
Payload Operations Integration Center
NASA Marshall Space Flight Center
Huntsville, Alabama
NASA
PRO-3

1
00:00:07,349 --> 00:00:04,870
we're talking about the extreme universe

2
00:00:09,270 --> 00:00:07,359
space observatory or uso now this will

3
00:00:11,350 --> 00:00:09,280
study cosmic rays as they enter the

4
00:00:13,110 --> 00:00:11,360
earth's atmosphere by recording air

5
00:00:15,430 --> 00:00:13,120
showers as they enter the earth's

6
00:00:18,070 --> 00:00:15,440
atmosphere and it's also referred to as

7
00:00:19,750 --> 00:00:18,080
gemuso because it will be placed on the

8
00:00:21,910 --> 00:00:19,760
exposed facility on the japanese

9
00:00:24,790 --> 00:00:21,920
experiment module and to tell us more

10
00:00:27,429 --> 00:00:24,800
about the gemuso experiment is roy young

11
00:00:29,669 --> 00:00:27,439
he was the optic module lead systems

12
00:00:30,950 --> 00:00:29,679
engineer for this experiment uh roy

13
00:00:33,670 --> 00:00:30,960

thanks for joining us and tell us a

14
00:00:35,750 --> 00:00:33,680
little bit about what jim uso is well

15
00:00:37,830 --> 00:00:35,760
lori jim yousso is an experiment that

16
00:00:39,430 --> 00:00:37,840
will study the highest energy

17
00:00:41,510 --> 00:00:39,440
cosmic rays

18
00:00:43,590 --> 00:00:41,520
by not looking up at the heavens but

19
00:00:46,950 --> 00:00:43,600
looking down at the earth's atmosphere

20
00:00:49,310 --> 00:00:46,960
jim uso is a fairly old experiment it

21
00:00:52,869 --> 00:00:49,320
was first envisioned back in the late

22
00:00:54,630 --> 00:00:52,879
1990s and was going to fly

23
00:00:57,270 --> 00:00:54,640
sponsored by esa

24
00:00:59,349 --> 00:00:57,280
it was going to fly on the iss up to the

25
00:01:01,910 --> 00:00:59,359
iss on the space shuttle after the

26
00:01:03,029 --> 00:01:01,920
columbia accident we had to redesign to

27
00:01:06,310 --> 00:01:03,039
fit onto

28
00:01:09,270 --> 00:01:06,320
the htv h2 transfer vehicle we have an

29
00:01:12,950 --> 00:01:09,280
animation showing the deployment of uso

30
00:01:15,190 --> 00:01:12,960
that we can show at this time and as you

31
00:01:18,149 --> 00:01:15,200
can see from this deployment

32
00:01:21,429 --> 00:01:18,159
the i the robotic arm will reach in pull

33
00:01:23,990 --> 00:01:21,439
jim uso out of the htv it will then

34
00:01:26,630 --> 00:01:24,000
attach it to the exposed facility

35
00:01:29,990 --> 00:01:26,640
we had to collapse the instrument to fit

36
00:01:32,149 --> 00:01:30,000
it inside the htv so once it is attached

37
00:01:34,550 --> 00:01:32,159
then we use an expansion mechanism to

38
00:01:37,109 --> 00:01:34,560

expand it this instrument is about 15

39
00:01:39,429 --> 00:01:37,119
feet long and it's about 10 feet in

40
00:01:40,789 --> 00:01:39,439
diameter so it's a fairly large

41
00:01:42,230 --> 00:01:40,799
experiment

42
00:01:43,510 --> 00:01:42,240
so for folks who don't know what are

43
00:01:47,830 --> 00:01:43,520
cosmic rays

44
00:01:50,630 --> 00:01:47,840
light

45
00:01:53,590 --> 00:01:50,640
cosmic rays are actually particles

46
00:01:55,670 --> 00:01:53,600
they're protons and the nucleuses of

47
00:01:57,510 --> 00:01:55,680
atoms and the interesting thing about

48
00:01:58,310 --> 00:01:57,520
them there's there's a wide spectrum of

49
00:02:01,109 --> 00:01:58,320
these

50
00:02:02,709 --> 00:02:01,119
energies for cosmic rays primarily the

51
00:02:04,870 --> 00:02:02,719
ones that we're going to be looking at

52
00:02:07,910 --> 00:02:04,880
are the higher energy cosmic rays called

53
00:02:10,469 --> 00:02:07,920
ultra high energy cosmic rays and

54
00:02:11,750 --> 00:02:10,479
they're an enigma they're a mystery uh

55
00:02:13,670 --> 00:02:11,760
we have

56
00:02:16,229 --> 00:02:13,680
these particles are

57
00:02:20,390 --> 00:02:16,239
minute minute mass

58
00:02:22,710 --> 00:02:20,400
but they are accelerated to 99.999

59
00:02:25,270 --> 00:02:22,720
i won't bother because it's 21 nines

60
00:02:27,110 --> 00:02:25,280
99.219

61
00:02:29,190 --> 00:02:27,120
percent the speed of light

62
00:02:32,229 --> 00:02:29,200
and if one of them should hit you it

63
00:02:33,830 --> 00:02:32,239

would have the uh punch of a 99 mile an

64
00:02:35,910 --> 00:02:33,840
hour fastball and this is from a

65
00:02:37,270 --> 00:02:35,920
particle that you can't even see nobody

66
00:02:38,470 --> 00:02:37,280
wants to get hit by that nobody wants to

67
00:02:40,790 --> 00:02:38,480
get hit by that

68
00:02:45,910 --> 00:02:42,630
the physics as we understand it is these

69
00:02:47,589 --> 00:02:45,920
things slowly lose energy due to the uh

70
00:02:50,390 --> 00:02:47,599
background radiation the three degree

71
00:02:52,150 --> 00:02:50,400
kelvin background from the big bang so

72
00:02:54,229 --> 00:02:52,160
they have to be the source of these

73
00:02:57,110 --> 00:02:54,239
high-energy cosmic rays has to be within

74
00:02:59,830 --> 00:02:57,120
about 100 million light years of us

75
00:03:02,630 --> 00:02:59,840
the mystery is we see nothing within 100

76
00:03:05,190 --> 00:03:02,640
million light years of of us that can

77
00:03:07,110 --> 00:03:05,200
accelerate particles to this tremendous

78
00:03:08,470 --> 00:03:07,120
speed and give them the energies that

79
00:03:10,309 --> 00:03:08,480
they have

80
00:03:13,030 --> 00:03:10,319
so this is the mystery the national

81
00:03:15,470 --> 00:03:13,040
science foundation has determined or

82
00:03:19,990 --> 00:03:15,480
released a report back in

83
00:03:23,030 --> 00:03:20,000
2003 and listed the top 11 remaining

84
00:03:24,869 --> 00:03:23,040
or major mysteries in physics this is

85
00:03:27,030 --> 00:03:24,879
one of them where do these ultra high

86
00:03:29,030 --> 00:03:27,040
energy cosmic rays come from how do they

87
00:03:30,390 --> 00:03:29,040
get accelerated to these tremendous

88
00:03:32,390 --> 00:03:30,400

velocities

89
00:03:35,830 --> 00:03:32,400
and this is what you sow will try to

90
00:03:37,509 --> 00:03:35,840
explore tell us how it works okay

91
00:03:39,030 --> 00:03:37,519
well first of all the cosmic rays we

92
00:03:41,030 --> 00:03:39,040
don't know what produces them but the

93
00:03:42,470 --> 00:03:41,040
end result is something that we can

94
00:03:44,070 --> 00:03:42,480
detect as it enters the earth's

95
00:03:47,030 --> 00:03:44,080
atmosphere we have an animation of this

96
00:03:49,910 --> 00:03:47,040
as well and what happens is these cosmic

97
00:03:52,390 --> 00:03:49,920
rays about 20 to 30 kilometers up in the

98
00:03:53,190 --> 00:03:52,400
atmosphere will hit

99
00:03:57,670 --> 00:03:53,200
air

100
00:03:59,910 --> 00:03:57,680
molecules they will of course

101
00:04:01,990 --> 00:03:59,920
collide and knock particles off these

102
00:04:03,509 --> 00:04:02,000
particles will knock other particles off

103
00:04:05,190 --> 00:04:03,519
and these particles will knock other

104
00:04:07,509 --> 00:04:05,200
particles off and as you can see from

105
00:04:09,589 --> 00:04:07,519
this animation you'll see a cosmic ray

106
00:04:11,670 --> 00:04:09,599
come in from the top and as you see it

107
00:04:12,949 --> 00:04:11,680
entering you'll you'll see all these

108
00:04:15,190 --> 00:04:12,959
particles

109
00:04:17,590 --> 00:04:15,200
being almost like fireworks

110
00:04:20,949 --> 00:04:17,600
and and this is

111
00:04:22,550 --> 00:04:20,959
maybe 200 billion particles and

112
00:04:25,350 --> 00:04:22,560
something you cannot see with your eye

113
00:04:27,510 --> 00:04:25,360

this is in primarily the ultra violet uh

114
00:04:28,710 --> 00:04:27,520
portion of the spectrum so you and i

115
00:04:31,510 --> 00:04:28,720
don't see it it'd be almost like a

116
00:04:34,310 --> 00:04:31,520
meteor but it's it's in the ultraviolet

117
00:04:35,110 --> 00:04:34,320
so we're trying to image that and the

118
00:04:41,990 --> 00:04:35,120
the

119
00:04:43,270 --> 00:04:42,000
from 100 watt light bulb moving at

120
00:04:46,469 --> 00:04:43,280
almost the speed of light through the

121
00:04:49,350 --> 00:04:46,479
atmosphere so it's it's a very faint

122
00:04:50,310 --> 00:04:49,360
object that you're trying to to to image

123
00:04:52,469 --> 00:04:50,320
and there's one other thing we were

124
00:04:54,629 --> 00:04:52,479
going to look at is that yes correct

125
00:04:57,030 --> 00:04:54,639
this is a model view so as i said uso

126
00:04:59,030 --> 00:04:57,040
has had several reincarnations this is a

127
00:05:01,189 --> 00:04:59,040
one of the older models but it consists

128
00:05:03,350 --> 00:05:01,199
of three lenses

129
00:05:05,670 --> 00:05:03,360
and a focal surface that's a big camera

130
00:05:08,070 --> 00:05:05,680
it's a big camera exactly now most

131
00:05:09,510 --> 00:05:08,080
lenses are made of glass and they're

132
00:05:12,070 --> 00:05:09,520
heavy and they're not really good for

133
00:05:14,710 --> 00:05:12,080
space but the interesting thing about

134
00:05:16,230 --> 00:05:14,720
light is it doesn't care how much glass

135
00:05:19,430 --> 00:05:16,240
is there it only cares about when it

136
00:05:21,110 --> 00:05:19,440
goes from air to glass and from glass

137
00:05:22,710 --> 00:05:21,120
back to air so

138
00:05:24,950 --> 00:05:22,720

anything in between

139
00:05:26,629 --> 00:05:24,960
doesn't matter so what if you took out

140
00:05:27,670 --> 00:05:26,639
all that glass in between the front and

141
00:05:30,230 --> 00:05:27,680
the back

142
00:05:31,430 --> 00:05:30,240
well that's called a fernell lens

143
00:05:32,629 --> 00:05:31,440
this is really cool it's like a fun

144
00:05:35,749 --> 00:05:32,639
house i think

145
00:05:37,670 --> 00:05:35,759
this is a small fernell lens and as you

146
00:05:40,550 --> 00:05:37,680
can see it can magnify it gives you a

147
00:05:41,990 --> 00:05:40,560
really big field of view

148
00:05:42,870 --> 00:05:42,000
so what do we hope to learn from this

149
00:05:44,070 --> 00:05:42,880
study

150
00:05:46,390 --> 00:05:44,080
well

151
00:05:48,310 --> 00:05:46,400
cosmic rays of course this this is a

152
00:05:50,550 --> 00:05:48,320
physics problem that has plagued us

153
00:05:52,710 --> 00:05:50,560
since they were first discovered back in

154
00:05:55,189 --> 00:05:52,720
the early 1900s

155
00:05:57,350 --> 00:05:55,199
we want to solve this problem cosmic

156
00:06:00,150 --> 00:05:57,360
rays can cause events inside of

157
00:06:02,150 --> 00:06:00,160
computers they can single event upsets

158
00:06:04,309 --> 00:06:02,160
they can rewrite

159
00:06:05,670 --> 00:06:04,319
programs in space so you want to shield

160
00:06:06,950 --> 00:06:05,680
yourself from these you want to show

161
00:06:09,110 --> 00:06:06,960
people from these

162
00:06:11,029 --> 00:06:09,120
the higher energy ones uh

163
00:06:12,870 --> 00:06:11,039

fortunately they don't happen that often

164
00:06:16,390 --> 00:06:12,880
there's one of these events

165
00:06:19,430 --> 00:06:16,400
per century per square kilometer so this

166
00:06:21,990 --> 00:06:19,440
is a these are extremely rare events so

167
00:06:23,670 --> 00:06:22,000
there's not a lot of concern of human

168
00:06:25,749 --> 00:06:23,680
impact but the lower energy ones in

169
00:06:28,390 --> 00:06:25,759
particular ones produced in our galaxy

170
00:06:30,150 --> 00:06:28,400
supernova you want to study and in fact

171
00:06:33,510 --> 00:06:30,160
on iss there are

172
00:06:34,629 --> 00:06:33,520
several experiments the alpha mac

173
00:06:36,309 --> 00:06:34,639
ams

174
00:06:38,309 --> 00:06:36,319
there is the um

175
00:06:40,309 --> 00:06:38,319
going to be one called ice cream there

176
00:06:41,990 --> 00:06:40,319
is one going to be called catalase and

177
00:06:44,230 --> 00:06:42,000
then with jim yuso you'll cover the

178
00:06:46,710 --> 00:06:44,240
whole spectrum of cosmic rays from the

179
00:06:48,309 --> 00:06:46,720
lower energy ones to the ultra high

180
00:06:49,909 --> 00:06:48,319
energy ones which is what you sow will

181
00:06:51,270 --> 00:06:49,919
look at and there's one other piece of

182
00:06:53,510 --> 00:06:51,280
animation or video we're going to look

183
00:06:56,309 --> 00:06:53,520
at yes uh and this is a this will be an

184
00:06:57,350 --> 00:06:56,319
animation showing what the cosmic ray

185
00:07:00,309 --> 00:06:57,360
looks like

186
00:07:04,629 --> 00:07:02,790
now inside of uso as i said there are

187
00:07:07,589 --> 00:07:04,639
these three lenses and there's also a

188
00:07:09,189 --> 00:07:07,599

focal detector and the focal detector is

189
00:07:11,189 --> 00:07:09,199
5 000

190
00:07:12,390 --> 00:07:11,199
photo multiplier tubes

191
00:07:15,510 --> 00:07:12,400
and that is

192
00:07:18,710 --> 00:07:15,520
the place where the image is recorded

193
00:07:21,189 --> 00:07:18,720
and stored and what we look for is a

194
00:07:23,589 --> 00:07:21,199
signal that indicates you've seen a

195
00:07:26,150 --> 00:07:23,599
cosmic ray so you basically store

196
00:07:29,110 --> 00:07:26,160
several frames of data and a frame of

197
00:07:30,550 --> 00:07:29,120
data for you so is about 2.5

198
00:07:33,110 --> 00:07:30,560
microseconds

199
00:07:35,909 --> 00:07:33,120
so it's it's millions of seconds so you

200
00:07:38,469 --> 00:07:35,919
store these frames until you recognize a

201
00:07:39,990 --> 00:07:38,479
cosmic ray then you save that particular

202
00:07:42,550 --> 00:07:40,000
piece of

203
00:07:44,469 --> 00:07:42,560
frame and you download it to the ground

204
00:07:46,390 --> 00:07:44,479
where it can be analyzed awesome well

205
00:07:49,990 --> 00:07:46,400
when will we see this launch well we're

206
00:07:51,510 --> 00:07:50,000
hoping to launch in late 2017 or 2018

207
00:07:53,189 --> 00:07:51,520
and uh

208
00:07:54,790 --> 00:07:53,199
ideally we'd like to be on station for

209
00:07:57,270 --> 00:07:54,800
three years and that's uh that's the

210
00:07:59,350 --> 00:07:57,280
goal to to gather the statistics that we