1
00:00:04,390 --> 00:00:03,110
hi welcome to the mission control center

2
00:00:06,789 --> 00:00:04,400
in the international space station

3
00:00:08,150 --> 00:00:06,799
flight control room in particular and we

4
00:00:10,310 --> 00:00:08,160
as i mentioned earlier are going to have

5
00:00:13,030 --> 00:00:10,320
a special guest joining us joining us

6
00:00:15,110 --> 00:00:13,040
from kennedy space center today dr paul

7
00:00:16,870 --> 00:00:15,120
shalhorn who is working on the next

8
00:00:19,670 --> 00:00:16,880
generation of the spheres experiment

9
00:00:22,310 --> 00:00:19,680
that's the synchronized position hold

10
00:00:24,150 --> 00:00:22,320
engage reorient experimental satellites

11
00:00:25,990 --> 00:00:24,160
that we talk about really a pretty good

12
00:00:27,589 --> 00:00:26,000
bit they do a lot of work with that on

13
00:00:29,429 --> 00:00:27,599

the space station have been for a number

14
00:00:31,109 --> 00:00:29,439
of expeditions they found a lot of

15
00:00:33,350 --> 00:00:31,119
different ways to

16
00:00:34,870 --> 00:00:33,360
to use that technology and and perform

17
00:00:36,870 --> 00:00:34,880
different experiments with it and one of

18
00:00:38,790 --> 00:00:36,880
them is going to be going up next week

19
00:00:40,470 --> 00:00:38,800
on board cygnus to the space station

20
00:00:42,549 --> 00:00:40,480
that's the one that dr shellhorn is

21
00:00:45,190 --> 00:00:42,559
working on i believe he's connected dr

22
00:00:46,310 --> 00:00:45,200
shalhorn

23
00:00:48,389 --> 00:00:46,320
yes

24
00:00:49,590 --> 00:00:48,399
we we have an experiment that's going up

25
00:00:50,869 --> 00:00:49,600
the station that's going to be using

26
00:00:51,910 --> 00:00:50,879
spheres

27
00:00:52,950 --> 00:00:51,920
to

28
00:00:55,910 --> 00:00:52,960
capture

29
00:00:58,790 --> 00:00:55,920
fluid motion inside of a small acrylic

30
00:01:00,869 --> 00:00:58,800
tank excuse me lexon lexan tank the

31
00:01:03,270 --> 00:01:00,879
thought for us is

32
00:01:06,230 --> 00:01:03,280
i work in launch services program

33
00:01:08,390 --> 00:01:06,240
our primary purpose is launching of most

34
00:01:10,710 --> 00:01:08,400
of the science missions

35
00:01:12,550 --> 00:01:10,720
and many of the launch vehicles we use

36
00:01:15,109 --> 00:01:12,560
have liquid upper stages

37
00:01:16,630 --> 00:01:15,119
and during the our launches the liquid

38
00:01:18,789 --> 00:01:16,640

upper stage

39
00:01:20,950 --> 00:01:18,799
will end up usually having a coast

40
00:01:23,190 --> 00:01:20,960
period and during that coast period of

41
00:01:24,630 --> 00:01:23,200
microgravity we're concerned with what

42
00:01:27,109 --> 00:01:24,640
is happening

43
00:01:28,789 --> 00:01:27,119
in the fuel and oxidizer tanks of those

44
00:01:31,190 --> 00:01:28,799
upper stages

45
00:01:33,190 --> 00:01:31,200
okay so in order to understand that

46
00:01:36,230 --> 00:01:33,200
excuse me i'm sorry go ahead

47
00:01:38,149 --> 00:01:36,240
no that's okay go ahead

48
00:01:39,590 --> 00:01:38,159
i was just going to say so during that

49
00:01:41,190 --> 00:01:39,600
coast phase

50
00:01:43,749 --> 00:01:41,200
liquids moving around we're wanting to

51
00:01:45,030 --> 00:01:43,759
know what's going on and we predict it

52
00:01:46,710 --> 00:01:45,040
using

53
00:01:48,870 --> 00:01:46,720
numerical tools called computational

54
00:01:50,870 --> 00:01:48,880
fluid dynamics but we don't have any

55
00:01:52,950 --> 00:01:50,880
real test data in which to to anchor

56
00:01:54,789 --> 00:01:52,960
these models so this experiment is

57
00:01:57,510 --> 00:01:54,799
giving us all the test data that we're

58
00:02:00,709 --> 00:01:57,520
hoping to use to simulate what happens

59
00:02:01,910 --> 00:02:00,719
to um the propellant tanks

60
00:02:03,830 --> 00:02:01,920
on

61
00:02:05,350 --> 00:02:03,840
our our vehicles we're using this to

62
00:02:06,709 --> 00:02:05,360
anchor our modeling methodology if you

63
00:02:08,630 --> 00:02:06,719

will

64
00:02:10,229 --> 00:02:08,640
so how is this different than how you're

65
00:02:13,270 --> 00:02:10,239
able to test it on the ground what do

66
00:02:15,350 --> 00:02:13,280
you gain from testing it in space well

67
00:02:17,030 --> 00:02:15,360
where our concerns are is we actually

68
00:02:18,710 --> 00:02:17,040
have gone and done a whole series of

69
00:02:20,150 --> 00:02:18,720
tests we've sponsored it

70
00:02:22,630 --> 00:02:20,160
um

71
00:02:23,589 --> 00:02:22,640
the launch services program with me as

72
00:02:25,270 --> 00:02:23,599
pi

73
00:02:26,869 --> 00:02:25,280
has sponsored the florida institute of

74
00:02:30,070 --> 00:02:26,879
technology

75
00:02:31,430 --> 00:02:30,080
specifically dr dan kirk and dr hector

76
00:02:33,670 --> 00:02:31,440
gutierrez

77
00:02:35,270 --> 00:02:33,680
to perform a whole series of liquid

78
00:02:37,110 --> 00:02:35,280
slosh maneuvers sloshing basically

79
00:02:39,030 --> 00:02:37,120
meaning liquid moves

80
00:02:41,190 --> 00:02:39,040
around

81
00:02:42,150 --> 00:02:41,200
in a random fashion

82
00:02:43,910 --> 00:02:42,160
and so

83
00:02:46,229 --> 00:02:43,920
we've sponsored it on the ground we've

84
00:02:47,750 --> 00:02:46,239
sponsored some zero-g flights but our

85
00:02:49,430 --> 00:02:47,760
biggest concern has always been what

86
00:02:51,350 --> 00:02:49,440
happens when you're in a microgravity

87
00:02:53,110 --> 00:02:51,360
situation

88
00:02:56,470 --> 00:02:53,120

upper stage fires

89
00:02:57,990 --> 00:02:56,480
it it shuts down as it coasts getting

90
00:03:00,390 --> 00:02:58,000
ready to do another

91
00:03:02,470 --> 00:03:00,400
firing to to send satellite into

92
00:03:05,190 --> 00:03:02,480
whatever orbit or trajectory that it

93
00:03:06,949 --> 00:03:05,200
needs to go into and so our concern is

94
00:03:10,149 --> 00:03:06,959
what's happening during that that time

95
00:03:11,990 --> 00:03:10,159
frame uh from from a vehicle controls

96
00:03:13,910 --> 00:03:12,000
perspective is sloshing around and

97
00:03:17,430 --> 00:03:13,920
overtaking the the vehicle control

98
00:03:21,190 --> 00:03:19,430
area that i i have interest in what is

99
00:03:24,070 --> 00:03:21,200
it doing to to the conditioning of the

100
00:03:25,110 --> 00:03:24,080
propellant will it be able to to

101
00:03:28,630 --> 00:03:25,120
fire

102
00:03:34,229 --> 00:03:31,270
great so where did the idea of using the

103
00:03:37,589 --> 00:03:34,239
spheres satellites on the space station

104
00:03:41,589 --> 00:03:39,509
that's a good question

105
00:03:42,710 --> 00:03:41,599
a number of years ago when when we were

106
00:03:45,350 --> 00:03:42,720
in the midst of doing a lot of our

107
00:03:47,589 --> 00:03:45,360
ground testing of slash

108
00:03:49,030 --> 00:03:47,599
the folks from mit came down

109
00:03:52,550 --> 00:03:49,040
specifically uh

110
00:03:55,030 --> 00:03:52,560
dr david miller and he was the person at

111
00:03:56,309 --> 00:03:55,040
mit that heads up the lab that developed

112
00:03:57,750 --> 00:03:56,319
spheres

113
00:03:58,830 --> 00:03:57,760

and he was coming around to show us what

114
00:04:01,750 --> 00:03:58,840
spheres

115
00:04:03,350 --> 00:04:01,760
was when he came around and showed our

116
00:04:05,350 --> 00:04:03,360
group the first thing that came to my

117
00:04:06,949 --> 00:04:05,360
mind is this is the next logical step

118
00:04:10,149 --> 00:04:06,959
that we can end up using

119
00:04:11,509 --> 00:04:10,159
to to advancing our understanding of

120
00:04:14,470 --> 00:04:11,519
liquid behavior

121
00:04:15,190 --> 00:04:14,480
during coast phase so i got dr miller

122
00:04:18,069 --> 00:04:15,200
and

123
00:04:19,430 --> 00:04:18,079
dr kirk together to start postulating

124
00:04:22,310 --> 00:04:19,440
how could we end up

125
00:04:24,150 --> 00:04:22,320
doing an integrated slash modeling

126
00:04:26,469 --> 00:04:24,160
capability using

127
00:04:29,990 --> 00:04:26,479
spheres and using some of the expertise

128
00:04:31,670 --> 00:04:30,000
that was developed by florida tech

129
00:04:34,790 --> 00:04:31,680
what were you able to figure out how

130
00:04:36,870 --> 00:04:34,800
does how's the experiment going to work

131
00:04:38,390 --> 00:04:36,880
well the the experiment that you see

132
00:04:40,070 --> 00:04:38,400
that'll be going up and hopefully have a

133
00:04:43,110 --> 00:04:40,080
picture of this

134
00:04:45,030 --> 00:04:43,120
has two of the spheres that are at the

135
00:04:47,510 --> 00:04:45,040
end of two long arms

136
00:04:49,990 --> 00:04:47,520
and in the middle is a

137
00:04:51,670 --> 00:04:50,000
uh tank that is clear that's filled with

138
00:04:55,110 --> 00:04:51,680

uh liquid water

139
00:04:57,030 --> 00:04:55,120
uh that has a food coloring instead the

140
00:04:58,310 --> 00:04:57,040
two there

141
00:04:59,990 --> 00:04:58,320
i think that's a little bit better the

142
00:05:01,990 --> 00:05:00,000
two satellites i guess on either end the

143
00:05:04,070 --> 00:05:02,000
red and blue and the tank is in the

144
00:05:04,870 --> 00:05:04,080
middle

145
00:05:06,950 --> 00:05:04,880
yes

146
00:05:09,830 --> 00:05:06,960
and then the tank has two cameras

147
00:05:12,310 --> 00:05:09,840
pointing at it and so we can know what

148
00:05:13,830 --> 00:05:12,320
where the the the motion is at any given

149
00:05:14,950 --> 00:05:13,840
time because we have

150
00:05:16,790 --> 00:05:14,960
uh

151
00:05:18,710 --> 00:05:16,800
accelerometers on board

152
00:05:20,710 --> 00:05:18,720
and so we we know what let's say the

153
00:05:24,230 --> 00:05:20,720
impulse is we're using spheres in this

154
00:05:25,909 --> 00:05:24,240
case just as as our propulsion system

155
00:05:27,350 --> 00:05:25,919
and then we'll end up having it go

156
00:05:30,230 --> 00:05:27,360
through a set of maneuvers typical of

157
00:05:31,990 --> 00:05:30,240
those of an upper stage and we'll watch

158
00:05:33,590 --> 00:05:32,000
through the two cameras that are that

159
00:05:36,230 --> 00:05:33,600
are mounted 90 degrees apart they're

160
00:05:39,110 --> 00:05:36,240
kind of sitting up on a on an arm

161
00:05:41,110 --> 00:05:39,120
to look down into the into the tank and

162
00:05:42,790 --> 00:05:41,120
see how the motion goes then we'll

163
00:05:44,710 --> 00:05:42,800

compare that directly to our our

164
00:05:46,790 --> 00:05:44,720
modeling simulations

165
00:05:47,990 --> 00:05:46,800
and so the main idea is to is to verify

166
00:05:49,909 --> 00:05:48,000
the simulations that you've already

167
00:05:51,430 --> 00:05:49,919
modeled

168
00:05:53,029 --> 00:05:51,440
right our concern is is there some

169
00:05:54,790 --> 00:05:53,039
physics that we that we are not

170
00:05:56,390 --> 00:05:54,800
currently capturing

171
00:05:58,150 --> 00:05:56,400
on the ground everything seems to be

172
00:05:59,510 --> 00:05:58,160
dominated by

173
00:06:02,309 --> 00:05:59,520
gravity but when you get into a

174
00:06:04,950 --> 00:06:02,319
microgravity situation our concern is is

175
00:06:06,629 --> 00:06:04,960
the things such as surface tension

176
00:06:09,110 --> 00:06:06,639
dominating is there something else in

177
00:06:10,629 --> 00:06:09,120
the physics that that we don't know

178
00:06:12,870 --> 00:06:10,639
so we just want to make sure we have a

179
00:06:15,029 --> 00:06:12,880
good proper understanding before we we

180
00:06:16,070 --> 00:06:15,039
end up using this modeling tool any

181
00:06:20,629 --> 00:06:16,080
further

182
00:06:22,710 --> 00:06:20,639
in in launches that involved

183
00:06:24,790 --> 00:06:22,720
multi-million dollar to billion dollar

184
00:06:26,309 --> 00:06:24,800
satellites and so we want

185
00:06:27,749 --> 00:06:26,319
it's it's our way of trying to get a

186
00:06:31,110 --> 00:06:27,759
good investment

187
00:06:32,469 --> 00:06:31,120
for for what we're doing in the future

188
00:06:35,909 --> 00:06:32,479

sounds like it's worth getting that

189
00:06:37,909 --> 00:06:35,919
exactly right so when will we yes we're

190
00:06:40,390 --> 00:06:37,919
gonna we expect it to launch next week

191
00:06:42,390 --> 00:06:40,400
on board cygnus um and then when will we

192
00:06:44,950 --> 00:06:42,400
actually be seeing the experiment start

193
00:06:46,950 --> 00:06:44,960
onboard the space station

194
00:06:48,309 --> 00:06:46,960
uh i believe that the the first round of

195
00:06:51,749 --> 00:06:48,319
experiments is going to be starting

196
00:06:54,469 --> 00:06:51,759
sometime in the mid january time frame

197
00:06:57,029 --> 00:06:54,479
and then we have two more

198
00:06:59,110 --> 00:06:57,039
experiment sets coming up in february

199
00:07:00,469 --> 00:06:59,120
and march and then based on on the

200
00:07:01,990 --> 00:07:00,479
result of those

201
00:07:03,909 --> 00:07:02,000
we'll end up evaluating and see if we

202
00:07:05,510 --> 00:07:03,919
can end up asking for additional test

203
00:07:06,870 --> 00:07:05,520
sessions

204
00:07:08,390 --> 00:07:06,880
all right well we'll look forward to

205
00:07:11,110 --> 00:07:08,400
seeing those thanks so much for talking