



1  
00:00:02,706 --> 00:00:03,986  
>> Kyle Herring:  
Almost two years ago,

2  
00:00:03,986 --> 00:00:07,366  
the International Space  
Station was visited

3  
00:00:08,006 --> 00:00:11,656  
by Space Shuttle Endeavor  
as part of the last couple

4  
00:00:11,656 --> 00:00:14,816  
of flights to the  
International Space Station.

5  
00:00:14,816 --> 00:00:18,506  
That flight delivered the  
Alpha Magnetic Spectrometer,

6  
00:00:18,996 --> 00:00:24,386  
and yesterday, obviously, there  
was an announcement relative

7  
00:00:24,496 --> 00:00:29,766  
to the progress of AMS's  
experiment activity

8  
00:00:29,766 --> 00:00:33,666  
on the outside truss segment of  
the International Space Station,

9  
00:00:33,666 --> 00:00:38,076  
and we're very fortunate to  
have Trent Martin join us

10  
00:00:38,076 --> 00:00:41,196  
from Marshall Space  
Flight Center this morning.

11

00:00:41,196 --> 00:00:42,056

Trent, how are you doing?

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00:00:44,316 --> 00:00:44,566

>> Trent Martin: Good.

13

00:00:44,566 --> 00:00:44,846

Thank you.

14

00:00:46,176 --> 00:00:46,506

>> Kyle Herring: Great.

15

00:00:46,666 --> 00:00:49,776

Well, Trent, just to set  
the stage, Trent's been,

16

00:00:50,016 --> 00:00:53,556

I guess you've been at JSC  
since, you said, 1995, I think,

17

00:00:53,556 --> 00:00:58,266

and you supported activities now

18

00:00:58,266 --> 00:01:00,936

through the JSC engineering  
directorate,

19

00:01:01,476 --> 00:01:04,996

but talk about your  
level of excitement based

20

00:01:04,996 --> 00:01:06,646

on what you heard yesterday.

21

00:01:09,156 --> 00:01:10,996

>> Trent Martin: Well, the  
entire team is excited.

22

00:01:11,176 --> 00:01:13,686

We're just excited to have  
the first paper published

23

00:01:13,686 --> 00:01:17,546

and out there, but really  
looking forward to all the rest

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00:01:17,546 --> 00:01:19,766

of the papers that will  
be coming this year

25

00:01:19,766 --> 00:01:21,276

and then throughout  
the coming years.

26

00:01:21,866 --> 00:01:25,156

We've been gathering data  
since AMS was installed

27

00:01:25,156 --> 00:01:28,856

on Space Station almost two  
years ago now, and, in fact,

28

00:01:28,856 --> 00:01:32,846

we've gathered over  
31 billion particles,

29

00:01:33,386 --> 00:01:35,996

which the scientists  
have to go through

30

00:01:35,996 --> 00:01:39,046

and identify specific  
science results that they'd

31

00:01:39,046 --> 00:01:41,696

like to publish, and,  
fortunately, yesterday,

32

00:01:41,696 --> 00:01:43,326  
the first paper was published.

33

00:01:44,336 --> 00:01:47,526  
>> Kyle Herring: How did, how  
have you been following this?

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00:01:47,526 --> 00:01:50,446  
I know, you know, you were  
integral with the team

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00:01:50,446 --> 00:01:54,096  
that basically integrated  
AMS into the shuttle mission

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00:01:54,326 --> 00:01:56,756  
and got all of that going  
and got it, obviously,

37

00:01:56,786 --> 00:01:59,596  
delivered to the station,  
but since that time,

38

00:01:59,596 --> 00:02:03,246  
how do you keep track of  
what's going on with AMS, and,

39

00:02:03,386 --> 00:02:08,716  
obviously, you're keenly  
interested in that.

40

00:02:08,716 --> 00:02:08,786  
>> Trent Martin: [Inaudible]

41

00:02:08,786 --> 00:02:11,526  
So I'm still considered  
the AMS project manager,

42

00:02:11,696 --> 00:02:12,536  
but at this point,

43

00:02:12,536 --> 00:02:14,976

we've essentially transitioned into operations.

44

00:02:15,536 --> 00:02:18,086

What that means is that on a day-to-day basis,

45

00:02:18,146 --> 00:02:20,706

the team that we have in Houston, which is fairly small

46

00:02:20,706 --> 00:02:24,386

at this point, coordinates with the collaboration,

47

00:02:24,386 --> 00:02:27,716

who are operating the experiment out of Geneva,

48

00:02:28,186 --> 00:02:31,246

out of payload operation control center at CERN,

49

00:02:31,726 --> 00:02:33,976

and also at night time in Geneva.

50

00:02:33,976 --> 00:02:36,826

They have a separate control center in Taiwan

51

00:02:36,926 --> 00:02:40,116

that provides some operation support for them.

52

00:02:40,546 --> 00:02:43,836

So what we do is integrate the activities

53

00:02:43,926 --> 00:02:47,786  
between those two control  
centers in Geneva and Taiwan

54

00:02:48,266 --> 00:02:49,966  
with the control  
centers in Houston

55

00:02:49,966 --> 00:02:53,576  
and the payload operation  
integration center here

56

00:02:53,576 --> 00:02:57,206  
in Huntsville, and on a  
daily basis just make sure

57

00:02:57,206 --> 00:02:58,846  
that they're getting  
the data that they need.

58

00:02:59,466 --> 00:03:02,846  
Make sure that if there's  
any configuration changes

59

00:03:02,846 --> 00:03:05,056  
to the Space Station that  
they need to be aware of,

60

00:03:05,056 --> 00:03:06,966  
that we inform them of those.

61

00:03:07,326 --> 00:03:11,196  
If there's some specific  
analysis or thermal

62

00:03:11,196 --> 00:03:15,026  
or structural or avionics  
or data analysis that needs

63

00:03:15,026 --> 00:03:18,766

to get done, we perform that activity in coordination

64

00:03:18,766 --> 00:03:21,886

with the collaboration and then get the data back over to them.

65

00:03:21,926 --> 00:03:24,746

Essentially, we act as their single point of contact

66

00:03:24,746 --> 00:03:27,906

into NASA, whoever NASA may be,

67

00:03:28,386 --> 00:03:30,176

whether it's the Space Station program

68

00:03:30,176 --> 00:03:32,186

or others within the agency.

69

00:03:33,046 --> 00:03:33,166

>> Kyle Herring: Well,

70

00:03:33,166 --> 00:03:39,306

you talked about the team right now being fairly small, but,

71

00:03:39,306 --> 00:03:41,676

obviously, it's, there's a reason for that

72

00:03:41,676 --> 00:03:45,496

because things are going well, obviously, but it started out,

73

00:03:45,496 --> 00:03:46,756

obviously, as a much

larger team,

74

00:03:46,756 --> 00:03:49,236  
and there's a much  
wider distribution

75

00:03:49,576 --> 00:03:51,256  
of the folks working  
on this, right.

76

00:03:51,446 --> 00:03:53,966  
It's, like, you did,  
said, it spans kind

77

00:03:53,966 --> 00:03:55,416  
of worldwide almost, right.

78

00:03:57,576 --> 00:03:57,756  
>> Trent Martin: Yeah.

79

00:03:57,756 --> 00:04:01,346  
We have as many partner  
nations on the AMS collaboration

80

00:04:01,346 --> 00:04:03,436  
as the Space Station  
has partner nations.

81

00:04:03,546 --> 00:04:07,376  
There are different nations,  
but it is a collaboration

82

00:04:07,376 --> 00:04:11,156  
in that each one of those  
partner nations and institutes,

83

00:04:11,156 --> 00:04:18,516  
of which there are 56, provide  
some component or some analysis

84

00:04:18,516 --> 00:04:21,916

or some computer resource  
to the collaboration.

85

00:04:21,916 --> 00:04:26,036

So, essentially, they  
bring a piece to the table,

86

00:04:26,626 --> 00:04:32,306

and then the collaboration led  
by Professor Ting from MIT works

87

00:04:32,306 --> 00:04:33,636

to coordinate those together.

88

00:04:34,226 --> 00:04:36,996

During the buildup of  
AMS, it was our job

89

00:04:37,236 --> 00:04:39,656

at the Johnson Space  
Center to ensure

90

00:04:39,846 --> 00:04:42,226

that those integration  
activities went smoothly.

91

00:04:42,646 --> 00:04:44,656

That we were able to  
build an experiment

92

00:04:44,656 --> 00:04:46,216

that could be launched  
on the Space Shuttle

93

00:04:46,216 --> 00:04:48,196

and eventually installed  
on the Space Station.

94

00:04:48,756 --> 00:04:51,346

We provided the systems engineering

95

00:04:51,346 --> 00:04:55,626

and the integration function for the entire collaboration.

96

00:04:55,706 --> 00:04:57,866

They provided the pieces.

97

00:04:57,866 --> 00:05:00,846

We put them together in Geneva, obviously,

98

00:05:00,846 --> 00:05:02,066

with a lot of their help.

99

00:05:02,926 --> 00:05:05,886

And so over the time, we had a team that was as large

100

00:05:05,886 --> 00:05:09,426

as 600 engineers, physicists, and technicians.

101

00:05:10,116 --> 00:05:13,296

My team in Houston now is down to just a few people,

102

00:05:13,296 --> 00:05:15,816

but the collaboration remains at a fairly high level.

103

00:05:16,506 --> 00:05:21,596

They operate the experiment 24 hours a day 7 days a week with,

104

00:05:21,866 --> 00:05:24,276

like I said, teams in

Geneva and in Taiwan.

105

00:05:24,856 --> 00:05:29,126

In addition to that, they're gathering 1.4 billion particles

106

00:05:29,126 --> 00:05:31,416

a month, which have to be analyzed.

107

00:05:31,416 --> 00:05:34,696

So they analyze those at science centers in Geneva and then

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00:05:34,696 --> 00:05:37,876

at various universities around the world.

109

00:05:38,786 --> 00:05:41,636

What they've done is they've broken up their science teams

110

00:05:41,636 --> 00:05:45,986

into two major groups so that they can actually double check

111

00:05:46,266 --> 00:05:48,736

any results that they're analyzing.

112

00:05:48,736 --> 00:05:52,176

So one group will check the results; the other, they'll meet

113

00:05:52,176 --> 00:05:53,986

on a regular basis and say, alright, we're looking

114

00:05:53,986 --> 00:05:55,636

at this particular issue.

115

00:05:55,636 --> 00:05:58,536

You need to go double check that before we publish.

116

00:06:00,036 --> 00:06:00,976

>> Kyle Herring: Well, let's say, Trent.

117

00:06:00,976 --> 00:06:04,706

I think, I don't know if we've, we've got some video of some

118

00:06:05,176 --> 00:06:09,076

of the AMS activities associated with the launch

119

00:06:09,426 --> 00:06:16,276

and rendezvous and, obviously, the docking and, obviously,

120

00:06:16,276 --> 00:06:18,396

then, the relocation of AMS from Endeavor,

121

00:06:18,396 --> 00:06:23,316

but it was a fairly intricate process, I'm assuming,

122

00:06:23,316 --> 00:06:24,706

and it started, obviously,

123

00:06:24,706 --> 00:06:27,736

way before the actual shuttle mission itself.

124

00:06:27,736 --> 00:06:30,216

That's how payloads work, but you were involved in this

125

00:06:30,216 --> 00:06:31,806  
from the very beginning, right.

126

00:06:33,966 --> 00:06:34,286  
>> Trent Martin: Right.

127

00:06:34,286 --> 00:06:38,906  
I began working on AMS  
in 1995 in a capacity

128

00:06:38,906 --> 00:06:41,276  
as a structural analyst, and  
then worked my way up as,

129

00:06:41,786 --> 00:06:43,746  
eventually as the  
project manager for NASA.

130

00:06:44,276 --> 00:06:47,306  
But along the way, AMS2,

131

00:06:47,836 --> 00:06:49,406  
which is the version  
you're seeing here,

132

00:06:49,406 --> 00:06:52,326  
was started in 1998, soon

133

00:06:52,326 --> 00:06:55,016  
after we had completed our  
initial mission of AMS1.

134

00:06:55,016 --> 00:06:58,176  
It included upgrades  
to the detectors.

135

00:06:58,336 --> 00:07:01,696  
I always like to say if you give  
scientists time, they'll upgrade

136

00:07:02,276 --> 00:07:04,326  
to the latest and  
greatest instrument,

137

00:07:04,326 --> 00:07:07,076  
which is what they did with AMS.

138

00:07:07,236 --> 00:07:10,836  
So over the years, the different  
components would come together.

139

00:07:10,836 --> 00:07:13,836  
We put them together and tested  
them in various facilities

140

00:07:13,836 --> 00:07:16,056  
around the world,  
eventually culminating

141

00:07:16,056 --> 00:07:20,706  
in the final integration in  
Geneva at CERN in a clean room

142

00:07:20,706 --> 00:07:23,466  
that was provided by CERN and  
then tested at [inaudible]

143

00:07:23,466 --> 00:07:25,656  
in the Netherlands at ASTEC.

144

00:07:26,616 --> 00:07:29,666  
And then was sent to the  
Kennedy Space Center,

145

00:07:29,666 --> 00:07:32,736  
where we finished off the final  
integration and installed it

146

00:07:32,736 --> 00:07:35,816  
in the Space Shuttle and  
launched it in May of 2011.

147

00:07:36,666 --> 00:07:40,086  
They just saw it being taken out  
of the Space Shuttle payload bay

148

00:07:40,086 --> 00:07:44,426  
and placed on to the starboard  
truss of the Space Station,

149

00:07:44,426 --> 00:07:47,286  
what's called the S3 upper  
inboard payload attach site.

150

00:07:48,206 --> 00:07:50,556  
AMS is not your typical  
payload on Space Station.

151

00:07:50,556 --> 00:07:51,606  
It's very, very large.

152

00:07:51,606 --> 00:07:55,476  
It's 15,251 pounds.

153

00:07:56,176 --> 00:07:59,456  
It takes up an entire site  
where you would typically have,

154

00:07:59,986 --> 00:08:02,726  
you know, four to  
eight payloads sitting

155

00:08:02,726 --> 00:08:04,266  
on an express logistics carrier.

156

00:08:04,966 --> 00:08:07,536  
And there you can see  
a nice shot of it right

157

00:08:07,946 --> 00:08:12,216  
as we finished the  
installation in May of 2011.

158

00:08:12,986 --> 00:08:14,026  
>> Kyle Herring: You  
know, that's a great view

159

00:08:14,026 --> 00:08:16,586  
because that gives you, you  
talked about the size of it,

160

00:08:17,056 --> 00:08:19,606  
but when you look at it  
on that Space Station,

161

00:08:19,606 --> 00:08:21,466  
it really gives you  
a perspective

162

00:08:21,466 --> 00:08:24,096  
of how large the Space  
Station is actually

163

00:08:24,096 --> 00:08:26,586  
because that is a large  
instrument as you saw

164

00:08:26,586 --> 00:08:28,056  
in the back end of  
the payload bay.

165

00:08:30,106 --> 00:08:32,006  
>> Trent Martin: It really  
does give you that perspective,

166

00:08:32,006 --> 00:08:34,066  
a really good perspective,  
and, in fact, in that picture,

167

00:08:34,066 --> 00:08:36,886

you can see the PV arrays,  
the photo [inaudible] rays

168

00:08:36,886 --> 00:08:39,666

of the Space Station behind AMS.

169

00:08:40,326 --> 00:08:42,056

And one of the things  
that we've had to deal

170

00:08:42,056 --> 00:08:44,256

with over the first two years,  
which we knew we would have

171

00:08:44,256 --> 00:08:46,986

to deal with, is  
the thermal cycles

172

00:08:46,986 --> 00:08:48,236

that occur on Space Station.

173

00:08:48,236 --> 00:08:51,256

Every 45 minutes, one side is  
hot, the other side is cold,

174

00:08:51,256 --> 00:08:52,836

and then 45 minutes  
later, it's reversed.

175

00:08:54,256 --> 00:08:57,196

As Space Station goes  
through its normal operations,

176

00:08:57,196 --> 00:09:00,286

those PV arrays rotate  
around, and from time

177

00:09:00,286 --> 00:09:02,816  
to time they shade  
various portions of AMS.

178  
00:09:02,816 --> 00:09:06,356  
And so with our over  
1,500 thermal sensors,

179  
00:09:06,356 --> 00:09:10,856  
we're constantly monitoring  
the status of the experiment,

180  
00:09:11,296 --> 00:09:13,926  
the various components of  
the experiment to make sure

181  
00:09:13,926 --> 00:09:16,476  
that nothing is getting too hot,  
nothing is getting too cold,

182  
00:09:17,076 --> 00:09:18,826  
and ensuring that the data

183  
00:09:18,826 --> 00:09:23,696  
that we're collecting all  
the time is legitimate useful

184  
00:09:23,696 --> 00:09:24,596  
scientific data.

185  
00:09:25,416 --> 00:09:27,926  
And so those PV arrays  
play a factor.

186  
00:09:27,926 --> 00:09:30,406  
There's large radiators on Space  
Station that are right next

187  
00:09:30,406 --> 00:09:34,616  
to AMS, which also play a factor

into the thermal conditions

188

00:09:34,616 --> 00:09:35,646  
of the payload itself.

189

00:09:36,486 --> 00:09:39,276  
Here's a great view  
that was taken by one

190

00:09:39,276 --> 00:09:42,636  
of our EVA astronauts during  
the installation of AMS.

191

00:09:42,636 --> 00:09:46,586  
I love this view because you can  
see Endeavor, you can see AMS

192

00:09:46,586 --> 00:09:47,686  
in the foreground, Endeavor

193

00:09:47,686 --> 00:09:49,586  
in the background docked  
to the Space Station.

194

00:09:49,776 --> 00:09:53,106  
It's a good view from the  
expressed logistics carrier

195

00:09:53,106 --> 00:09:55,376  
sitting right next door  
to AMS to give you an idea

196

00:09:55,376 --> 00:09:58,276  
of where the other  
payloads are next to AMS.

197

00:09:58,276 --> 00:10:01,856  
You can also see the radiators,

198

00:10:01,956 --> 00:10:03,946  
the white on the  
bottom left-hand corner,

199  
00:10:03,946 --> 00:10:05,926  
those are the large  
radiators of Space Station

200  
00:10:05,926 --> 00:10:10,416  
that help remove the heat  
away from the components

201  
00:10:10,416 --> 00:10:15,326  
on the Space Station that are  
too hot, and those play a factor

202  
00:10:15,326 --> 00:10:19,046  
in temperatures on  
the AMS itself.

203  
00:10:20,776 --> 00:10:24,126  
>> Kyle Herring: Well,  
they have their work cut

204  
00:10:24,126 --> 00:10:25,036  
out for them with that.

205  
00:10:25,136 --> 00:10:28,846  
I think you mentioned  
1.6 billion samples

206  
00:10:29,646 --> 00:10:32,186  
that they're getting  
per month right now.

207  
00:10:32,366 --> 00:10:36,116  
So they've got a lot  
of work that they're,

208  
00:10:36,116 --> 00:10:37,536

I mean, it's just continuous.

209

00:10:37,536 --> 00:10:39,936

It's just an amazing number  
when you think about that.

210

00:10:41,466 --> 00:10:41,533

>> Trent Martin: Yeah.

211

00:10:42,096 --> 00:10:43,786

It's really, it's never ending.

212

00:10:43,996 --> 00:10:44,936

It just keeps coming.

213

00:10:45,356 --> 00:10:47,856

It's a large quantity of data.

214

00:10:48,296 --> 00:10:49,726

Yesterday, I was  
fortunate enough

215

00:10:49,726 --> 00:10:52,696

to go visit the payload  
operation integration center

216

00:10:52,696 --> 00:10:53,596

here in Huntsville.

217

00:10:53,686 --> 00:10:57,796

As the data comes down from  
Space Station, it works its way

218

00:10:57,796 --> 00:10:59,766

through [inaudible]  
down to White Sands

219

00:11:00,306 --> 00:11:02,406

onto Marshall Space Flight

Center and eventually

220

00:11:02,406 --> 00:11:03,976  
across the ocean to Geneva.

221

00:11:04,656 --> 00:11:07,736  
Along the way, there is  
a storage facility here

222

00:11:07,736 --> 00:11:11,136  
in Huntsville where all of our  
data sits, and every bit of data

223

00:11:11,136 --> 00:11:12,576  
that we've collected  
on AMS is sitting

224

00:11:12,576 --> 00:11:13,616  
in one of those computers.

225

00:11:14,186 --> 00:11:18,086  
In addition, we gather the data  
in Geneva and store it there,

226

00:11:18,086 --> 00:11:20,216  
and we have multiple places  
where we store the data

227

00:11:20,216 --> 00:11:23,016  
so that we can ensure  
its integrity and ensure

228

00:11:23,016 --> 00:11:26,066  
that we never lose any of  
the data because it's a once

229

00:11:26,066 --> 00:11:28,246  
in a lifetime kind of event.

230

00:11:28,326 --> 00:11:31,326

Once you've measured it, it's never going to happen again.

231

00:11:31,326 --> 00:11:32,106

You don't want to lose it.

232

00:11:33,056 --> 00:11:35,676

As we're looking for various science, some of the science

233

00:11:35,676 --> 00:11:37,696

that we're looking for including anti-matter science,

234

00:11:38,116 --> 00:11:41,166

you're really looking for that one particle in billions.

235

00:11:42,076 --> 00:11:46,576

You may find that one anti-helium or anti-carbon atom,

236

00:11:46,576 --> 00:11:49,746

and it may be in that data that we already have collected.

237

00:11:49,746 --> 00:11:51,926

We just don't know yet because we haven't gotten to it.

238

00:11:53,316 --> 00:11:55,946

>> Kyle Herring: And that's the fascination with this type

239

00:11:55,946 --> 00:11:59,316

of experiment that you don't, you might not know

240

00:11:59,316 --> 00:12:01,106

yet what you're going  
to find out,

241

00:12:01,106 --> 00:12:03,656

and that's really just  
absolutely amazing.

242

00:12:03,806 --> 00:12:07,706

And, Trent, I really  
appreciate you taking time out.

243

00:12:07,706 --> 00:12:11,796

I know you're busy up there in  
Huntsville, and we'll be glad

244

00:12:12,086 --> 00:12:15,106

to get you back to  
JSC when you get back,

245

00:12:15,106 --> 00:12:18,126

and we appreciate you taking  
time out to talk to us today.

246

00:12:18,126 --> 00:12:18,586

Thanks a lot.