space

385
00:16:54,060 --> 00:16:51,220
environment service is focused at

386
00:16:57,030 --> 00:16:54,070
Boulder among the data that are used

387
00:17:00,120 --> 00:16:57,040
there along with the goes data from from

388
00:17:04,080 --> 00:17:00,130

NOAA also you'll see NASA data from SDO

389
00:17:06,750 --> 00:17:04,090
from ace from stereo from Soho and also

390
00:17:08,940 --> 00:17:06,760
those data feed into models here is the

391
00:17:12,090 --> 00:17:08,950
Enlil model from the solar wind that we

392
00:17:13,980 --> 00:17:12,100
get and it enables the forecasters to

393
00:17:16,350 --> 00:17:13,990
make the best assessment of the current

394
00:17:18,300 --> 00:17:16,360
conditions and allows them to give good

395
00:17:21,060 --> 00:17:18,310
predictions of the conditions in the

396
00:17:24,360 --> 00:17:21,070
near future in the next slide I'll show

397
00:17:27,090 --> 00:17:24,370
you how one of the ways at which we get

398
00:17:29,360 --> 00:17:27,100
the word out from from in real time as

399
00:17:32,490 --> 00:17:29,370
conditions occur this is a graph showing

400
00:17:35,070 --> 00:17:32,500
in white the progress of the current

401
00:17:37,230 --> 00:17:35,080
solar cycle and in blue the number of

402
00:17:39,630 --> 00:17:37,240
subscribers to our email product

403
00:17:43,470 --> 00:17:39,640
subscription service now yet numbers

404
00:17:47,220 --> 00:17:43,480
more than 32,000 subscribers of those

405
00:17:49,200 --> 00:17:47,230
subscribers about 9500 characterized

406
00:17:51,030 --> 00:17:49,210
themselves as having something to do

407
00:17:53,310 --> 00:17:51,040
with satellites either they are

408
00:17:56,010 --> 00:17:53,320
designers they're engineers they're

409
00:17:57,930 --> 00:17:56,020
manufacturers they're operators so

410
00:18:00,210 --> 00:17:57,940
clearly the satellite community is a

411
00:18:03,000 --> 00:18:00,220
very important community for us to serve

412
00:18:05,820 --> 00:18:03,010
with the best real-time space weather

413
00:18:07,500 --> 00:18:05,830

information that we can garner now to

414
00:18:09,570 --> 00:18:07,510
focus for a minute on the satellite

415
00:18:10,410 --> 00:18:09,580
community this probably comes as no

416
00:18:13,110 --> 00:18:10,420
surprise to any

417
00:18:15,210 --> 00:18:13,120
but in the next slide here's a chart

418
00:18:19,410 --> 00:18:15,220
from the satellite Industry Association

419
00:18:22,730 --> 00:18:19,420
which shows the revenues over about the

420
00:18:25,920 --> 00:18:22,740
last five years this goes back to 2006

421
00:18:27,870 --> 00:18:25,930
2011 is the last full year for which the

422
00:18:30,330 --> 00:18:27,880
data are available and what you can see

423
00:18:33,720 --> 00:18:30,340
without looking too hard is that its

424
00:18:36,600 --> 00:18:33,730
growth 9% about on average over the last

425
00:18:39,630 --> 00:18:36,610
five years but also the last year is

426
00:18:41,970 --> 00:18:39,640
about 177 billion dollars worth of

427
00:18:44,070 --> 00:18:41,980
revenues further underscoring the fact

428
00:18:46,770 --> 00:18:44,080
that this is a very important customer

429
00:18:49,080 --> 00:18:46,780
base that needs the best space weather

430
00:18:52,110 --> 00:18:49,090
information they can get and finally

431
00:18:54,630 --> 00:18:52,120
just to maybe wrap it up what is it

432
00:18:56,640 --> 00:18:54,640
about the space environment and space

433
00:18:58,860 --> 00:18:56,650
weather that causes disruptions to

434
00:19:01,470 --> 00:18:58,870
satellites and this really goes to the

435
00:19:04,140 --> 00:19:01,480
activities that the Van Allen probes are

436
00:19:06,390 --> 00:19:04,150
designed to do it's charged particles

437
00:19:08,490 --> 00:19:06,400
and on the next slide there's an

438
00:19:11,520 --> 00:19:08,500

illustration of the kinds of things that

439
00:19:14,310 --> 00:19:11,530
can happen to satellites by virtue of

440
00:19:16,350 --> 00:19:14,320
say low energy electrons which can do

441
00:19:18,180 --> 00:19:16,360
surface charging or high energy

442
00:19:20,850 --> 00:19:18,190
electrons which can embed themselves

443
00:19:24,390 --> 00:19:20,860
within the spacecraft and cause deep

444
00:19:27,510 --> 00:19:24,400
dielectric charging or it can be protons

445
00:19:31,260 --> 00:19:27,520
or galactic cosmic rays that cause

446
00:19:33,870 --> 00:19:31,270
single event upsets and in mass the lot

447
00:19:36,360 --> 00:19:33,880
of them cause radiation damage to the

448
00:19:38,430 --> 00:19:36,370
solar panels and other systems so it's

449
00:19:40,920 --> 00:19:38,440
very very important for the satellite

450
00:19:43,760 --> 00:19:40,930
community to have the best the most

451
00:19:47,160 --> 00:19:43,770
timely information that they can get and

452
00:19:49,650 --> 00:19:47,170
that's the purpose of this activity and

453
00:19:52,290 --> 00:19:49,660
I'm very happy to be here to participate

454
00:19:54,810 --> 00:19:52,300
in this so I'll turn it back over to Dan

455
00:19:57,780 --> 00:19:54,820
for some concluding remarks thank you

456
00:20:00,540 --> 00:19:57,790
very much Joe it's a delight to be able

457
00:20:02,790 --> 00:20:00,550
to tell you that we turned on our

458
00:20:05,250 --> 00:20:02,800
instruments and we saw fascinating new

459
00:20:08,790 --> 00:20:05,260
phenomena in the Earth's vicinity driven

460
00:20:10,500 --> 00:20:08,800
by solar disturbances it's also delight

461
00:20:15,120 --> 00:20:10,510
to be able to tell you that we are

462
00:20:18,210 --> 00:20:15,130
really able to do so much research with

463
00:20:19,830 --> 00:20:18,220

our basic research Astrophysical

464
00:20:22,050 --> 00:20:19,840
research if you say it would say in our

465
00:20:23,700 --> 00:20:22,060
local neighborhood but it's wonderful to

466
00:20:25,950 --> 00:20:23,710
be part of a field

467
00:20:29,580 --> 00:20:25,960
where that research also has good

468
00:20:32,190 --> 00:20:29,590
practical applicability and we know that

469
00:20:33,960 --> 00:20:32,200
the things that we're measuring now have

470
00:20:36,049 --> 00:20:33,970
the kind of relevance to society that

471
00:20:38,850 --> 00:20:36,059
Jo's spoken about so we're delighted to

472
00:20:41,490 --> 00:20:38,860
try to answer any questions you may have

473
00:20:45,090 --> 00:20:41,500
today and to talk about this duality in

474
00:20:47,669 --> 00:20:45,100
our field great basic research and also

475
00:20:49,250 --> 00:20:47,679
great applicability of societal needs

476
00:20:51,450 --> 00:20:49,260
thank you very much

477
00:20:53,490 --> 00:20:51,460
okay thank you Dan and thank you to all

478
00:20:56,279 --> 00:20:53,500
the panelists we'll take questions now

479
00:20:57,750 --> 00:20:56,289
from media in the audience on the phone

480
00:21:00,210 --> 00:20:57,760
lines and then also from you all

481
00:21:02,639 --> 00:21:00,220
watching online as a reminder you can

482
00:21:07,080 --> 00:21:02,649
ask a question via Twitter by just using

483
00:21:08,850 --> 00:21:07,090
this hashtag ask NASA if you have a

484
00:21:11,159 --> 00:21:08,860
question in the audience please get to

485
00:21:13,409 --> 00:21:11,169
one of the people with microphones over

486
00:21:15,570 --> 00:21:13,419
here we did receive a question or two

487
00:21:16,830 --> 00:21:15,580
before their briefing so let me just

488
00:21:19,529 --> 00:21:16,840

throw that out to begin with

489
00:21:21,450 --> 00:21:19,539
first question what has this third Van

490
00:21:24,810 --> 00:21:21,460
Allen belt been doing since you first

491
00:21:27,690 --> 00:21:24,820
observed it last year well I can try to

492
00:21:32,430 --> 00:21:27,700
answer that question a bit we saw this

493
00:21:34,350 --> 00:21:32,440
phenomenon for about four weeks then as

494
00:21:36,419 --> 00:21:34,360
the data showed and as Nikki remarked on

495
00:21:39,269 --> 00:21:36,429
as well it was cut off like a knife edge

496
00:21:40,799 --> 00:21:39,279
it disappeared the rebound

497
00:21:42,539 --> 00:21:40,809
there was a rebuilding of the Van Allen

498
00:21:45,539 --> 00:21:42,549
belts also in a very abrupt fashion on

499
00:21:46,799 --> 00:21:45,549
about the 9th or 10th of October but

500
00:21:48,930 --> 00:21:46,809
since that time we've not seen a

501
00:21:51,810 --> 00:21:48,940
recurrence of the third belt we're

502
00:21:54,240 --> 00:21:51,820
watching with eagle eyes to see if there

503
00:21:55,620 --> 00:21:54,250
is a resurgence of this but so far in

504
00:21:59,100 --> 00:21:55,630
the last five months there really hasn't

505
00:22:00,659 --> 00:21:59,110
been a recurrence of that ok and I guess

506
00:22:04,320 --> 00:22:00,669
we have some questions already via

507
00:22:07,460 --> 00:22:04,330
Twitter yes I read that Sierra's saw a

508
00:22:11,250 --> 00:22:07,470
third ring in 1990 and solar activity in

509
00:22:13,350 --> 00:22:11,260
1998 made a brief third ring is this

510
00:22:17,279 --> 00:22:13,360
really the first time we've seen a third

511
00:22:20,460 --> 00:22:17,289
ring the crest was the mission that was

512
00:22:23,399 --> 00:22:20,470
mentioned back in 1991 and that showed a

513
00:22:25,139 --> 00:22:23,409

new population of particles injected

514
00:22:27,899 --> 00:22:25,149
into much deeper into the magnetosphere

515
00:22:30,240 --> 00:22:27,909
into more or less the inner zone and

516
00:22:32,159 --> 00:22:30,250
slot region this is the first time that

517
00:22:34,919 --> 00:22:32,169
reported in the literature that one has

518
00:22:35,600 --> 00:22:34,929
really seen embedded in this outer part

519
00:22:39,860 --> 00:22:35,610
of

520
00:22:42,200 --> 00:22:39,870
phenomenon and so we believe that this

521
00:22:44,530 --> 00:22:42,210
is a fundamentally different than what's

522
00:22:48,919 --> 00:22:44,540
been reported in previous kind of

523
00:22:50,060 --> 00:22:48,929
observations back in the past okay it's

524
00:22:53,539 --> 00:22:50,070
another question from Twitter

525
00:22:55,940 --> 00:22:53,549
yes which belt was actually new was the

526
00:22:58,190 --> 00:22:55,950
original outer belt did it shrink back

527
00:23:01,400 --> 00:22:58,200
into a storage ring and then a new belt

528
00:23:03,289 --> 00:23:01,410
form outside of that well let me again

529
00:23:05,390 --> 00:23:03,299
try we're still trying to piece together

530
00:23:09,409 --> 00:23:05,400
exactly what happened but yes it seems

531
00:23:11,480 --> 00:23:09,419
as though the entire outer Van Allen

532
00:23:13,039 --> 00:23:11,490
belt acceleration event occurred and

533
00:23:15,620 --> 00:23:13,049
then part of it was sort of ripped away

534
00:23:18,590 --> 00:23:15,630
was was torn away from the outermost

535
00:23:21,830 --> 00:23:18,600
part leaving the storage ring and that's

536
00:23:23,539 --> 00:23:21,840
what persisted so immune apparently to

537
00:23:26,299 --> 00:23:23,549
external forcing for the next four weeks

538
00:23:29,150 --> 00:23:26,309

and so what we were really seeing was

539
00:23:32,120 --> 00:23:29,160
that that the storage ring was the

540
00:23:34,159 --> 00:23:32,130
remnant of an earlier acceleration event

541
00:23:37,610 --> 00:23:34,169
due to the kind of solar drivers that

542
00:23:41,090 --> 00:23:37,620
Mona Nikki talked about let me add to

543
00:23:43,909 --> 00:23:41,100
that also if I may this is still early

544
00:23:46,039 --> 00:23:43,919
days and so we don't completely

545
00:23:48,380 --> 00:23:46,049
understand this phenomena that we're

546
00:23:50,480 --> 00:23:48,390
seeing we're modeling it now we're

547
00:23:52,310 --> 00:23:50,490
trying to develop the understanding

548
00:23:54,830 --> 00:23:52,320
we're looking as Nikki mentioned earlier

549
00:23:57,230 --> 00:23:54,840
at the wave instruments because they are

550
00:24:00,169 --> 00:23:57,240
likely one of the drivers the waves that

551
00:24:01,820 --> 00:24:00,179
are generated and it's all driven by the

552
00:24:04,460 --> 00:24:01,830
Sun but then there are internal waves

553
00:24:06,260 --> 00:24:04,470
that are generated as well where we're

554
00:24:09,880 --> 00:24:06,270
trying to piece this all together right

555
00:24:12,740 --> 00:24:09,890
now and stay tuned we will know more

556
00:24:15,890 --> 00:24:12,750
that's really what's exciting about new

557
00:24:17,120 --> 00:24:15,900
observations is that when you know

558
00:24:18,860 --> 00:24:17,130
you've done something right

559
00:24:20,180 --> 00:24:18,870
observational II when theoreticians say

560
00:24:21,530 --> 00:24:20,190
well that's that doesn't look right

561
00:24:24,409 --> 00:24:21,540
we've got to go back to the drawing

562
00:24:26,000 --> 00:24:24,419
board here okay and one other question

563
00:24:28,549 --> 00:24:26,010

from Twitter before we go to the media a

564
00:24:31,010 --> 00:24:28,559
two-prong question what does the third

565
00:24:34,490 --> 00:24:31,020
ring mean for astronauts and satellites

566
00:24:38,960 --> 00:24:34,500
and also what impact will it have if any

567
00:24:42,140 --> 00:24:38,970
on the earth Oh Joe take part of that

568
00:24:44,620 --> 00:24:42,150
question yeah III think I think it

569
00:24:47,480 --> 00:24:44,630
probably will have little impact on

570
00:24:48,960 --> 00:24:47,490
astronauts and satellites given the

571
00:24:51,510 --> 00:24:48,970
characteristics but

572
00:24:52,799 --> 00:24:51,520
but I would hurry hurry up to say that

573
00:24:55,890 --> 00:24:52,809
you know there's still a lot that we

574
00:24:58,710 --> 00:24:55,900
don't know and and we can we can talk

575
00:25:00,899 --> 00:24:58,720
about space operations of today but also

576
00:25:04,289 --> 00:25:00,909
there's operations in the future that

577
00:25:05,970 --> 00:25:04,299
are planned so I think probably the the

578
00:25:08,820 --> 00:25:05,980
true answer to the question is still to

579
00:25:11,130 --> 00:25:08,830
be known and if you look if you remember

580
00:25:14,190 --> 00:25:11,140
the picture that I showed during my

581
00:25:16,980 --> 00:25:14,200
presentation the the International Space

582
00:25:20,100 --> 00:25:16,990
Station is down below the interval this

583
00:25:23,460 --> 00:25:20,110
new ring is actually much further out

584
00:25:25,590 --> 00:25:23,470
than that it sits at about 12,000 miles

585
00:25:28,320 --> 00:25:25,600
above the surface so it's much higher

586
00:25:30,480 --> 00:25:28,330
than astronauts code now if we send

587
00:25:32,730 --> 00:25:30,490
another mission to the moon or to Mars

588
00:25:35,039 --> 00:25:32,740

then we would have to pass through the

589
00:25:36,690 --> 00:25:35,049
region but we've done that before too in

590
00:25:39,330 --> 00:25:36,700
the past with Apollo would pass through

591
00:25:40,980 --> 00:25:39,340
pretty quickly so and in but in

592
00:25:42,690 --> 00:25:40,990
realistic terms it's not going to affect

593
00:25:47,880 --> 00:25:42,700
our astronauts certainly not on the

594
00:25:49,169 --> 00:25:47,890
space station the the regions that we're

595
00:25:51,740 --> 00:25:49,179
looking at with the third belt are

596
00:25:55,710 --> 00:25:51,750
magnetically connected to the the

597
00:25:58,350 --> 00:25:55,720
altitudes that the space station is is

598
00:26:00,330 --> 00:25:58,360
orbiting on so while there's no direct

599
00:26:02,039 --> 00:26:00,340
impact there are still going to be

600
00:26:04,770 --> 00:26:02,049
effects that are seen and I think that

601
00:26:06,570 --> 00:26:04,780
just understanding more about the outer

602
00:26:10,200 --> 00:26:06,580
radiation belt its structure and its

603
00:26:12,180 --> 00:26:10,210
dynamics are very important for enabling

604
00:26:14,070 --> 00:26:12,190
us to have better models better

605
00:26:16,140 --> 00:26:14,080
prediction models do a better job of

606
00:26:18,330 --> 00:26:16,150
predicting the lifetime of spacecraft

607
00:26:21,299 --> 00:26:18,340
just by knowing that it's way more

608
00:26:23,340 --> 00:26:21,309
dynamic than we had even expected prior

609
00:26:25,140 --> 00:26:23,350
to the launch I'd like to jump in on

610
00:26:26,820 --> 00:26:25,150
this and just say too that we're

611
00:26:28,760 --> 00:26:26,830
fortunate that nature performed an

612
00:26:32,010 --> 00:26:28,770
active experiment for us that really

613
00:26:34,440 --> 00:26:32,020

gave us this very kind of discrete onset

614
00:26:36,870 --> 00:26:34,450
and then a very discrete end to this

615
00:26:38,970 --> 00:26:36,880
particular three built phenomenon and

616
00:26:41,520 --> 00:26:38,980
this is going to teach us a lot about

617
00:26:44,250 --> 00:26:41,530
how effectively the magnetosphere can

618
00:26:46,230 --> 00:26:44,260
store and and maintain an electron

619
00:26:48,990 --> 00:26:46,240
population for extended periods of time

620
00:26:51,690 --> 00:26:49,000
and by doing that I think it's going to

621
00:26:54,470 --> 00:26:51,700
greatly and help us greatly increase our

622
00:26:56,370 --> 00:26:54,480
understanding of just how this complex

623
00:27:01,660 --> 00:26:56,380
accelerator that niki talked about

624
00:27:08,930 --> 00:27:04,850
total energy content of the three then

625
00:27:12,350 --> 00:27:08,940
two belts changed during the process let

626
00:27:15,169 --> 00:27:12,360
me first say that I want to emphasize

627
00:27:18,290 --> 00:27:15,179
what Mona said to which is that we're

628
00:27:19,580 --> 00:27:18,300
just studying these things now many of

629
00:27:21,560 --> 00:27:19,590
the questions that are being asked are

630
00:27:24,350 --> 00:27:21,570
exactly in our minds and we're going to

631
00:27:27,470 --> 00:27:24,360
try to more quantitatively address those

632
00:27:30,080 --> 00:27:27,480
so this is relatively early in the

633
00:27:32,480 --> 00:27:30,090
mission we're trying to piece together

634
00:27:34,430 --> 00:27:32,490
what happened why did it happen and what

635
00:27:38,270 --> 00:27:34,440
are the implications for such things as

636
00:27:41,419 --> 00:27:38,280
total energy content okay our next

637
00:27:44,530 --> 00:27:41,429
question still from Twitter how did this

638
00:27:47,480 --> 00:27:44,540

radiation belt go undetected for so long

639
00:27:50,330 --> 00:27:47,490
we've never had the capability and the

640
00:27:51,919 --> 00:27:50,340
outstanding technology that we have with

641
00:27:53,570 --> 00:27:51,929
the radiation belt storm probes the Van

642
00:27:56,030 --> 00:27:53,580
Allen probes I'm sorry

643
00:27:59,210 --> 00:27:56,040
you know we it is a mission that is

644
00:28:01,010 --> 00:27:59,220
designed to go after the dynamics and

645
00:28:02,990 --> 00:28:01,020
the structure of the radiation belts

646
00:28:04,640 --> 00:28:03,000
we're carrying the right instruments and

647
00:28:06,290 --> 00:28:04,650
we're in the right orbit to be able to

648
00:28:07,910 --> 00:28:06,300
do that and I think the fact that we've

649
00:28:10,400 --> 00:28:07,920
had such an amazing discovery

650
00:28:13,700 --> 00:28:10,410
within days of turning on the

651
00:28:16,040 --> 00:28:13,710
instruments is really proving just how

652
00:28:18,860 --> 00:28:16,050
spectacular the science from the ven on

653
00:28:22,580 --> 00:28:18,870
the Van Allen probes will be I like to

654
00:28:24,140 --> 00:28:22,590
quote America's most notable philosopher

655
00:28:26,650 --> 00:28:24,150
Yogi Berra who said you can observe a

656
00:28:30,200 --> 00:28:26,660
lot just by looking and I believe that

657
00:28:33,590 --> 00:28:30,210
when you open new eyes on the universe

658
00:28:35,060 --> 00:28:33,600
you invariably see new things and so I

659
00:28:38,450 --> 00:28:35,070
think that's what where we find

660
00:28:38,660 --> 00:28:38,460
ourselves now okay our next question

661
00:28:41,480 --> 00:28:38,670
please

662
00:28:43,970 --> 00:28:41,490
question for Joe conscious what can

663
00:28:45,799 --> 00:28:43,980

operate errs and companies do in order

664
00:28:48,350 --> 00:28:45,809
to protect their satellites once they

665
00:28:50,930 --> 00:28:48,360
have the predictions well that's a good

666
00:28:53,450 --> 00:28:50,940
question because it's it depends a lot

667
00:28:55,520 --> 00:28:53,460
on the particulars of the mission and

668
00:28:58,220 --> 00:28:55,530
what they're trying to do but I can give

669
00:29:00,410 --> 00:28:58,230
you an example from the past and in 2006

670
00:29:02,750 --> 00:29:00,420
the U Mets at the European

671
00:29:05,930 --> 00:29:02,760
meteorological satellite organization

672
00:29:09,200 --> 00:29:05,940
launched a satellite called MIT op and

673
00:29:12,409 --> 00:29:09,210
met hophead on board to high-rate

674
00:29:13,910 --> 00:29:12,419
transmitters to send down broadcast a

675
00:29:15,680 --> 00:29:13,920
Direct TV like image

676
00:29:17,770 --> 00:29:15,690
three of the weather and they really

677
00:29:20,450 --> 00:29:17,780
wanted to do it over Northern Europe

678
00:29:22,660 --> 00:29:20,460
surely after the launch they found that

679
00:29:25,490 --> 00:29:22,670
one of their transmitters quickly failed

680
00:29:27,140 --> 00:29:25,500
unfortunately they had a backup onboard

681
00:29:29,030 --> 00:29:27,150
but before they turned the backup on

682
00:29:31,250 --> 00:29:29,040
they wanted to figure out what the

683
00:29:34,520 --> 00:29:31,260
problem was in terms of the environment

684
00:29:36,380 --> 00:29:34,530
or exactly what so they went back to the

685
00:29:38,120 --> 00:29:36,390
engineering lab and they found out that

686
00:29:41,510 --> 00:29:38,130
this particular piece of equipment had a

687
00:29:43,790 --> 00:29:41,520
susceptibility to charge particles that

688
00:29:47,120 --> 00:29:43,800

had a prevalence in the auroral zone and

689
00:29:49,130 --> 00:29:47,130
in the South Atlantic anomaly so when

690
00:29:51,650 --> 00:29:49,140
they turned the backup transmitter on

691
00:29:54,890 --> 00:29:51,660
they then organized or created a

692
00:29:56,900 --> 00:29:54,900
procedure through which they turn it off

693
00:29:58,940 --> 00:29:56,910
as it flies through the auroral zones

694
00:30:01,190 --> 00:29:58,950
and they also turn it off when it flies

695
00:30:02,510 --> 00:30:01,200
through the South Atlantic anomaly but

696
00:30:04,190 --> 00:30:02,520
then they turn it on the rest of the

697
00:30:06,890 --> 00:30:04,200
time and in particular they're able to

698
00:30:09,440 --> 00:30:06,900
capture the the weather imagery from

699
00:30:11,810 --> 00:30:09,450
from Europe which at times is right on

700
00:30:14,960 --> 00:30:11,820
the edge between the auroral zone and in

701
00:30:18,350 --> 00:30:14,970
the safe places so depending on on the

702
00:30:20,570 --> 00:30:18,360
kinds of activities and the the

703
00:30:24,110 --> 00:30:20,580
particulars of the spacecraft there are

704
00:30:26,870 --> 00:30:24,120
things that can be done to respond to

705
00:30:28,670 --> 00:30:26,880
the current state of the space weather I

706
00:30:30,860 --> 00:30:28,680
don't want to say that every satellite

707
00:30:32,690 --> 00:30:30,870
works like this there's there's a little

708
00:30:35,030 --> 00:30:32,700
bit of the Three Little Pigs philosophy

709
00:30:36,680 --> 00:30:35,040
and in in building satellites you can

710
00:30:38,300 --> 00:30:36,690
build your satellite out of bricks and

711
00:30:40,760 --> 00:30:38,310
you don't have to worry about anything

712
00:30:41,960 --> 00:30:40,770
well that can be costly and heavy and

713
00:30:43,790 --> 00:30:41,970

maybe you wouldn't be able to get the

714
00:30:47,890 --> 00:30:43,800
payload that you'd want it every point

715
00:30:50,690 --> 00:30:47,900
so to then go to the to the less less

716
00:30:52,430 --> 00:30:50,700
robust state you may have to drive it a

717
00:30:54,500 --> 00:30:52,440
little bit and and many satellite

718
00:30:57,110 --> 00:30:54,510
operators will do that they will they

719
00:30:59,120 --> 00:30:57,120
will reschedule command sequences they

720
00:31:02,180 --> 00:30:59,130
will do the things that are at their

721
00:31:04,700 --> 00:31:02,190
disposal to account for harsh radiation

722
00:31:08,680 --> 00:31:04,710
conditions that can occur from time to

723
00:31:11,990 --> 00:31:08,690
time okay our next question please

724
00:31:13,940 --> 00:31:12,000
dr. Baker could you briefly describe any

725
00:31:16,190 --> 00:31:13,950
innovations that improved the

726
00:31:19,930 --> 00:31:16,200
sensitivity and capability of the repped

727
00:31:22,440 --> 00:31:19,940
device yes we tried to build with

728
00:31:27,210 --> 00:31:22,450
detectors that were

729
00:31:29,520 --> 00:31:27,220
more stable and more sensitive to charge

730
00:31:31,230 --> 00:31:29,530
deposition from the detected particles

731
00:31:33,260 --> 00:31:31,240
we tried to build much faster

732
00:31:37,020 --> 00:31:33,270
electronics so we could avoid

733
00:31:38,910 --> 00:31:37,030
traditional problems of pile up and dead

734
00:31:40,860 --> 00:31:38,920
time and other such effects but we

735
00:31:42,390 --> 00:31:40,870
really were primarily focused on being

736
00:31:47,040 --> 00:31:42,400
able to do a better job of very

737
00:31:48,810 --> 00:31:47,050
resolving to a high precision the energy

738
00:31:51,150 --> 00:31:48,820

spectra at these higher energies many

739
00:31:53,040 --> 00:31:51,160
previous measurements have sort of just

740
00:31:54,660 --> 00:31:53,050
made very broad brush kind of

741
00:31:56,010 --> 00:31:54,670
measurements at the higher energies and

742
00:31:57,810 --> 00:31:56,020
without the kind of energy resolution

743
00:31:59,310 --> 00:31:57,820
that we were able to achieve with the

744
00:32:01,980 --> 00:31:59,320
repped instrument I think we would have

745
00:32:03,480 --> 00:32:01,990
again probably sort of smushed all this

746
00:32:05,610 --> 00:32:03,490
out and we wouldn't have really seen so

747
00:32:08,750 --> 00:32:05,620
clearly at all that we had these kind of

748
00:32:12,090 --> 00:32:08,760
distinct spatial and temporal features

749
00:32:14,340 --> 00:32:12,100
ok next question please are the collapse

750
00:32:16,590 --> 00:32:14,350
of the outer belt and its reenergize

751
00:32:20,040 --> 00:32:16,600
ation connected with any external

752
00:32:21,900 --> 00:32:20,050
phenomena that you can identify yes I

753
00:32:25,920 --> 00:32:21,910
think all of us in a way have addressed

754
00:32:28,410 --> 00:32:25,930
that but we see very clearly and maybe

755
00:32:29,880 --> 00:32:28,420
more clearly than we ever imagined we

756
00:32:32,370 --> 00:32:29,890
could with the living with a star

757
00:32:34,560 --> 00:32:32,380
program we're able to watch the ultimate

758
00:32:35,760 --> 00:32:34,570
driver the Sun we can watch these things

759
00:32:38,280 --> 00:32:35,770
propagate through the interplanetary

760
00:32:40,170 --> 00:32:38,290
medium we can then observe directly the

761
00:32:42,810 --> 00:32:40,180
effects with the radiation belt storm

762
00:32:45,060 --> 00:32:42,820
probes the consequences in the radiation

763
00:32:47,340 --> 00:32:45,070

belts so we're in a Envia Bowl time here

764
00:32:48,870 --> 00:32:47,350
where we can really watch cause and

765
00:32:52,560 --> 00:32:48,880
effect play out before our eyes

766
00:32:54,480 --> 00:32:52,570
maybe moan our Nikki we have seen in the

767
00:32:57,030 --> 00:32:54,490
past when we've had coronal mass

768
00:32:59,760 --> 00:32:57,040
ejections we have seen a drainage and

769
00:33:01,260 --> 00:32:59,770
then a repopulation of the belts we've

770
00:33:02,880 --> 00:33:01,270
seen that before that's pretty

771
00:33:05,730 --> 00:33:02,890
well-established what we haven't seen

772
00:33:08,190 --> 00:33:05,740
before is those from the original

773
00:33:10,440 --> 00:33:08,200
particles in the outer belt coming in

774
00:33:12,180 --> 00:33:10,450
and forming this storage ring or this at

775
00:33:14,520 --> 00:33:12,190
this extra area and then lasting for a

776
00:33:18,210 --> 00:33:14,530
month that we've never seen before but

777
00:33:20,730 --> 00:33:18,220
we pretty well understand at least at

778
00:33:23,190 --> 00:33:20,740
some level the the process that that

779
00:33:25,380 --> 00:33:23,200
happens to drain the belts originally

780
00:33:27,930 --> 00:33:25,390
and then refill them but the fact that

781
00:33:29,850 --> 00:33:27,940
very similar solar drivers can have such

782
00:33:33,540 --> 00:33:29,860
a different effect on the radiation

783
00:33:35,640 --> 00:33:33,550
belts is is really the central focus of

784
00:33:36,419 --> 00:33:35,650
the of the Van Allen probes just you

785
00:33:38,759 --> 00:33:36,429
know sometimes they

786
00:33:40,590 --> 00:33:38,769
it does bring up the radiation belts and

787
00:33:43,230 --> 00:33:40,600
other times it just annihilates them as

788
00:33:45,060 --> 00:33:43,240

you saw in the plots that the Dan hat

789
00:33:47,279 --> 00:33:45,070
and I think that you know now we've got

790
00:33:49,919 --> 00:33:47,289
the ability to really bring those outer

791
00:33:52,529 --> 00:33:49,929
belts into focus as Dan said with new

792
00:33:55,019 --> 00:33:52,539
technology what we saw before is kind of

793
00:33:58,830 --> 00:33:55,029
a fuzzy image we're now seeing with

794
00:34:01,200 --> 00:33:58,840
great clarity I think the since we're

795
00:34:02,340 --> 00:34:01,210
talking in fairy tales the three little

796
00:34:05,159 --> 00:34:02,350
pigs while we can also talk about

797
00:34:08,549 --> 00:34:05,169
Goldilocks and having the sort of the

798
00:34:10,619 --> 00:34:08,559
right intense enough but not too intense

799
00:34:12,930 --> 00:34:10,629
so you don't completely eradicate the

800
00:34:15,240 --> 00:34:12,940
outer Van Allen belt but you eradicate a

801
00:34:17,099 --> 00:34:15,250
portion of it I don't think we'd really

802
00:34:19,200 --> 00:34:17,109
suspected before that that there could

803
00:34:20,790 --> 00:34:19,210
be this kind of Goldilocks event that

804
00:34:24,059 --> 00:34:20,800
would lead to this storage ring

805
00:34:26,190 --> 00:34:24,069
phenomenon okay next question could the

806
00:34:29,960 --> 00:34:26,200
probes themselves affect the radiation

807
00:34:33,780 --> 00:34:29,970
belts for instance by generating waves

808
00:34:36,990 --> 00:34:33,790
no the that the spacecraft themselves

809
00:34:40,680 --> 00:34:37,000
will not affect the radiation belts only

810
00:34:42,000 --> 00:34:40,690
very locally possibly but it's pretty

811
00:34:47,970 --> 00:34:42,010
unlikely that that would have much

812
00:34:54,629 --> 00:34:47,980
effect okay next question do intersect

813
00:35:00,630 --> 00:34:54,639

the Lagrangian points no our simplest

814
00:35:03,329 --> 00:35:00,640
answer so far okay I think that's all

815
00:35:04,620 --> 00:35:03,339
the questions we have online thank you

816
00:35:06,900 --> 00:35:04,630
for asking the questions thank you to

817
00:35:08,849 --> 00:35:06,910
our panelists and you can follow along

818
00:35:15,240 --> 00:35:08,859
what's going on with the Van Alen

819
00:35:16,950 --> 00:35:15,250
provision online at WWF an Allen probes

820
00:35:18,960 --> 00:35:16,960
and you can keep up with all the

821
00:35:21,390 --> 00:35:18,970
different NASA scientific findings

822
00:35:23,069 --> 00:35:21,400
through our social media channels we've

823
00:35:25,140 --> 00:35:23,079
got quite a wide array from them there's

824
00:35:27,809 --> 00:35:25,150
always something amazing happening at