1
00:00:06,710 --> 00:00:03,990
let's welcome to mission control via

2
00:00:07,990 --> 00:00:06,720
telephone right now dr ray sedwick with

3
00:00:10,230 --> 00:00:08,000
the uh

4
00:00:12,390 --> 00:00:10,240
spheres rings experiment welcome to

5
00:00:13,669 --> 00:00:12,400
mission control dr sedwick all right

6
00:00:15,110 --> 00:00:13,679
thanks very much

7
00:00:17,109 --> 00:00:15,120
we're happy to have you here over the

8
00:00:19,429 --> 00:00:17,119
phone of course the international space

9
00:00:22,390 --> 00:00:19,439
station getting ready to celebrate the

10
00:00:24,950 --> 00:00:22,400
15th anniversary of its first element

11
00:00:26,550 --> 00:00:24,960
launch and a host of research that's

12
00:00:28,150 --> 00:00:26,560
been going on aboard the international

13
00:00:31,589 --> 00:00:28,160

space station

14
00:00:33,030 --> 00:00:31,599
since the first crew members arrived uh

15
00:00:35,030 --> 00:00:33,040
mike hopkins worked with one of the

16
00:00:37,030 --> 00:00:35,040
experiments that you're most familiar

17
00:00:38,709 --> 00:00:37,040
with a little bit earlier this week

18
00:00:40,709 --> 00:00:38,719
could you describe

19
00:00:43,670 --> 00:00:40,719
your experiment for us a little bit yeah

20
00:00:44,790 --> 00:00:43,680
certainly so our experiment is called

21
00:00:46,470 --> 00:00:44,800
rings

22
00:00:49,350 --> 00:00:46,480
it's an acronym it stands for resonant

23
00:00:52,549 --> 00:00:49,360
inductive near field generation system

24
00:00:55,990 --> 00:00:52,559
it's a a piece of hardware that is being

25
00:00:58,709 --> 00:00:56,000
used to demonstrate two technologies

26
00:01:00,869 --> 00:00:58,719
one technology is what we refer to as

27
00:01:03,590 --> 00:01:00,879
electromagnetic formation flight and

28
00:01:06,230 --> 00:01:03,600
that's the idea of using magnetic fields

29
00:01:09,350 --> 00:01:06,240
to control the relative positions and

30
00:01:11,510 --> 00:01:09,360
attitudes of spacecraft in a cluster

31
00:01:13,750 --> 00:01:11,520
and the other technology is a form of

32
00:01:16,550 --> 00:01:13,760
wireless power transfer that would allow

33
00:01:18,149 --> 00:01:16,560
one spacecraft to transfer power uh to

34
00:01:21,190 --> 00:01:18,159
another spacecraft

35
00:01:22,789 --> 00:01:21,200
and uh this uh hardware is being flown

36
00:01:29,910 --> 00:01:22,799
as a

37
00:01:31,109 --> 00:01:29,920
spheres facility uh located on the iss

38
00:01:33,590 --> 00:01:31,119

and

39
00:01:36,310 --> 00:01:33,600
the one of those that makes

40
00:01:38,390 --> 00:01:36,320
peaks my interest the most is the uh the

41
00:01:40,630 --> 00:01:38,400
power transfer how do you transfer power

42
00:01:41,830 --> 00:01:40,640
between satellites like this without any

43
00:01:44,469 --> 00:01:41,840
cables

44
00:01:46,550 --> 00:01:44,479
well the there are many mechanisms that

45
00:01:48,469 --> 00:01:46,560
one could consider for power transfer

46
00:01:50,710 --> 00:01:48,479
this particular one

47
00:01:52,550 --> 00:01:50,720
is essentially an inductive

48
00:01:54,149 --> 00:01:52,560
power coupling it's the same type of

49
00:01:55,510 --> 00:01:54,159
power coupling that you would find in a

50
00:01:57,670 --> 00:01:55,520
transformer

51
00:01:59,510 --> 00:01:57,680
if you have an electric toothbrush

52
00:02:02,389 --> 00:01:59,520
probably the charging station and the

53
00:02:04,310 --> 00:02:02,399
toothbrush operate on the same principle

54
00:02:06,950 --> 00:02:04,320
usually you have to have the primary and

55
00:02:08,790 --> 00:02:06,960
the secondary coils of the transformer

56
00:02:09,910 --> 00:02:08,800
in close proximity to get efficient

57
00:02:13,110 --> 00:02:09,920
coupling

58
00:02:15,190 --> 00:02:13,120
but if the coils are actually tuned to

59
00:02:17,190 --> 00:02:15,200
the same resonant frequency

60
00:02:19,589 --> 00:02:17,200
then you can get a much more efficient

61
00:02:21,030 --> 00:02:19,599
transfer of power between the primary

62
00:02:22,869 --> 00:02:21,040
and the secondary even if they are

63
00:02:24,309 --> 00:02:22,879

separated by a fairly substantial

64
00:02:26,790 --> 00:02:24,319
distance

65
00:02:28,470 --> 00:02:26,800
that's really interesting and and so

66
00:02:30,070 --> 00:02:28,480
what exactly you're trying to use to

67
00:02:32,229 --> 00:02:30,080
learn specifically with these

68
00:02:33,830 --> 00:02:32,239
experiments as they relate to your two

69
00:02:36,150 --> 00:02:33,840
major objectives

70
00:02:38,390 --> 00:02:36,160
well in truth the the real advantage of

71
00:02:40,229 --> 00:02:38,400
operating on the iss is not so much for

72
00:02:42,229 --> 00:02:40,239
the wireless power transfer we can

73
00:02:43,589 --> 00:02:42,239
demonstrate that on the ground

74
00:02:46,470 --> 00:02:43,599
it's really focused on the

75
00:02:48,550 --> 00:02:46,480
electromagnetic formation flight because

76
00:02:50,790 --> 00:02:48,560
while we can do experiments on the

77
00:02:53,670 --> 00:02:50,800
ground to demonstrate the principle

78
00:02:55,990 --> 00:02:53,680
behind emf as we call it

79
00:02:59,830 --> 00:02:56,000
we can only do it really effectively in

80
00:03:02,390 --> 00:02:59,840
kind of a two-dimensional uh setup where

81
00:03:04,869 --> 00:03:02,400
we could have multiple vehicles

82
00:03:05,910 --> 00:03:04,879
traveling you know on a on a flat

83
00:03:08,229 --> 00:03:05,920
surface

84
00:03:10,309 --> 00:03:08,239
on what we call a flat floor

85
00:03:12,390 --> 00:03:10,319
using air carriages and we can

86
00:03:14,790 --> 00:03:12,400
demonstrate the principle but the the

87
00:03:16,229 --> 00:03:14,800
dynamics becomes much more complicated

88
00:03:17,509 --> 00:03:16,239

when you consider

89
00:03:19,509 --> 00:03:17,519
kind of the full

90
00:03:21,830 --> 00:03:19,519
six degrees of freedom where we have

91
00:03:24,149 --> 00:03:21,840
three translational and three trans and

92
00:03:26,869 --> 00:03:24,159
three rotational degrees of freedom for

93
00:03:30,070 --> 00:03:26,879
for each object so by being able to

94
00:03:32,470 --> 00:03:30,080
operate uh in the microgravity

95
00:03:35,509 --> 00:03:32,480
environment of the iss we can really

96
00:03:38,550 --> 00:03:35,519
exercise the full control algorithm and

97
00:03:40,630 --> 00:03:38,560
dynamic capability of the system

98
00:03:42,470 --> 00:03:40,640
i noticed watching the experiment

99
00:03:44,710 --> 00:03:42,480
earlier this week that there were at

100
00:03:47,830 --> 00:03:44,720
times one of the

101
00:03:51,750 --> 00:03:47,840
rings experiments was uh

102
00:03:53,190 --> 00:03:51,760
uh anchored with uh bungee cords uh

103
00:03:55,990 --> 00:03:53,200
what's that about

104
00:03:59,110 --> 00:03:56,000
so um so in in kind of developing the

105
00:04:02,630 --> 00:03:59,120
technology we're pursuing kind of a

106
00:04:04,309 --> 00:04:02,640
crawl then walk then run paradigm and

107
00:04:06,390 --> 00:04:04,319
the first thing we wanted to do this is

108
00:04:08,550 --> 00:04:06,400
our first science session

109
00:04:12,869 --> 00:04:08,560
and in the first science session

110
00:04:14,550 --> 00:04:12,879
to simplify uh the dynamics and also to

111
00:04:15,990 --> 00:04:14,560
make it easier for

112
00:04:18,310 --> 00:04:16,000
for mike to be able to conduct the

113
00:04:20,390 --> 00:04:18,320

experiments we decided that that

114
00:04:22,710 --> 00:04:20,400
anchoring one of the vehicles using the

115
00:04:25,110 --> 00:04:22,720
bungees and only have the other vehicle

116
00:04:27,510 --> 00:04:25,120
flying relative to it would be the

117
00:04:28,550 --> 00:04:27,520
easier way to go in the second science

118
00:04:30,150 --> 00:04:28,560
session

119
00:04:32,870 --> 00:04:30,160
we will most likely have both of the

120
00:04:34,629 --> 00:04:32,880
vehicles untethered and so mike's going

121
00:04:36,469 --> 00:04:34,639
to have to be able or whoever i guess

122
00:04:37,590 --> 00:04:36,479
next time it might not be him will have

123
00:04:40,710 --> 00:04:37,600
to be

124
00:04:43,270 --> 00:04:40,720
able to you know initially position the

125
00:04:44,950 --> 00:04:43,280
vehicles and somewhat in the proximity

126
00:04:47,590 --> 00:04:44,960
of where we'd like them to be

127
00:04:50,230 --> 00:04:47,600
and then because the control

128
00:04:52,390 --> 00:04:50,240
happens as a result of forces generated

129
00:04:54,710 --> 00:04:52,400
between the vehicles both of them are

130
00:04:57,110 --> 00:04:54,720
going to be moving the dynamics is much

131
00:04:58,469 --> 00:04:57,120
more complicated as is the control

132
00:04:59,990 --> 00:04:58,479
coincidentally we're watching some

133
00:05:01,990 --> 00:05:00,000
recorded video right now that shows

134
00:05:04,070 --> 00:05:02,000
hopkins positioning the two satellites

135
00:05:05,670 --> 00:05:04,080
without the bungie so exactly what you

136
00:05:06,870 --> 00:05:05,680
were talking about that we're watching

137
00:05:08,310 --> 00:05:06,880
right now

138
00:05:09,830 --> 00:05:08,320

can you tell us a little about your

139
00:05:11,749 --> 00:05:09,840
background where are you from where'd

140
00:05:12,950 --> 00:05:11,759
you go to school where do you work now

141
00:05:15,270 --> 00:05:12,960
uh sure

142
00:05:17,830 --> 00:05:15,280
so i grew up in western pennsylvania and

143
00:05:19,430 --> 00:05:17,840
i did my undergraduate degree at penn

144
00:05:22,230 --> 00:05:19,440
state university

145
00:05:25,350 --> 00:05:22,240
and then i moved to boston and i did my

146
00:05:27,830 --> 00:05:25,360
master's and phd at mit

147
00:05:29,270 --> 00:05:27,840
and then i stayed there for 10 years

148
00:05:31,270 --> 00:05:29,280
after that

149
00:05:33,270 --> 00:05:31,280
i was the associate director of the

150
00:05:34,390 --> 00:05:33,280
space systems laboratory in the

151
00:05:36,790 --> 00:05:34,400
department of aeronautics and

152
00:05:40,390 --> 00:05:36,800
astronautics for 10 years

153
00:05:41,990 --> 00:05:40,400
and then uh in 2007

154
00:05:44,629 --> 00:05:42,000
i moved down to the university of

155
00:05:47,510 --> 00:05:44,639
maryland uh where i established the

156
00:05:50,590 --> 00:05:47,520
space power and propulsion laboratory

157
00:05:53,590 --> 00:05:50,600
but i still uh work very closely in

158
00:05:55,749 --> 00:05:53,600
collaboration with the folks back at mit

159
00:05:57,430 --> 00:05:55,759
and they actually were co-developers

160
00:05:59,350 --> 00:05:57,440
along with a company called aurora

161
00:06:00,870 --> 00:05:59,360
flight sciences in developing this

162
00:06:02,230 --> 00:06:00,880
technology

163
00:06:05,029 --> 00:06:02,240

and do you have students involved in

164
00:06:06,870 --> 00:06:05,039
your research i sure do so i had two

165
00:06:10,070 --> 00:06:06,880
students here

166
00:06:12,710 --> 00:06:10,080
students

167
00:06:14,070 --> 00:06:12,720
one completed his master's degree

168
00:06:16,550 --> 00:06:14,080
over the summer

169
00:06:18,230 --> 00:06:16,560
one is working on her doctoral degree

170
00:06:21,189 --> 00:06:18,240
right now and there have also been

171
00:06:23,029 --> 00:06:21,199
several students involved at mit working

172
00:06:25,430 --> 00:06:23,039
on the the control algorithm development

173
00:06:29,029 --> 00:06:27,430
there's obvious benefits to the work

174
00:06:31,510 --> 00:06:29,039
that you're doing for

175
00:06:34,950 --> 00:06:31,520
space vehicles

176
00:06:37,029 --> 00:06:34,960
in orbit or on long-duration

177
00:06:39,110 --> 00:06:37,039
transfers to other locations of the

178
00:06:40,950 --> 00:06:39,120
solar system is there any application of

179
00:06:42,070 --> 00:06:40,960
your research that will help folks here

180
00:06:44,550 --> 00:06:42,080
on earth

181
00:06:46,230 --> 00:06:44,560
well i think the primary

182
00:06:48,150 --> 00:06:46,240
way that it would impact at least like

183
00:06:52,550 --> 00:06:48,160
the electromagnetic formation flight

184
00:06:53,749 --> 00:06:52,560
it's really a space dedicated technology

185
00:06:55,189 --> 00:06:53,759
where it

186
00:06:58,309 --> 00:06:55,199
could help

187
00:07:01,589 --> 00:06:58,319
folks on the ground is is in

188
00:07:03,430 --> 00:07:01,599

providing more capability for future

189
00:07:05,430 --> 00:07:03,440
space systems and so

190
00:07:07,589 --> 00:07:05,440
using clusters of spacecraft instead of

191
00:07:09,029 --> 00:07:07,599
individual spacecraft

192
00:07:11,350 --> 00:07:09,039
will allow

193
00:07:13,830 --> 00:07:11,360
certain capabilities like getting higher

194
00:07:15,029 --> 00:07:13,840
resolution images maybe on the ground or

195
00:07:16,390 --> 00:07:15,039
in space

196
00:07:17,350 --> 00:07:16,400
which could be used

197
00:07:18,629 --> 00:07:17,360
for

198
00:07:20,469 --> 00:07:18,639
improving

199
00:07:22,790 --> 00:07:20,479
you know weather prediction

200
00:07:23,909 --> 00:07:22,800
things like that the the wireless power

201
00:07:25,990 --> 00:07:23,919
transfer

202
00:07:28,070 --> 00:07:26,000
has many terrestrial applications and

203
00:07:29,589 --> 00:07:28,080
we're not necessarily

204
00:07:31,909 --> 00:07:29,599
leading the charge on that there are

205
00:07:34,309 --> 00:07:31,919
several companies that are pursuing

206
00:07:36,870 --> 00:07:34,319
development of that technology to be

207
00:07:38,790 --> 00:07:36,880
able to power let's say small

208
00:07:40,230 --> 00:07:38,800
electronics like your laptop or your

209
00:07:42,629 --> 00:07:40,240
cell phone without having to plug them

210
00:07:46,550 --> 00:07:45,110
well ray sedwick uh with the spheres

211
00:07:47,990 --> 00:07:46,560
rings we want to thank you very much for

212
00:07:49,670 --> 00:07:48,000
joining us here at mission control and

213
00:07:52,230 --> 00:07:49,680

explaining your experiment we've enjoyed

214
00:07:53,350 --> 00:07:52,240
watching it uh on the downlinks uh today

215
00:07:55,270 --> 00:07:53,360
and now we understand more about it