



1
00:00:27,109 --> 00:00:24,890
we'd like the crew of ATF I would also

2
00:00:28,820 --> 00:00:27,119
like to echo mr. Abby's thanks to all

3
00:00:30,919 --> 00:00:28,830
the folks who made our mission possible

4
00:00:33,620 --> 00:00:30,929
and easy and a lot of fun for us so

5
00:00:35,299 --> 00:00:33,630
again our hats are off our heads are off

6
00:00:38,569 --> 00:00:35,309
to y'all for all the hard work you put

7
00:00:40,400 --> 00:00:38,579
into the mission and and a little bit of

8
00:00:42,799 --> 00:00:40,410
thank you for all the work y'all have

9
00:00:44,330 --> 00:00:42,809
done we have a movie here that we put

10
00:00:47,000 --> 00:00:44,340
together with all of our post-flight

11
00:00:48,500 --> 00:00:47,010
video that we had and some slide so if

12
00:00:50,600 --> 00:00:48,510
we'll go ahead and dim the lights we're

13
00:00:52,340 --> 00:00:50,610

going to start the movie and we'll try

14

00:00:56,420 --> 00:00:52,350

to narrate it for you give you some idea

15

00:00:59,990 --> 00:00:56,430

what it was like to go on 85 was August

16

00:01:02,029 --> 00:01:00,000

seventh 1997 the vehicles already go out

17

00:01:05,000 --> 00:01:02,039

on the pad it's a busy morning launch

18

00:01:07,039 --> 00:01:05,010

morning so we were all a little bite to

19

00:01:08,539 --> 00:01:07,049

eat he got into the suit room got all

20

00:01:10,149 --> 00:01:08,549

suited up it takes quite a while to do

21

00:01:12,649 --> 00:01:10,159

that if you've seen a previous flight

22

00:01:16,070 --> 00:01:12,659

everyone was in great spirits everyone

23

00:01:20,660 --> 00:01:16,080

was excited to go got beam away from the

24

00:01:23,060 --> 00:01:20,670

breakfast table and Steve's all excited

25

00:01:25,130 --> 00:01:23,070

and last but not least be Arnie got his

26
00:01:30,080 --> 00:01:25,140
suit all checked out and he was ready to

27
00:01:32,210 --> 00:01:30,090
go also vehicles out in the pad is fully

28
00:01:34,069 --> 00:01:32,220
loaded with propellant and fuel and it

29
00:01:36,649 --> 00:01:34,079
was a flawless countdown it was all

30
00:01:37,819 --> 00:01:36,659
ready to go we departed the operational

31
00:01:40,880 --> 00:01:37,829
check-out building the crew quarters

32
00:01:42,740 --> 00:01:40,890
where we stay for our trip hopefully our

33
00:01:45,200 --> 00:01:42,750
only trip out to the pad for this flight

34
00:01:48,560 --> 00:01:45,210
and due to the great weather and a

35
00:01:49,850 --> 00:01:48,570
countdown it happened our first try once

36
00:01:51,740 --> 00:01:49,860
in the white womb would get a little bit

37
00:01:53,660 --> 00:01:51,750
more equipment on our harnesses for our

38
00:01:54,740 --> 00:01:53,670

parachutes and oxygen bottles and now

39

00:01:57,350 --> 00:01:54,750

we're going to show you inside the

40

00:01:59,510 --> 00:01:57,360

cockpit climbing kind of doing a chin up

41

00:02:02,020 --> 00:01:59,520

here to get into the deceits a little

42

00:02:04,399 --> 00:02:02,030

bit different view than you normally see

43

00:02:06,920 --> 00:02:04,409

Joe chana was our astronaut support

44

00:02:08,300 --> 00:02:06,930

person to strap us in try to get

45

00:02:09,619 --> 00:02:08,310

comfortable and on the mid deck while

46

00:02:14,080 --> 00:02:09,629

that was happening Steve was getting

47

00:02:23,000 --> 00:02:18,140

Kent's getting his helmet on jans doing

48

00:02:24,440 --> 00:02:23,010

what she always does actually Jan if you

49

00:02:25,940 --> 00:02:24,450

see on the left down there is in the

50

00:02:28,550 --> 00:02:25,950

cocktail ready and the last but not

51
00:02:30,440 --> 00:02:28,560
least was Beamer or Bob Curbeam to get

52
00:02:33,050 --> 00:02:30,450
in ms two-seat our flight engineer for a

53
00:02:35,020 --> 00:02:33,060
sent the mid-deck ready to go with Steve

54
00:02:37,880 --> 00:02:35,030
and B Arnie all strapped in with

55
00:02:39,710 --> 00:02:37,890
everyone aboard it's time to remove the

56
00:02:41,900 --> 00:02:39,720
white room it rotated back as you can

57
00:02:43,430 --> 00:02:41,910
see at two minutes they give us a call

58
00:02:45,470 --> 00:02:43,440
that closer advisors so we put our

59
00:02:47,900 --> 00:02:45,480
visors down and turn our suit on O2 on

60
00:02:50,500 --> 00:02:47,910
in preparation for start six and a half

61
00:02:53,000 --> 00:02:50,510
seconds there goes the main engines

62
00:02:54,410 --> 00:02:53,010
which is always a really a beautiful

63
00:02:56,290 --> 00:02:54,420

feeling inside the vehicle you can see

64

00:02:58,940 --> 00:02:56,300

the tank kind of does a little twang and

65

00:02:59,900 --> 00:02:58,950

at t0 we're on our way and now we're

66

00:03:02,990 --> 00:02:59,910

going to show you what that looked like

67

00:03:06,470 --> 00:03:03,000

from inside the cockpit the same exact

68

00:03:07,940 --> 00:03:06,480

sequence there's an engine start a lot

69

00:03:11,120 --> 00:03:07,950

of rumbling on a vibration you'll see

70

00:03:15,020 --> 00:03:11,130

the big jolt here for liftoff boom there

71

00:03:16,580 --> 00:03:15,030

goes liftoff and we're on our way and if

72

00:03:19,009 --> 00:03:16,590

you watch the lighting condition as we

73

00:03:20,449 --> 00:03:19,019

cleared the tower we did a big roll

74

00:03:21,710 --> 00:03:20,459

maneuver to align ourselves for our

75

00:03:23,210 --> 00:03:21,720

asset and you can see the lighting

76
00:03:24,740 --> 00:03:23,220
conditions change and the Sun winds up

77
00:03:33,140 --> 00:03:24,750
writing jams phase for pretty much the

78
00:03:35,000 --> 00:03:33,150
whole asset as you know it doesn't take

79
00:03:38,180 --> 00:03:35,010
long day to get out of Dodge here when

80
00:03:40,900 --> 00:03:38,190
those engines get going and and start

81
00:03:43,310 --> 00:03:40,910
pushing and all that thrust gets going

82
00:03:44,960 --> 00:03:43,320
so we were feeling acceleration about

83
00:03:47,780 --> 00:03:44,970
this time we're a high inclination

84
00:03:49,820 --> 00:03:47,790
flight going up the eastern seaboard 57

85
00:03:55,430 --> 00:03:49,830
degree inclination going up to about 160

86
00:03:56,930 --> 00:03:55,440
nautical miles the launch was in the

87
00:03:58,820 --> 00:03:56,940
kind of a hazy conditions but we could

88
00:04:01,040 --> 00:03:58,830

see as our be step so two minutes after

89

00:04:01,850 --> 00:04:01,050

launch we got rid of the SRBs and now

90

00:04:03,979 --> 00:04:01,860

we're going to show you what that looks

91

00:04:05,180 --> 00:04:03,989

like inside the cockpit the big flash so

92

00:04:09,560 --> 00:04:05,190

you'll have an idea of what we see it

93

00:04:11,030 --> 00:04:09,570

SRB Sep so it definitely gets your

94

00:04:13,610 --> 00:04:11,040

attention you know the boosters are now

95

00:04:16,940 --> 00:04:13,620

separated we can put our visors up at

96

00:04:19,009 --> 00:04:16,950

that time and I ride the three Shuttle

97

00:04:21,080 --> 00:04:19,019

main engines to the orbital speed and

98

00:04:24,080 --> 00:04:21,090

orbital altitude for the rest of the

99

00:04:25,310 --> 00:04:24,090

asset after we get off the tank the tank

100

00:04:26,340 --> 00:04:25,320

re-enters the atmosphere that gives you

101

00:04:28,560 --> 00:04:26,350

some idea of our speed

102

00:04:30,330 --> 00:04:28,570

is real time this is not sped up some

103

00:04:32,670 --> 00:04:30,340

idea of our speed at the yellow altitude

104

00:04:34,200 --> 00:04:32,680

we're at much Ron orbit is now time to

105

00:04:35,610 --> 00:04:34,210

turn the rocket into an orbital Space

106

00:04:41,540 --> 00:04:35,620

Station so we opened a big payload bay

107

00:04:46,710 --> 00:04:44,130

once we have the payload bay door open

108

00:04:48,600 --> 00:04:46,720

we can start our payload operations this

109

00:04:51,330 --> 00:04:48,610

is a very busy flight with over 40

110

00:04:53,070 --> 00:04:51,340

different payloads some of which are you

111

00:04:54,480 --> 00:04:53,080

see here in the payload Bay in the

112

00:04:56,880 --> 00:04:54,490

middle of the payload Bay is the

113

00:04:59,460 --> 00:04:56,890

christus paws one of our primary palos

114

00:05:01,830 --> 00:04:59,470

which was a scientific satellite looking

115

00:05:03,390 --> 00:05:01,840

at chemicals in the ozone layer Ellen

116

00:05:05,550 --> 00:05:03,400

very first day we had to deploy

117

00:05:07,680 --> 00:05:05,560

christosp oz to give it as much time as

118

00:05:09,810 --> 00:05:07,690

we could on orbit and here Steven are in

119

00:05:11,400 --> 00:05:09,820

the app flight deck getting ready for

120

00:05:13,860 --> 00:05:11,410

those robotic operations with the

121

00:05:15,870 --> 00:05:13,870

shuttle remote manipulator system the

122

00:05:18,870 --> 00:05:15,880

Canadian robot arm on the shuttle and

123

00:05:22,110 --> 00:05:18,880

here i am maneuvering the canadian rms

124

00:05:24,720 --> 00:05:22,120

to the christus paws grapple fixture so

125

00:05:27,090 --> 00:05:24,730

that we can grapple the christus paws as

126

00:05:30,000 --> 00:05:27,100

you see here and lift it up out of the

127

00:05:32,760 --> 00:05:30,010

payload bay and take it over the payload

128

00:05:35,820 --> 00:05:32,770

bay and get it ready for deploy and here

129

00:05:37,800 --> 00:05:35,830

it is just before we release it we're

130

00:05:40,050 --> 00:05:37,810

activating all of the experiments and

131

00:05:41,700 --> 00:05:40,060

instrumentation on the christus spohn

132

00:05:43,830 --> 00:05:41,710

satellite which was controlled by the

133

00:05:49,200 --> 00:05:43,840

Germans from Kennedy Space Center

134

00:05:51,780 --> 00:05:49,210

payload Operations Center here's a

135

00:05:53,700 --> 00:05:51,790

release of the RMS from the grapple

136

00:05:56,520 --> 00:05:53,710

fixture that's on the christus paws and

137

00:05:58,650 --> 00:05:56,530

we send it on its way to a nine-day

138

00:06:00,360 --> 00:05:58,660

scientific mission and we retrieve the

139

00:06:02,730 --> 00:06:00,370

Christmas paws on the tenth day of the

140

00:06:04,800 --> 00:06:02,740

mission to separate away from the

141

00:06:07,050 --> 00:06:04,810

christus paws we maneuvered actually

142

00:06:09,270 --> 00:06:07,060

Rama maneuvered the orbiter with some

143

00:06:10,950 --> 00:06:09,280

separation burns to get us away from the

144

00:06:15,060 --> 00:06:10,960

christus paws and you can see the

145

00:06:17,310 --> 00:06:15,070

christus paws as it is separated from

146

00:06:25,140 --> 00:06:17,320

the orbiter by moving the orbiter away

147

00:06:30,040 --> 00:06:27,850

they were able to get a lot of data in

148

00:06:32,290 --> 00:06:30,050

those nine days as you can see here it

149

00:06:35,860 --> 00:06:32,300

does now fully separated from the

150

00:06:38,350 --> 00:06:35,870

orbiter although crystal was our main

151
00:06:40,030 --> 00:06:38,360
payload our payload Bay was very full as

152
00:06:42,400 --> 00:06:40,040
you can see here forward in the orbiter

153
00:06:44,290 --> 00:06:42,410
is to your left and the first payload

154
00:06:47,770 --> 00:06:44,300
you see there is the Japanese robotic

155
00:06:50,230 --> 00:06:47,780
arm or the MFD the manipulator flight

156
00:06:51,700 --> 00:06:50,240
demonstration then the next bridge you

157
00:06:54,250 --> 00:06:51,710
see there is the technology and

158
00:06:57,580 --> 00:06:54,260
applications in science experiment which

159
00:06:59,500 --> 00:06:57,590
had a bunch of engineering models to be

160
00:07:01,750 --> 00:06:59,510
tested in zero-g and also scientific

161
00:07:04,930 --> 00:07:01,760
experiments in the aft and we'll get a

162
00:07:06,190 --> 00:07:04,940
close-up of that soon you'll see another

163
00:07:09,040 --> 00:07:06,200

hitchhiker bridge and that was the

164

00:07:11,650 --> 00:07:09,050

international extreme UV hitchhiker and

165

00:07:13,719 --> 00:07:11,660

it had a multitude of payloads looking

166

00:07:16,180 --> 00:07:13,729

in the ultraviolet at stars there

167

00:07:18,790 --> 00:07:16,190

Earth's atmosphere any interaction of

168

00:07:21,510 --> 00:07:18,800

the shuttle with the upper atmosphere a

169

00:07:23,650 --> 00:07:21,520

lot of these facilities add optical

170

00:07:25,330 --> 00:07:23,660

systems and so we had a lot of

171

00:07:28,029 --> 00:07:25,340

hitchhiker doors as these are called

172

00:07:29,980 --> 00:07:28,039

which closed to protect them from debris

173

00:07:34,750 --> 00:07:29,990

during some of the more sensitive times

174

00:07:37,450 --> 00:07:34,760

of flight we also had some mid dec

175

00:07:40,020 --> 00:07:37,460

experiments me taken a media sample out

176
00:07:42,670 --> 00:07:40,030
of the bioreactor demonstration system

177
00:07:44,800 --> 00:07:42,680
what I was doing I was growing colon

178
00:07:48,130 --> 00:07:44,810
cancer cells too much larger aggregates

179
00:07:49,900 --> 00:07:48,140
than we could do in 1g environment both

180
00:07:51,070 --> 00:07:49,910
for colon cancer research and cell

181
00:07:52,510 --> 00:07:51,080
research and there you see that

182
00:07:54,640 --> 00:07:52,520
aggregates and they grew to about three

183
00:08:01,210 --> 00:07:54,650
or four times larger than you would see

184
00:08:03,340 --> 00:08:01,220
and 1g continuing on with some of the

185
00:08:06,100 --> 00:08:03,350
mid-deck experiments this is a Kent

186
00:08:07,629 --> 00:08:06,110
rominger romulus we call him getting

187
00:08:09,070 --> 00:08:07,639
ready to serve a solid surface

188
00:08:10,750 --> 00:08:09,080

combustion experiment and it's an

189

00:08:12,760 --> 00:08:10,760

experiment that is flown on a number of

190

00:08:15,250 --> 00:08:12,770

shuttle missions and builds up the

191

00:08:17,740 --> 00:08:15,260

knowledge of how materials burn in the

192

00:08:20,770 --> 00:08:17,750

zero-g environment of space in this case

193

00:08:21,969 --> 00:08:20,780

we're burning a plexiglass type of

194

00:08:24,909 --> 00:08:21,979

plexiglass and near they see the

195

00:08:26,980 --> 00:08:24,919

ignition of that Plexiglas and we filmed

196

00:08:28,840 --> 00:08:26,990

the burn for about 10 minutes before the

197

00:08:31,899 --> 00:08:28,850

flame this little blue flame finally

198

00:08:33,640 --> 00:08:31,909

extinguished this is the swiss telescope

199

00:08:35,920 --> 00:08:33,650

used to have a look at the hale-bopp

200

00:08:37,630 --> 00:08:35,930

comet through the side hatch window and

201

00:08:39,520 --> 00:08:37,640

it diffuses the comedy

202

00:08:42,460 --> 00:08:39,530

violet which gives us a better signature

203

00:08:45,030 --> 00:08:42,470

some of the ions and elements coming off

204

00:08:47,320 --> 00:08:45,040

the comet that give off light in the UV

205

00:08:49,330 --> 00:08:47,330

Steve Penn spent a fair bit of his time

206

00:08:51,580 --> 00:08:49,340

during a mission doing this experiment

207

00:08:53,080 --> 00:08:51,590

and that little bright spot there just

208

00:08:55,090 --> 00:08:53,090

to the left of center is the actual

209

00:08:57,130 --> 00:08:55,100

comet you can't see it very well pieces

210

00:08:58,780 --> 00:08:57,140

of long distance from the earth but by

211

00:09:00,040 --> 00:08:58,790

summing up a lot of these images as

212

00:09:05,140 --> 00:09:00,050

scientists can pull out some of the

213

00:09:07,180 --> 00:09:05,150

structure in the comment itself there's

214

00:09:09,310 --> 00:09:07,190

Janna myself just preparing the

215

00:09:10,960 --> 00:09:09,320

microgravity vibration isolation mount

216

00:09:13,990 --> 00:09:10,970

for one of the experiments are doing on

217

00:09:15,670 --> 00:09:14,000

it this system isolates experiments

218

00:09:18,490 --> 00:09:15,680

fluid dynamics and material science

219

00:09:23,320 --> 00:09:18,500

experiments from the vibrations of the

220

00:09:25,750 --> 00:09:23,330

shuttle and we'll see in the next shot

221

00:09:27,610 --> 00:09:25,760

that not only can we isolate but we can

222

00:09:30,250 --> 00:09:27,620

actually shake an experiment with very

223

00:09:32,370 --> 00:09:30,260

well controlled acceleration profiles to

224

00:09:34,090 --> 00:09:32,380

look at the sensitivity of experiments

225

00:09:36,100 --> 00:09:34,100

typically the kind of we're going to

226

00:09:38,380 --> 00:09:36,110

doing a space station to the vibrations

227

00:09:40,450 --> 00:09:38,390

and here's a little student experiment

228

00:09:42,670 --> 00:09:40,460

to do where we can visualize a motion of

229

00:09:44,140 --> 00:09:42,680

rather large local molecules that would

230

00:09:49,720 --> 00:09:44,150

behave the same as molecules in the air

231

00:09:51,400 --> 00:09:49,730

around us here today the robot arm on

232

00:09:52,900 --> 00:09:51,410

the Space Shuttle on this flight is the

233

00:09:55,420 --> 00:09:52,910

Japanese manipulator flight

234

00:09:58,270 --> 00:09:55,430

demonstration it's a small robotic arm

235

00:10:00,160 --> 00:09:58,280

about five feet long as you see here in

236

00:10:02,110 --> 00:10:00,170

the payload Bay we're taking Stephen are

237

00:10:04,750 --> 00:10:02,120

with the operators of this we're taking

238

00:10:06,340 --> 00:10:04,760

it from the stowed position to the

239

00:10:08,710 --> 00:10:06,350

operational position where we can

240

00:10:10,360 --> 00:10:08,720

maneuver it around this is the real time

241

00:10:13,210 --> 00:10:10,370

speed of it it's a very precise

242

00:10:16,810 --> 00:10:13,220

instrument so it's therefore very slow

243

00:10:19,390 --> 00:10:16,820

but it's very functional we can use it

244

00:10:21,100 --> 00:10:19,400

on the space station to take experiments

245

00:10:23,970 --> 00:10:21,110

off of a pallet put them inside of a

246

00:10:26,770 --> 00:10:23,980

scientific airlock or to do very fine

247

00:10:29,350 --> 00:10:26,780

tasks that will need to do on the space

248

00:10:30,850 --> 00:10:29,360

station one of the things that we did on

249

00:10:33,820 --> 00:10:30,860

our flight to demonstrate this

250

00:10:35,530 --> 00:10:33,830

capability was we took this arm which

251
00:10:37,960 --> 00:10:35,540
has a grapple fixture at the end of it

252
00:10:40,540 --> 00:10:37,970
attached it to the box you see there we

253
00:10:42,940 --> 00:10:40,550
called it orbital replacement unit we

254
00:10:45,730 --> 00:10:42,950
attach it to the box and unscrew some of

255
00:10:48,370 --> 00:10:45,740
the bolts that are attaching that box to

256
00:10:50,950 --> 00:10:48,380
its plate and we actually moving this

257
00:10:53,440 --> 00:10:50,960
around to test the performance of the

258
00:10:55,410 --> 00:10:53,450
arm and test its capability with a load

259
00:10:57,910 --> 00:10:55,420
on the end of the arm so we moved this

260
00:11:00,280 --> 00:10:57,920
orbital replacement unit around and

261
00:11:02,950 --> 00:11:00,290
that's a similar type of activity will

262
00:11:05,350 --> 00:11:02,960
be doing with this arm which is on the

263
00:11:07,180 --> 00:11:05,360

end of a very long arm on the space

264

00:11:10,330 --> 00:11:07,190

station so we discussed to the small

265

00:11:17,410 --> 00:11:10,340

fine arm portion of what will fly on the

266

00:11:20,530 --> 00:11:17,420

space station another thing we did with

267

00:11:23,280 --> 00:11:20,540

this arm was we attached the arm to this

268

00:11:27,070 --> 00:11:23,290

door and actually unlocked the door and

269

00:11:29,440 --> 00:11:27,080

we used the arm to open up the door we

270

00:11:32,050 --> 00:11:29,450

did this with a program mode we also did

271

00:11:33,940 --> 00:11:32,060

a lot of operations with some control

272

00:11:36,550 --> 00:11:33,950

from the ground not just with the crew

273

00:11:38,680 --> 00:11:36,560

on the flight deck operating the arm so

274

00:11:41,800 --> 00:11:38,690

this demonstrated a lot of capability

275

00:11:45,430 --> 00:11:41,810

for the future and it performed very

276

00:11:47,860 --> 00:11:45,440

well this is sped up a little bit this

277

00:11:50,230 --> 00:11:47,870

function in the last scene you saw we

278

00:11:51,970 --> 00:11:50,240

celebrated the success of this arm by

279

00:11:54,340 --> 00:11:51,980

eating some Japanese curry rice you

280

00:12:00,700 --> 00:11:54,350

notice the chopsticks and rice and curry

281

00:12:02,410 --> 00:12:00,710

which was just delicious we also had a

282

00:12:04,030 --> 00:12:02,420

little free time later in the flight

283

00:12:06,940 --> 00:12:04,040

when we got an extra day and one of the

284

00:12:10,720 --> 00:12:06,950

things our folks did was some fluid

285

00:12:13,030 --> 00:12:10,730

experiments fluids tend to form a ball

286

00:12:14,740 --> 00:12:13,040

because of the surface tension they form

287

00:12:16,900 --> 00:12:14,750

a sphere and here we're trying to join

288

00:12:20,010 --> 00:12:16,910

the red sphere in the water together and

289

00:12:23,140 --> 00:12:20,020

we were successful after a few tries

290

00:12:25,950 --> 00:12:23,150

another typical mid-deck activity is

291

00:12:28,030 --> 00:12:25,960

exercise when you're in space your

292

00:12:30,940 --> 00:12:28,040

cardiovascular system doesn't have to

293

00:12:33,760 --> 00:12:30,950

work as hard so we have to exercise to

294

00:12:35,170 --> 00:12:33,770

make sure it works fine we stayed busy

295

00:12:36,640 --> 00:12:35,180

on the flight deck as well throughout

296

00:12:38,620 --> 00:12:36,650

the flight along with a lot of the

297

00:12:41,380 --> 00:12:38,630

payloads came pointing constraints

298

00:12:44,140 --> 00:12:41,390

pointed at various planets stars the Sun

299

00:12:45,880 --> 00:12:44,150

and back at the earth so Kurt and I both

300

00:12:48,640 --> 00:12:45,890

stayed busy putting in digital auto

301

00:12:51,460 --> 00:12:48,650

pilot inputs to point at the different

302

00:12:53,380 --> 00:12:51,470

payloads of that also on the flight deck

303

00:12:55,150 --> 00:12:53,390

you're usually busy with earth ops and

304

00:12:58,230 --> 00:12:55,160

just to give you an idea we bring back

305

00:13:00,640 --> 00:12:58,240

more than 3,000 photos of the earth and

306

00:13:02,410 --> 00:13:00,650

here's some of the earth going by over

307

00:13:06,610 --> 00:13:02,420

17,000 miles an hour

308

00:13:08,800 --> 00:13:06,620

and the earth observation scientists as

309

00:13:10,420 --> 00:13:08,810

well as oceanographers meteorologists

310

00:13:13,360 --> 00:13:10,430

particularly interested in this view

311

00:13:15,579 --> 00:13:13,370

this is super typhoon winning and we

312

00:13:17,920 --> 00:13:15,589

were fortunate enough to pass right over

313

00:13:19,300 --> 00:13:17,930

the eye of it it's a very distinct I you

314

00:13:23,290 --> 00:13:19,310

could see the blue water through the eye

315

00:13:25,329 --> 00:13:23,300

and also super typhoon is hundreds of

316

00:13:26,860 --> 00:13:25,339

miles across this is probably three to

317

00:13:28,810 --> 00:13:26,870

four hundred miles across that you're

318

00:13:30,759 --> 00:13:28,820

looking at and the way we get these

319

00:13:32,019 --> 00:13:30,769

photos that was video that you saw but

320

00:13:33,790 --> 00:13:32,029

the stills that we're going to show you

321

00:13:36,129 --> 00:13:33,800

later are from several different sources

322

00:13:37,960 --> 00:13:36,139

we use a Hasselblad camera it's a 70

323

00:13:40,780 --> 00:13:37,970

millimeter format and that does the

324

00:13:42,939 --> 00:13:40,790

majority of our earth ops we just seemed

325

00:13:44,590 --> 00:13:42,949

beemer with one of those cameras we also

326

00:13:46,629 --> 00:13:44,600

though carried a Linhof camera which

327

00:13:48,009 --> 00:13:46,639

just brings back gorgeous photos and

328

00:13:50,470 --> 00:13:48,019

that's because the negative on that is a

329

00:13:52,030 --> 00:13:50,480

four inch by 5 inch shot and a lot of

330

00:13:54,430 --> 00:13:52,040

times we're busy doing other payloads

331

00:13:56,769 --> 00:13:54,440

such as this somebody floats up to the

332

00:13:59,199 --> 00:13:56,779

window and says hey look at this target

333

00:14:01,420 --> 00:13:59,209

going by what is this and so we kind of

334

00:14:03,819 --> 00:14:01,430

scramble for the cameras in this case it

335

00:14:05,350 --> 00:14:03,829

happened to be the Aurora the video here

336

00:14:07,420 --> 00:14:05,360

is black and white it doesn't really do

337

00:14:09,460 --> 00:14:07,430

it justice and we've got slides later on

338

00:14:11,980 --> 00:14:09,470

to show you but it was a gorgeous green

339

00:14:15,340 --> 00:14:11,990
color they had Stan the south of

340

00:14:16,990 --> 00:14:15,350
Australia the southern lights I'd like

341

00:14:19,180 --> 00:14:17,000
to transition now and do the rendezvous

342

00:14:21,040 --> 00:14:19,190
day here we are on rendezvous morning

343

00:14:23,620 --> 00:14:21,050
getting ready on flight they tend to go

344

00:14:27,340 --> 00:14:23,630
pick up Krista spas and it really is a

345

00:14:28,870 --> 00:14:27,350
team effort the it takes to everybody in

346

00:14:30,370 --> 00:14:28,880
the crew was involved from Curtin doing

347

00:14:33,389 --> 00:14:30,380
the manual fly and me doing some flying

348

00:14:35,980 --> 00:14:33,399
up front Steve running a handheld laser

349

00:14:37,990 --> 00:14:35,990
here we are approaching on Krista spas

350

00:14:40,030 --> 00:14:38,000
in hours before we get this close to it

351
00:14:42,220 --> 00:14:40,040
we're doing a set of burns to go ahead

352
00:14:45,490 --> 00:14:42,230
and phase ourselves in and close in on

353
00:14:47,139 --> 00:14:45,500
Krista from the time we're within about

354
00:14:48,759 --> 00:14:47,149
a thousand feet it's manual fly and

355
00:14:51,100 --> 00:14:48,769
incurred at the aft station has a

356
00:14:52,870 --> 00:14:51,110
position here at the arm if we were only

357
00:14:54,970 --> 00:14:52,880
again a grapple Krista we would have

358
00:14:56,410 --> 00:14:54,980
done it at that point but along in our

359
00:14:58,120 --> 00:14:56,420
flight we had a you tailed test

360
00:15:00,400 --> 00:14:58,130
objective which was to go ahead and

361
00:15:03,009 --> 00:15:00,410
simulate a docking on a future Space

362
00:15:05,019 --> 00:15:03,019
Station mission coming up or a fluke

363
00:15:07,870 --> 00:15:05,029

rishta right into the payload bay at a

364

00:15:10,000 --> 00:15:07,880

very precise rate and now once it was

365

00:15:12,699 --> 00:15:10,010

just broke the mould line of the payload

366

00:15:14,079 --> 00:15:12,709

Bay backed back out and to me it's

367

00:15:15,850 --> 00:15:14,089

always amazing that here you've got a

368

00:15:18,790 --> 00:15:15,860

7,000 pound satellite

369

00:15:21,220 --> 00:15:18,800

and we have a probably a 250 thousand

370

00:15:23,860 --> 00:15:21,230

pound at this point orbiter and we can

371

00:15:25,329 --> 00:15:23,870

control that orbiter to a point one foot

372

00:15:28,329 --> 00:15:25,339

per second plus or minus point oh three

373

00:15:31,840 --> 00:15:28,339

and very precisely flight into the

374

00:15:33,850 --> 00:15:31,850

grapple as you can see Kurt did a great

375

00:15:35,590 --> 00:15:33,860

job flying the orbiter right up around

376

00:15:37,930 --> 00:15:35,600

Kristin he offered just a berth it for

377

00:15:40,720 --> 00:15:37,940

us without using the arm at all and we

378

00:15:44,050 --> 00:15:40,730

politely decline that offer and so Jan

379

00:15:46,329 --> 00:15:44,060

took control the arm and this is jann

380

00:15:48,639 --> 00:15:46,339

flying in to grapple the christus paws

381

00:15:50,350 --> 00:15:48,649

satellite and it's a very gentle

382

00:15:53,920 --> 00:15:50,360

maneuver and here here it is ready to

383

00:15:55,930 --> 00:15:53,930

get put back into the payload Bay your

384

00:15:56,920 --> 00:15:55,940

eyeballs are essential tools up there in

385

00:16:00,009 --> 00:15:56,930

orbit especially when you're doing

386

00:16:01,900 --> 00:16:00,019

robotics operations like we did a lot of

387

00:16:04,389 --> 00:16:01,910

in-flight your stand looking up out the

388

00:16:06,850 --> 00:16:04,399

overhead window and this is kind of an

389

00:16:08,769 --> 00:16:06,860

unusual view where we've got a camera up

390

00:16:10,870 --> 00:16:08,779

on the arm looking back down at our crew

391

00:16:12,880 --> 00:16:10,880

compartment this teeny little spot up

392

00:16:14,199 --> 00:16:12,890

there in the heavens and I don't know if

393

00:16:18,370 --> 00:16:14,209

you can see Jan looking out the window

394

00:16:20,680 --> 00:16:18,380

there but it's a it's a really important

395

00:16:22,420 --> 00:16:20,690

part of doing accurate robotics

396

00:16:24,370 --> 00:16:22,430

operations in the future however we're

397

00:16:26,079 --> 00:16:24,380

going to have to learn to rely on other

398

00:16:28,090 --> 00:16:26,089

sensors of the knives we won't always be

399

00:16:30,759 --> 00:16:28,100

able to see out of the space station to

400

00:16:32,530 --> 00:16:30,769

see our arms you see targets on the arm

401
00:16:34,540 --> 00:16:32,540
here and also targets on our payloads

402
00:16:37,030 --> 00:16:34,550
Krista spas here these are for a

403
00:16:38,350 --> 00:16:37,040
canadian developed synthetic vision

404
00:16:40,509 --> 00:16:38,360
system that gives you a computer

405
00:16:44,530 --> 00:16:40,519
representation of where the payload is

406
00:16:46,180 --> 00:16:44,540
and relative to the payload bay we

407
00:16:48,250 --> 00:16:46,190
brought the christus paws right down

408
00:16:51,579 --> 00:16:48,260
over the crew cabin on the arm in order

409
00:16:54,069 --> 00:16:51,589
to test this this system that use these

410
00:16:55,269 --> 00:16:54,079
spots as tracking targets you can see

411
00:16:57,220 --> 00:16:55,279
them here on the telescope at the

412
00:16:59,769 --> 00:16:57,230
christus pause just about five feet over

413
00:17:01,630 --> 00:16:59,779

our head very dramatic view we let the

414

00:17:02,920 --> 00:17:01,640

Sun go down and we kept lights on it and

415

00:17:05,380 --> 00:17:02,930

you can see it even in the dark were

416

00:17:07,270 --> 00:17:05,390

able to track the targets speaking of

417

00:17:09,250 --> 00:17:07,280

the Sun going down as a first-time flyer

418

00:17:11,919 --> 00:17:09,260

I found that to be one of the really

419

00:17:18,340 --> 00:17:11,929

spectacular sights in orbit and it comes

420

00:17:21,340 --> 00:17:18,350

out even well on video well

421

00:17:23,409 --> 00:17:21,350

unfortunately after 11 days 20 hours and

422

00:17:25,390 --> 00:17:23,419

27 minutes as time to put the orbiter

423

00:17:27,130 --> 00:17:25,400

back on the ground bring it back home

424

00:17:30,940 --> 00:17:27,140

both the crew and the vehicle back home

425

00:17:32,650 --> 00:17:30,950

to the Kennedy Space Center we started

426
00:17:34,600 --> 00:17:32,660
our entry well on the other side of the

427
00:17:37,870 --> 00:17:34,610
earth around south of India Australia

428
00:17:40,870 --> 00:17:37,880
time frame our position we slowed

429
00:17:43,990 --> 00:17:40,880
orbiter down from it's just over 17,000

430
00:17:45,580 --> 00:17:44,000
miles an hour as you see here we had a

431
00:17:47,710 --> 00:17:45,590
early morning landing and the glow of

432
00:17:49,800 --> 00:17:47,720
the early morning sun through the the

433
00:17:52,330 --> 00:17:49,810
atmosphere was quite impressive

434
00:17:54,370 --> 00:17:52,340
approaching overhead we started a big

435
00:17:57,160 --> 00:17:54,380
right hand turn about 280 degrees to

436
00:17:58,660 --> 00:17:57,170
align the orbiter up on final for

437
00:18:02,170 --> 00:17:58,670
landing at Kennedy Space Center runway

438
00:18:03,820 --> 00:18:02,180

33 we actually did a new kind of

439

00:18:05,410 --> 00:18:03,830

technique on the landing we use short

440

00:18:07,120 --> 00:18:05,420

field speed brake which is a technique

441

00:18:08,920 --> 00:18:07,130

to help control our energy in case we

442

00:18:10,960 --> 00:18:08,930

have tail winds and we were the first

443

00:18:15,340 --> 00:18:10,970

landing ever to use that and it was it

444

00:18:16,810 --> 00:18:15,350

work exactly as planned the uber was my

445

00:18:19,150 --> 00:18:16,820

first chance to fly the orbiter it flew

446

00:18:20,590 --> 00:18:19,160

very nicely just like some of the

447

00:18:22,720 --> 00:18:20,600

training that we get here at Kennedy or

448

00:18:25,620 --> 00:18:22,730

at JSC and at white sands and Kennedy

449

00:18:28,210 --> 00:18:25,630

Space Center Rhode Island final

450

00:18:30,490 --> 00:18:28,220

approaching the 300-foot point can't put

451
00:18:32,860 --> 00:18:30,500
the gear down we crossed the threshold

452
00:18:37,030 --> 00:18:32,870
around 230 knots looking for a touchdown

453
00:18:38,470 --> 00:18:37,040
around 195 knots right now kids telling

454
00:18:39,760 --> 00:18:38,480
me all the right things to do trying to

455
00:18:43,990 --> 00:18:39,770
make sure I got it get it right the

456
00:18:45,820 --> 00:18:44,000
first time and we touch down about 3,000

457
00:18:47,740 --> 00:18:45,830
foot down the runway drag shoe came out

458
00:18:49,660 --> 00:18:47,750
right away and just a little bit of

459
00:18:54,040 --> 00:18:49,670
different view here as we look down the

460
00:18:55,480 --> 00:18:54,050
runway again to drag shoots out the

461
00:18:58,240 --> 00:18:55,490
speed brakes and the vertical tilt art

462
00:18:59,950 --> 00:18:58,250
opening up to slow us down as a drag

463
00:19:03,310 --> 00:18:59,960

shoe comes out at dis Reese opens up

464

00:19:06,760 --> 00:19:03,320

fully the cushion the nose touchdown and

465

00:19:08,680 --> 00:19:06,770

now we roll safely safely down the

466

00:19:14,130 --> 00:19:08,690

runaway at Kennedy Space Center after

467

00:19:17,680 --> 00:19:16,360

if we bring the lights of just a moment

468

00:19:19,180 --> 00:19:17,690

I actually left out something I want to

469

00:19:20,860 --> 00:19:19,190

do earlier and I want to introduce the

470

00:19:23,410 --> 00:19:20,870

crew and explain a little bit about what

471

00:19:27,160 --> 00:19:23,420

each one did on the flight first of all

472

00:19:28,870 --> 00:19:27,170

to my right was kept roaming her i Kent

473

00:19:31,300 --> 00:19:28,880

will be referred to as Rommel since has

474

00:19:33,340 --> 00:19:31,310

a whole lot easier to say and this was

475

00:19:36,130 --> 00:19:33,350

Kent's third flight he flew on st s 73

476
00:19:37,600 --> 00:19:36,140
and sts-80 that caused del norte

477
00:19:39,760 --> 00:19:37,610
colorado his home

478
00:19:41,440 --> 00:19:39,770
and Kent was invaluable helping me stay

479
00:19:44,080 --> 00:19:41,450
out of trouble on the mission backing me

480
00:19:45,370 --> 00:19:44,090
up as the pilot and the rendezvous he

481
00:19:47,680 --> 00:19:45,380
was my right-hand man making sure all

482
00:19:50,890 --> 00:19:47,690
the rendezvous things went correctly to

483
00:19:54,220 --> 00:19:50,900
his right is a dr. Jan Davis JD or

484
00:19:56,020 --> 00:19:54,230
whatever this is my chance to fly my

485
00:19:58,930 --> 00:19:56,030
second mission with Jan we flew on sds

486
00:20:02,230 --> 00:19:58,940
47 back in 92 and Jan also flew on st

487
00:20:03,520 --> 00:20:02,240
s60 it was her third flight Jan's a

488
00:20:06,400 --> 00:20:03,530

sweetheart she comes from Huntsville

489

00:20:08,260 --> 00:20:06,410

Alabama and I sure hope I get to fly

490

00:20:10,150 --> 00:20:08,270

with Jan again she did a great job she

491

00:20:12,820 --> 00:20:10,160

was my payload commander and also she

492

00:20:15,940 --> 00:20:12,830

was a the head person on the MFD the

493

00:20:19,750 --> 00:20:15,950

little robot arm payload to her right is

494

00:20:23,560 --> 00:20:19,760

a bob Curbeam don't get between Bob and

495

00:20:25,650 --> 00:20:23,570

any food or you're in trouble but you'll

496

00:20:27,789 --> 00:20:25,660

hear is called Bob beam or Beamer and

497

00:20:30,460 --> 00:20:27,799

that was a name that came with him from

498

00:20:33,190 --> 00:20:30,470

the Navy bob was our flight engineer

499

00:20:38,770 --> 00:20:33,200

during ascent and entry and he's also

500

00:20:42,669 --> 00:20:38,780

the BDS the reactor person on the

501
00:20:44,080 --> 00:20:42,679
mid-deck but also he kept us Rahman I

502
00:20:45,640 --> 00:20:44,090
that is coordinated on the Rhonda though

503
00:20:47,049 --> 00:20:45,650
he was a the guy who ran all the

504
00:20:48,250 --> 00:20:47,059
computers and kept all the data coming

505
00:20:52,180 --> 00:20:48,260
in and make sure our rendezvous went

506
00:20:55,090 --> 00:20:52,190
correctly and his right we have dr.

507
00:20:57,460 --> 00:20:55,100
Steve Robinson stand by the way beam

508
00:20:59,710 --> 00:20:57,470
comes from Baltimore Maryland he calls

509
00:21:04,690 --> 00:20:59,720
at home or Woodlawn is that correct yeah

510
00:21:07,570 --> 00:21:04,700
okay I was practicing that but Bob's

511
00:21:10,570 --> 00:21:07,580
right is Steve Robinson Steve comes from

512
00:21:15,010 --> 00:21:10,580
Sacramento California and we have a lot

513
00:21:16,570 --> 00:21:15,020

of names for Steve Steve was our primary

514

00:21:17,860 --> 00:21:16,580

person on the Swiss payload which was

515

00:21:20,140 --> 00:21:17,870

the telescope to look at the hell Bob

516

00:21:21,940 --> 00:21:20,150

comet so he became head cheese so to

517

00:21:24,010 --> 00:21:21,950

speak they called the Swiss you know the

518

00:21:26,770 --> 00:21:24,020

Swiss cheese but it was much funnier

519

00:21:29,660 --> 00:21:26,780

when we made it up on an orbit buddy

520

00:21:31,670 --> 00:21:29,670

Steve Steve did a great job as his first

521

00:21:33,980 --> 00:21:31,680

light as was beamers first flight and

522

00:21:37,160 --> 00:21:33,990

they did an outstanding job as rookies

523

00:21:39,410 --> 00:21:37,170

and last but not least is the Arnie trig

524

00:21:40,640 --> 00:21:39,420

vison be arnes a Canadian astronaut he's

525

00:21:42,620 --> 00:21:40,650

been in this program longer than we have

526

00:21:44,360 --> 00:21:42,630

trying to get to go fly and I admire him

527

00:21:47,900 --> 00:21:44,370

for that his determination and effort

528

00:21:49,280 --> 00:21:47,910

but be army be Arnie was obviously his

529

00:21:52,160 --> 00:21:49,290

first flight as a payload specialist

530

00:21:53,270 --> 00:21:52,170

with us he was a principal investigator

531

00:21:55,630 --> 00:21:53,280

on the men payload which is a

532

00:21:57,560 --> 00:21:55,640

microgravity isolation mount payload and

533

00:21:58,880 --> 00:21:57,570

unfortunately already spent most of his

534

00:22:00,320 --> 00:21:58,890

time on the mid-deck working the men

535

00:22:02,240 --> 00:22:00,330

payload and hardly got to look out the

536

00:22:03,530 --> 00:22:02,250

windows much but if you already did a

537

00:22:05,270 --> 00:22:03,540

great job and it was my pleasure to fly

538

00:22:06,950 --> 00:22:05,280

with all these folks and I sure wish we

539

00:22:09,710 --> 00:22:06,960

could go do it again we had such a great

540

00:22:11,810 --> 00:22:09,720

time and what we'd like to do now is we

541

00:22:13,070 --> 00:22:11,820

have a some slides we show you to help

542

00:22:14,450 --> 00:22:13,080

explain our mission a little bit better

543

00:22:16,190 --> 00:22:14,460

than to film because the film is pretty

544

00:22:18,050 --> 00:22:16,200

fast pace and it's kind of tough to get

545

00:22:19,460 --> 00:22:18,060

all our words out so go ahead and go

546

00:22:21,620 --> 00:22:19,470

through those slides if we could bring

547

00:22:24,920 --> 00:22:21,630

the lights back down and bring the

548

00:22:26,780 --> 00:22:24,930

slides up okay they give me the easy

549

00:22:28,570 --> 00:22:26,790

slides because again I'm the commander

550

00:22:30,680 --> 00:22:28,580

and it's tough for me to do these things

551
00:22:32,360 --> 00:22:30,690
but obviously you've seen our crew patch

552
00:22:34,610 --> 00:22:32,370
we designed that as a crew member or as

553
00:22:36,530 --> 00:22:34,620
a crew and you see in the payload Bay a

554
00:22:39,040 --> 00:22:36,540
representation of some of our payloads

555
00:22:41,450 --> 00:22:39,050
also the high inclination flight and our

556
00:22:42,500 --> 00:22:41,460
our mission was primarily a mission to

557
00:22:44,780 --> 00:22:42,510
Planet Earth to study the Earth's

558
00:22:46,130 --> 00:22:44,790
atmosphere and how we as humans have

559
00:22:52,160 --> 00:22:46,140
affected that earth and that's

560
00:22:53,810 --> 00:22:52,170
represented on the patch a picture of

561
00:22:56,330 --> 00:22:53,820
the crew again I can't say enough good

562
00:22:59,720 --> 00:22:56,340
things about those folks they did a

563
00:23:01,490 --> 00:22:59,730

great job and between you and them it

564

00:23:05,870 --> 00:23:01,500

kept me out of trouble and we had a very

565

00:23:07,610 --> 00:23:05,880

very successful mission on 85 and again

566

00:23:09,350 --> 00:23:07,620

they give me any easy photo here no

567

00:23:11,540 --> 00:23:09,360

presentation would be complete without a

568

00:23:14,930 --> 00:23:11,550

launch photo this was a third to 23rd

569

00:23:17,600 --> 00:23:14,940

mission of discovery and she performed

570

00:23:19,580 --> 00:23:17,610

flawlessly we had no malfunctions no

571

00:23:21,590 --> 00:23:19,590

anomalies on flight that impacted any of

572

00:23:23,750 --> 00:23:21,600

our operations so we had nothing to

573

00:23:25,540 --> 00:23:23,760

worry about with the uber and it was the

574

00:23:28,040 --> 00:23:25,550

86 mission and a space shuttle program

575

00:23:29,180 --> 00:23:28,050

so we should be all proud with the

576

00:23:33,170 --> 00:23:29,190

things we've accomplished in those

577

00:23:35,480 --> 00:23:33,180

missions as I said in the film we

578

00:23:38,240 --> 00:23:35,490

deployed the christus paws on flight day

579

00:23:38,840 --> 00:23:38,250

one the spa's is actually the carrier

580

00:23:40,550 --> 00:23:38,850

for the

581

00:23:43,130 --> 00:23:40,560

instruments and spas has flown four

582

00:23:44,930 --> 00:23:43,140

times before three times before this was

583

00:23:47,900 --> 00:23:44,940

the fourth flight and it flew once

584

00:23:50,300 --> 00:23:47,910

before with the Krista and instrument

585

00:23:53,570 --> 00:23:50,310

which is the main instrument you see

586

00:23:55,430 --> 00:23:53,580

there on the top as a cryostat actually

587

00:23:57,920 --> 00:23:55,440

because it has infrared detectors that

588

00:24:00,620 --> 00:23:57,930

looked at about 15 different gases in

589

00:24:02,450 --> 00:24:00,630

our middle atmosphere and again looking

590

00:24:04,850 --> 00:24:02,460

at the dynamics and the formation of

591

00:24:07,100 --> 00:24:04,860

ozone in our atmosphere and that was a

592

00:24:09,830 --> 00:24:07,110

German instrument as was the spa's

593

00:24:11,660 --> 00:24:09,840

carrier next to it was a large

594

00:24:14,360 --> 00:24:11,670

instrument called Marcy which was an

595

00:24:17,930 --> 00:24:14,370

American experiment which looked at two

596

00:24:20,870 --> 00:24:17,940

specific chemicals in our atmosphere OHI

597

00:24:22,670 --> 00:24:20,880

on and also in a n.o which are very

598

00:24:24,860 --> 00:24:22,680

instrumental in determining some of the

599

00:24:27,290 --> 00:24:24,870

equations and dynamics of what's going

600

00:24:30,220 --> 00:24:27,300

on in our atmosphere and they received

601
00:24:34,010 --> 00:24:30,230
lots of data from pole to pole at

602
00:24:37,160 --> 00:24:34,020
different altitudes in the world below

603
00:24:39,170 --> 00:24:37,170
that you can see probably down in the

604
00:24:41,330 --> 00:24:39,180
lower right corner of snow-capped

605
00:24:43,010 --> 00:24:41,340
mountain that's Mount Adam and we're

606
00:24:47,510 --> 00:24:43,020
actually near the Oregon Washington

607
00:24:49,130 --> 00:24:47,520
border in the United States Steve and I

608
00:24:52,790 --> 00:24:49,140
control the remote manipulator system

609
00:24:54,650 --> 00:24:52,800
from the a flight deck my right hand is

610
00:24:57,230 --> 00:24:54,660
on the rotational hand controller which

611
00:25:00,380 --> 00:24:57,240
we use to control the pitch yaw and roll

612
00:25:03,200 --> 00:25:00,390
of the arm and my left hand is actually

613
00:25:04,780 --> 00:25:03,210

just resting on an orbiter controller

614

00:25:07,070 --> 00:25:04,790

but above it the square-shaped

615

00:25:11,210 --> 00:25:07,080

controller is what we put our left hand

616

00:25:15,260 --> 00:25:11,220

on for translation x y&z to maneuver the

617

00:25:16,790 --> 00:25:15,270

remote manipulator system well thanks to

618

00:25:19,040 --> 00:25:16,800

some of the folks we recognized earlier

619

00:25:21,890 --> 00:25:19,050

today Alan bartos and his gang and and

620

00:25:23,330 --> 00:25:21,900

it has broken her gang each morning one

621

00:25:25,070 --> 00:25:23,340

of the first things we got to see was a

622

00:25:28,460 --> 00:25:25,080

bunch of messages that were kind of

623

00:25:30,290 --> 00:25:28,470

faxed up to the to discovery to inform

624

00:25:33,320 --> 00:25:30,300

us that the changes in the updates and

625

00:25:35,630 --> 00:25:33,330

our big we call it a flight plan or our

626

00:25:37,990 --> 00:25:35,640

big activity plan for the rest of the

627

00:25:40,880 --> 00:25:38,000

day as you can see it's quite a lot of

628

00:25:42,320 --> 00:25:40,890

quite a lot of pages this about 50 pages

629

00:25:43,820 --> 00:25:42,330

that day I think we have to go through

630

00:25:45,440 --> 00:25:43,830

all those pages and sort them out put

631

00:25:46,990 --> 00:25:45,450

them in the correct books and get them

632

00:25:49,100 --> 00:25:47,000

organized for the day's activities and

633

00:25:50,960 --> 00:25:49,110

also if you look up my head you can see

634

00:25:52,370 --> 00:25:50,970

a bunch of legs and stuff it's right

635

00:25:54,950 --> 00:25:52,380

after the wake up so it's a very

636

00:25:57,230 --> 00:25:54,960

very busy time on the shuttle everyone's

637

00:25:59,780 --> 00:25:57,240

getting cleaned up for work and getting

638

00:26:01,550 --> 00:25:59,790

things sorted out so each one we did

639

00:26:06,530 --> 00:26:01,560

that operation so that we could carry on

640

00:26:08,330 --> 00:26:06,540

a very efficient rest of the day well

641

00:26:11,120 --> 00:26:08,340

for some of the payload operations we

642

00:26:12,680 --> 00:26:11,130

did I'm working a mid dec secondary

643

00:26:15,380 --> 00:26:12,690

experiment called brick which is

644

00:26:19,040 --> 00:26:15,390

bioreactor or excuse me biological

645

00:26:20,600 --> 00:26:19,050

research in canisters and it's actually

646

00:26:22,220 --> 00:26:20,610

if you look I have some gloves on and

647

00:26:24,290 --> 00:26:22,230

I'm opening a container of liquid

648

00:26:25,790 --> 00:26:24,300

nitrogen and I'm putting some samples in

649

00:26:29,510 --> 00:26:25,800

that to preserve them for the rest of

650

00:26:31,400 --> 00:26:29,520

the mission it's pretty simple but all

651
00:26:33,980 --> 00:26:31,410
payloads that we have on the on the

652
00:26:36,230 --> 00:26:33,990
mission take time under crew day and

653
00:26:38,180 --> 00:26:36,240
each one's important and we try to make

654
00:26:42,530 --> 00:26:38,190
sure we get all those done according to

655
00:26:45,590 --> 00:26:42,540
that plan that we had earlier this is a

656
00:26:47,810 --> 00:26:45,600
view of our payload over Korea payload

657
00:26:49,070 --> 00:26:47,820
Bay that is over Korea and this is what

658
00:26:51,320 --> 00:26:49,080
it looked like when we're looking at the

659
00:26:54,500 --> 00:26:51,330
app windows of the shuttle in their

660
00:26:56,360 --> 00:26:54,510
front you can see the minus the

661
00:26:58,670 --> 00:26:56,370
manipulator flight demonstration test

662
00:27:02,210 --> 00:26:58,680
the japanese robot arm and it is stowed

663
00:27:04,610 --> 00:27:02,220

in this configuration Steve and I

664

00:27:06,380 --> 00:27:04,620

operated the MFD which is a lot easier

665

00:27:09,290 --> 00:27:06,390

to say than manipulator flight

666

00:27:11,600 --> 00:27:09,300

demonstration we have rated the MFD from

667

00:27:14,030 --> 00:27:11,610

this workstation that was in the a

668

00:27:16,910 --> 00:27:14,040

flight deck we also had to hand

669

00:27:19,580 --> 00:27:16,920

controllers for this arm the again the

670

00:27:22,730 --> 00:27:19,590

translation went on the left for XYZ and

671

00:27:25,130 --> 00:27:22,740

the rotational one on the right for pity

672

00:27:27,680 --> 00:27:25,140

our role and then the laptop computer in

673

00:27:29,720 --> 00:27:27,690

the center showed us what the arm was

674

00:27:31,850 --> 00:27:29,730

doing and some other parameters that we

675

00:27:34,100 --> 00:27:31,860

needed to know and we looked at the TV

676
00:27:36,560 --> 00:27:34,110
monitors just behind my head to actually

677
00:27:38,810 --> 00:27:36,570
get a view of what was going on on my

678
00:27:43,490 --> 00:27:38,820
headband in honor of the Japanese it

679
00:27:45,320 --> 00:27:43,500
says ms ichiban which means ms one here

680
00:27:47,480 --> 00:27:45,330
is the view of myself working with the

681
00:27:49,370 --> 00:27:47,490
again with a microgravity vibrational

682
00:27:51,320 --> 00:27:49,380
isolation mode this work is really

683
00:27:52,940 --> 00:27:51,330
designed to better understand some of

684
00:27:54,800 --> 00:27:52,950
the challenges we face with doing

685
00:27:57,080 --> 00:27:54,810
sensitive a fluid physics material

686
00:27:59,090 --> 00:27:57,090
science and crystal growth experiments

687
00:28:00,890 --> 00:27:59,100
on the space station many of these will

688
00:28:02,720 --> 00:28:00,900

be affected by the vibrations of station

689

00:28:04,580 --> 00:28:02,730

and min which is the little purple thing

690

00:28:05,800 --> 00:28:04,590

lower half of that double a cloak

691

00:28:08,080 --> 00:28:05,810

enclosure just in front of me

692

00:28:09,340 --> 00:28:08,090

actually is a magnetic levitation system

693

00:28:11,290 --> 00:28:09,350

that will isolate many of these

694

00:28:13,570 --> 00:28:11,300

impairments from the vibrations of

695

00:28:15,670 --> 00:28:13,580

station on this flight we were looking

696

00:28:17,290 --> 00:28:15,680

at two different these one how well mem

697

00:28:18,760 --> 00:28:17,300

works as an isolator how clean and

698

00:28:23,380 --> 00:28:18,770

environment it can provide to the

699

00:28:24,760 --> 00:28:23,390

experiment and then using the men with

700

00:28:26,830 --> 00:28:24,770

the experiments model on top of it

701
00:28:31,420 --> 00:28:26,840
looking at the effect of the vibrations

702
00:28:33,940 --> 00:28:31,430
on the experimental results both were

703
00:28:36,280 --> 00:28:33,950
isolated situation sometimes running in

704
00:28:37,780 --> 00:28:36,290
on isolation mode and sometimes using

705
00:28:42,760 --> 00:28:37,790
mint actually vibrate the experiment

706
00:28:44,830 --> 00:28:42,770
with controlled acceleration levels and

707
00:28:46,840 --> 00:28:44,840
this is me with one of the fluid cells

708
00:28:49,840 --> 00:28:46,850
that were using as particular cells is

709
00:28:52,180 --> 00:28:49,850
designed to study the interaction or the

710
00:28:54,070 --> 00:28:52,190
dynamics of a interface between the

711
00:28:57,190 --> 00:28:54,080
fluid and the vapor above the interface

712
00:28:58,840 --> 00:28:57,200
I will spin the cell on the mem to

713
00:29:01,120 --> 00:28:58,850

establish a void right in the center of

714

00:29:03,040 --> 00:29:01,130

a cell and then look at the dynamics of

715

00:29:04,990 --> 00:29:03,050

the interface between the fluid and the

716

00:29:06,820 --> 00:29:05,000

void here this sort of a fundamental

717

00:29:11,800 --> 00:29:06,830

problem a typical of many experiments

718

00:29:13,480 --> 00:29:11,810

will do a space station later on here's

719

00:29:15,990 --> 00:29:13,490

a another secondary experiment on the

720

00:29:18,430 --> 00:29:16,000

mid-deck protein crystal growth and

721

00:29:21,430 --> 00:29:18,440

along with posting crystal growth we had

722

00:29:24,670 --> 00:29:21,440

630 chambers of proteins at on flight

723

00:29:26,710 --> 00:29:24,680

day two I activated and the reason we

724

00:29:29,050 --> 00:29:26,720

fly proteins in space is that in the

725

00:29:31,570 --> 00:29:29,060

microgravity environment the proteins

726

00:29:33,310 --> 00:29:31,580

will grow more perfectly sometimes

727

00:29:35,500 --> 00:29:33,320

larger but not necessarily always larger

728

00:29:37,420 --> 00:29:35,510

but more perfectly and by flying

729

00:29:40,060 --> 00:29:37,430

proteins if we can form a more perfectly

730

00:29:41,920 --> 00:29:40,070

than they kind of serve as keys to solve

731

00:29:44,110 --> 00:29:41,930

the puzzle to all kinds of different

732

00:29:46,240 --> 00:29:44,120

diseases that are out there and also can

733

00:29:48,850 --> 00:29:46,250

help us come up with medications but

734

00:29:53,610 --> 00:29:48,860

typically what's flown or or a different

735

00:29:57,730 --> 00:29:53,620

HIV virus or antibodies some cancer

736

00:30:00,340 --> 00:29:57,740

studies different livers proteins for

737

00:30:03,700 --> 00:30:00,350

little liver prevention for liver

738

00:30:05,500 --> 00:30:03,710

disease and it's a very important part

739

00:30:10,450 --> 00:30:05,510

of flying in the micro gravity gravity

740

00:30:12,640 --> 00:30:10,460

environment one of the great things that

741

00:30:15,700 --> 00:30:12,650

the opportunities that having a space

742

00:30:17,039 --> 00:30:15,710

shuttle gives you is to go up and study

743

00:30:19,169 --> 00:30:17,049

things that are temporary

744

00:30:20,700 --> 00:30:19,179

and such as a visitor from outer space

745

00:30:22,440 --> 00:30:20,710

called a comment in the comment

746

00:30:24,539 --> 00:30:22,450

hale-bopp we we were fortunate enough to

747

00:30:26,789 --> 00:30:24,549

be able to go up and study hale-bopp

748

00:30:29,700 --> 00:30:26,799

from our perch above the earth's

749

00:30:32,430 --> 00:30:29,710

atmosphere in discovery the black

750

00:30:36,060 --> 00:30:32,440

looking canister in there in my hands my

751

00:30:38,159 --> 00:30:36,070

carefully gloved hands was a small

752

00:30:39,930 --> 00:30:38,169

telescope looking out the side hatch

753

00:30:42,269 --> 00:30:39,940

window that's the hatch that we crawl in

754

00:30:44,310 --> 00:30:42,279

and out of the orbiter on launch and

755

00:30:47,100 --> 00:30:44,320

landing and it's got about an 80-inch

756

00:30:48,539 --> 00:30:47,110

window in it this telescope was bolted

757

00:30:51,450 --> 00:30:48,549

to the hatch and looked out that window

758

00:30:54,169 --> 00:30:51,460

and we were able to use the whole

759

00:30:57,210 --> 00:30:54,179

orbiter thanks to some really fantastic

760

00:30:58,889 --> 00:30:57,220

mathematics and and effort by folks here

761

00:31:02,249 --> 00:30:58,899

on the ground point the whole orbiter at

762

00:31:04,560 --> 00:31:02,259

the comet zero in with some controls you

763

00:31:06,930 --> 00:31:04,570

can probably see there with the

764

00:31:09,479 --> 00:31:06,940

telescope and get some pictures in the

765

00:31:11,099 --> 00:31:09,489

ultraviolet range of the spectrum that

766

00:31:13,529 --> 00:31:11,109

you really can't get from the ground and

767

00:31:15,180 --> 00:31:13,539

this was all recorded on a digital

768

00:31:17,820 --> 00:31:15,190

camera you can see at the very end there

769

00:31:24,359 --> 00:31:17,830

to the sort of the back of the telescope

770

00:31:25,859 --> 00:31:24,369

with the wires coming out of it so it's

771

00:31:30,409 --> 00:31:25,869

like another combustion experiment

772

00:31:32,310 --> 00:31:30,419

waiting to happen but it's not it's uh I

773

00:31:35,789 --> 00:31:32,320

didn't know this photograph was gonna

774

00:31:37,259 --> 00:31:35,799

look like this when it was taken no nor

775

00:31:40,139 --> 00:31:37,269

did I choose it to be in the in the

776

00:31:42,450 --> 00:31:40,149

group but but I'm going to talk about it

777

00:31:45,289 --> 00:31:42,460

another good reason to go into space is

778

00:31:47,639 --> 00:31:45,299

to study what happens to to human body's

779

00:31:49,590 --> 00:31:47,649

physiology does change and the

780

00:31:50,970 --> 00:31:49,600

adaptation process is fascinating and

781

00:31:52,919 --> 00:31:50,980

one of the things you have to adapt to

782

00:31:55,499 --> 00:31:52,929

is changing your sleep cycles when you

783

00:31:57,389 --> 00:31:55,509

go to bed and when you wake up and we

784

00:31:58,859 --> 00:31:57,399

did quite a bit of that in both in

785

00:32:03,629 --> 00:31:58,869

preparation for the flight and during

786

00:32:04,979 --> 00:32:03,639

the flight and there's a study to to try

787

00:32:07,739 --> 00:32:04,989

to ascertain what happens to the human

788

00:32:10,289 --> 00:32:07,749

body and in situations like that both on

789

00:32:12,210 --> 00:32:10,299

the ground and in space you can see on

790

00:32:13,879 --> 00:32:12,220

my arm they're wrapped around and white

791

00:32:16,619 --> 00:32:13,889

there there's a little module that's

792

00:32:19,139 --> 00:32:16,629

records we were Kurt and I wore one of

793

00:32:21,389 --> 00:32:19,149

these the whole flight and it records

794

00:32:24,690 --> 00:32:21,399

our arm movements as an accelerometer

795

00:32:27,480 --> 00:32:24,700

inside and also a light sensor and what

796

00:32:28,740 --> 00:32:27,490

I'm really doing is it's a little cotton

797

00:32:34,200 --> 00:32:28,750

walled wat for

798

00:32:36,350 --> 00:32:34,210

saliva sample really as I mentioned

799

00:32:38,580 --> 00:32:36,360

earlier bioreactor was a very important

800

00:32:41,340 --> 00:32:38,590

secondary payload we had on the mid-deck

801
00:32:43,200 --> 00:32:41,350
Here I am stowing a sample of the media

802
00:32:45,510 --> 00:32:43,210
that the cancer cells were growing in a

803
00:32:48,420 --> 00:32:45,520
few times a day i would take samples of

804
00:32:50,100 --> 00:32:48,430
the media to see to check the metabolic

805
00:32:51,870 --> 00:32:50,110
rate of the cells and also take a few of

806
00:32:54,060 --> 00:32:51,880
the cells out and fix them or preserve

807
00:32:56,730 --> 00:32:54,070
them so they could be studied later it's

808
00:32:59,040 --> 00:32:56,740
hoped that by using the zero-g

809
00:33:01,470 --> 00:32:59,050
environment to grow the cells in three

810
00:33:03,180 --> 00:33:01,480
dimensional in three dimensions sort of

811
00:33:04,950 --> 00:33:03,190
like they would in a tumor we can learn

812
00:33:06,570 --> 00:33:04,960
a lot more about how cells grow in the

813
00:33:08,610 --> 00:33:06,580

human body and more specifically how

814

00:33:10,560 --> 00:33:08,620

colon cancer grows in the human body and

815

00:33:12,840 --> 00:33:10,570

hopefully this will aid in colon cancer

816

00:33:17,730 --> 00:33:12,850

research and help us defeat that disease

817

00:33:19,140 --> 00:33:17,740

at some point well one of the big parts

818

00:33:22,920 --> 00:33:19,150

of spaceflight is learning about

819

00:33:24,990 --> 00:33:22,930

personal hygiene showering without

820

00:33:26,820 --> 00:33:25,000

without a shower it's a kind of an

821

00:33:29,160 --> 00:33:26,830

interesting thing and they have rinse

822

00:33:30,870 --> 00:33:29,170

lists shampoo and rinsed with soap and

823

00:33:34,080 --> 00:33:30,880

this is me I think a first or second

824

00:33:35,460 --> 00:33:34,090

time i shampooed in in space and it was

825

00:33:36,960 --> 00:33:35,470

kind of interesting you put it in it

826
00:33:38,610 --> 00:33:36,970
lathers up and you just wipe it out with

827
00:33:43,800 --> 00:33:38,620
a towel and actually it works pretty

828
00:33:45,540 --> 00:33:43,810
well the earlier in the video we saw

829
00:33:47,040 --> 00:33:45,550
Beeman riding the bike and he didn't

830
00:33:51,320 --> 00:33:47,050
have his shirt on and if I were built

831
00:34:03,640 --> 00:33:58,169
but

832
00:34:05,710 --> 00:34:03,650
space obviously because when the

833
00:34:07,480 --> 00:34:05,720
microgravity environment our muscles

834
00:34:10,990 --> 00:34:07,490
don't have to support our weight the

835
00:34:12,490 --> 00:34:11,000
weekend very rapidly so i tried daily i

836
00:34:15,220 --> 00:34:12,500
think i missed two days in the flight

837
00:34:16,830 --> 00:34:15,230
daily to ride the stationary bike for 30

838
00:34:19,359 --> 00:34:16,840

minutes and it just helps your recovery

839

00:34:24,520 --> 00:34:19,369

landing day as well as their after from

840

00:34:25,359 --> 00:34:24,530

the process and if i look like beamer i

841

00:34:29,710 --> 00:34:25,369

wouldn't have my shirt on at the

842

00:34:36,310 --> 00:34:29,720

computer either so but one of the neat

843

00:34:38,649 --> 00:34:36,320

things that one of the neat things that

844

00:34:40,240 --> 00:34:38,659

we're able to do on orbit during post

845

00:34:41,770 --> 00:34:40,250

sleep and priestly time when we're not

846

00:34:44,470 --> 00:34:41,780

actually working payloads is we can

847

00:34:47,139 --> 00:34:44,480

receive mail from our family and friends

848

00:34:48,550 --> 00:34:47,149

and stuff here and on the ground so

849

00:34:50,379 --> 00:34:48,560

that's one of the things I'm doing also

850

00:34:52,899 --> 00:34:50,389

we had a record flight we had 11 of the

851
00:34:54,250 --> 00:34:52,909
laptop computers onboard little computer

852
00:34:55,810 --> 00:34:54,260
you see I'm working with there we had 11

853
00:34:58,330 --> 00:34:55,820
on board due to all the activities with

854
00:34:59,920 --> 00:34:58,340
all the payloads we had so we as we

855
00:35:04,260 --> 00:34:59,930
mentioned had a busy flight and all the

856
00:35:09,190 --> 00:35:07,359
following those days of hard work and

857
00:35:10,570 --> 00:35:09,200
most of exercise there and Washington

858
00:35:13,090 --> 00:35:10,580
hair you do have to spend a little bit

859
00:35:15,099 --> 00:35:13,100
of time sleeping sleeping in space is a

860
00:35:16,780 --> 00:35:15,109
little bit different and sleeping on the

861
00:35:19,420 --> 00:35:16,790
ground for one you don't have a mattress

862
00:35:20,920 --> 00:35:19,430
to lie on so if you tried that you just

863
00:35:23,080 --> 00:35:20,930

float off the mattress and your blanket

864

00:35:25,300 --> 00:35:23,090

of a float away so we use our sleeping

865

00:35:26,920 --> 00:35:25,310

bags and just tie these down to any

866

00:35:29,770 --> 00:35:26,930

convenient spot i happen to be tied to

867

00:35:31,780 --> 00:35:29,780

the floor here rama was tied above me at

868

00:35:33,580 --> 00:35:31,790

the ceiling and John and Steve are tied

869

00:35:35,650 --> 00:35:33,590

to the wall above my head in this

870

00:35:37,930 --> 00:35:35,660

picture and knee just let your body

871

00:35:40,240 --> 00:35:37,940

relax and they wear my hands are in this

872

00:35:42,460 --> 00:35:40,250

position it's just a natural place at

873

00:35:45,849 --> 00:35:42,470

your hands go if you're completely

874

00:35:47,200 --> 00:35:45,859

relaxed and without the the effect of

875

00:35:49,090 --> 00:35:47,210

gravity trying to pull them down they

876

00:35:51,520 --> 00:35:49,100

just float in front of your face you'll

877

00:35:53,020 --> 00:35:51,530

notice I don't have a pillow here first

878

00:35:54,790 --> 00:35:53,030

couple of nights there is a pillow is

879

00:35:56,200 --> 00:35:54,800

kind of attached to the sleeping bag and

880

00:35:58,330 --> 00:35:56,210

you can kind of tie that to your head to

881

00:36:00,070 --> 00:35:58,340

give you the comfortable feeling of

882

00:36:02,020 --> 00:36:00,080

being at home sleeping on your bed but

883

00:36:03,710 --> 00:36:02,030

after a couple of days you don't bother

884

00:36:06,380 --> 00:36:03,720

with a pillow and just let your head

885

00:36:08,900 --> 00:36:06,390

around one of the pleasures of coming

886

00:36:10,700 --> 00:36:08,910

back to space from space is you get to

887

00:36:13,880 --> 00:36:10,710

lie on a bed and and feel that thing

888

00:36:18,230 --> 00:36:13,890

against your back but it's great doing

889

00:36:19,880 --> 00:36:18,240

this stuff in space another thing that's

890

00:36:24,020 --> 00:36:19,890

a lot more difficult to do in space is

891

00:36:26,240 --> 00:36:24,030

to get control of my hair every morning

892

00:36:28,099 --> 00:36:26,250

I would attempt to do that and I'd have

893

00:36:31,400 --> 00:36:28,109

some great tape nearby brush out all the

894

00:36:32,930 --> 00:36:31,410

stray hairs and I would always tie it

895

00:36:34,310 --> 00:36:32,940

back in a ponytail during the day so

896

00:36:36,349 --> 00:36:34,320

that it wouldn't get in the way of the

897

00:36:37,550 --> 00:36:36,359

equipment and everything and whenever I

898

00:36:39,890 --> 00:36:37,560

would go up to the flight deck before

899

00:36:42,109 --> 00:36:39,900

I'd tied it back I got a lot of flack

900

00:36:43,190 --> 00:36:42,119

from my crew because my my hair would

901
00:36:46,160 --> 00:36:43,200
take up the whole window and they

902
00:36:48,290 --> 00:36:46,170
couldn't see out the window I'll has

903
00:36:54,800 --> 00:36:48,300
made sure that I I tied it back every

904
00:36:57,080 --> 00:36:54,810
day every crew takes a crew portrait in

905
00:36:58,490 --> 00:36:57,090
space and we thought we would take

906
00:37:01,820 --> 00:36:58,500
advantage of the fact that we no longer

907
00:37:04,609 --> 00:37:01,830
have the airlock inside of the mid-deck

908
00:37:07,070 --> 00:37:04,619
and we have this is the second flight of

909
00:37:08,450 --> 00:37:07,080
the external airlock on discovery so

910
00:37:11,630 --> 00:37:08,460
it's out in the payload Bay and it

911
00:37:13,130 --> 00:37:11,640
leaves a really nice volume in the mid

912
00:37:16,099 --> 00:37:13,140
deck so we thought would take advantage

913
00:37:17,900 --> 00:37:16,109

of that and as you can tell our crew has

914

00:37:23,480 --> 00:37:17,910

a lot of fun together and we had a lot

915

00:37:26,180 --> 00:37:23,490

of fun making this picture too here's a

916

00:37:28,370 --> 00:37:26,190

picture of the forward flight deck on

917

00:37:30,050 --> 00:37:28,380

the Iran to every day and it's a nice

918

00:37:32,000 --> 00:37:30,060

way to show what kind of team works

919

00:37:33,620 --> 00:37:32,010

involved in doing a rendezvous here we

920

00:37:34,820 --> 00:37:33,630

are going through a little briefing at

921

00:37:36,470 --> 00:37:34,830

the start of the round of your day with

922

00:37:38,420 --> 00:37:36,480

Curtin commander seat and myself in the

923

00:37:40,730 --> 00:37:38,430

pilot being we're down in the ms2

924

00:37:42,530 --> 00:37:40,740

position and it's too bad you can't even

925

00:37:44,390 --> 00:37:42,540

pan out more with the camera because

926
00:37:46,310 --> 00:37:44,400
you'd see the other three crew mates in

927
00:37:48,320 --> 00:37:46,320
the a flight deck it's a very busy place

928
00:37:50,060 --> 00:37:48,330
on the rendezvous day and as I can't

929
00:37:55,400 --> 00:37:50,070
alluded to earlier it really is a full

930
00:37:57,020 --> 00:37:55,410
team effort and this was the effort that

931
00:37:58,490 --> 00:37:57,030
we're going after on flight day 10 and

932
00:38:01,370 --> 00:37:58,500
again it was mentioned in the video but

933
00:38:06,200 --> 00:38:01,380
Krista spas the just like the ad was a

934
00:38:07,970 --> 00:38:06,210
an ideal satellite the Germans that that

935
00:38:09,740 --> 00:38:07,980
ran Krista as well as the American

936
00:38:12,890 --> 00:38:09,750
instruments are on board all performed

937
00:38:14,870 --> 00:38:12,900
flawlessly and we were very excited to

938
00:38:17,220 --> 00:38:14,880

get that news back up to us in a daily

939

00:38:19,620 --> 00:38:17,230

summaries on how well Krista was doing

940

00:38:21,000 --> 00:38:19,630

and she performed awesome and she was

941

00:38:25,440 --> 00:38:21,010

very very stable during the rendezvous

942

00:38:29,130 --> 00:38:25,450

forced to Grandpa learn of course during

943

00:38:30,900 --> 00:38:29,140

the rendezvous process there's a lot of

944

00:38:32,550 --> 00:38:30,910

information coming into the cockpit and

945

00:38:34,260 --> 00:38:32,560

being processed by everybody on board

946

00:38:36,810 --> 00:38:34,270

especially Kurt when he's flying the

947

00:38:38,880 --> 00:38:36,820

vehicle by hand and we have some fairly

948

00:38:41,370 --> 00:38:38,890

complex sensors and some fairly simple

949

00:38:42,660 --> 00:38:41,380

ones to this is a handheld laser just a

950

00:38:44,609 --> 00:38:42,670

battery-powered little box with a

951
00:38:46,320 --> 00:38:44,619
trigger on it and I'm citing up through

952
00:38:49,109 --> 00:38:46,330
the overhead window at the spa's when

953
00:38:52,230 --> 00:38:49,119
it's not too far away and it sounds out

954
00:38:53,670 --> 00:38:52,240
a laser pulse a timed laser pulse counts

955
00:38:55,880 --> 00:38:53,680
how much time it takes to get there

956
00:38:58,470 --> 00:38:55,890
bounce off the target and come back and

957
00:39:08,010 --> 00:38:58,480
can tell us how far the spa's is a way

958
00:39:10,859 --> 00:39:08,020
to within inches what's the once the

959
00:39:12,840 --> 00:39:10,869
payload is on the arm or for other

960
00:39:15,570 --> 00:39:12,850
reasons of removing the arm this is how

961
00:39:17,550 --> 00:39:15,580
we do it facing aft in the baseball cap

962
00:39:19,290 --> 00:39:17,560
and all looking looking out the back

963
00:39:21,090 --> 00:39:19,300

window actually that was really useful

964

00:39:23,580 --> 00:39:21,100

for two reasons so that I crew wouldn't

965

00:39:25,349 --> 00:39:23,590

make fun of my hair so much and so that

966

00:39:27,570 --> 00:39:25,359

it would keep the bright Sun out of your

967

00:39:29,310 --> 00:39:27,580

eyes sometimes the the lighting

968

00:39:30,840 --> 00:39:29,320

conditions are very dramatic up there I

969

00:39:33,720 --> 00:39:30,850

was kind of surprising to me just don't

970

00:39:35,430 --> 00:39:33,730

see Sun that bright there on earth so it

971

00:39:37,020 --> 00:39:35,440

was great to have sunglasses and hats

972

00:39:39,240 --> 00:39:37,030

and stuff to protect yourself sometimes

973

00:39:42,300 --> 00:39:39,250

you can see the word Canada written on

974

00:39:45,420 --> 00:39:42,310

the robot arm or the remote manipulator

975

00:39:47,520 --> 00:39:45,430

system are long 60-foot arm provided by

976
00:39:49,440 --> 00:39:47,530
the Canadian Space Agency which did a

977
00:39:52,200 --> 00:39:49,450
great job for us we had it out and busy

978
00:39:54,450 --> 00:39:52,210
almost every day 2n deployed the

979
00:39:57,210 --> 00:39:54,460
satellite with it and retrieved it and I

980
00:39:59,640 --> 00:39:57,220
was able to move the satellite around to

981
00:40:04,830 --> 00:39:59,650
do some space station construction tests

982
00:40:06,840 --> 00:40:04,840
also and as we said many times earth

983
00:40:08,730 --> 00:40:06,850
observation is a very important part of

984
00:40:10,230 --> 00:40:08,740
every mission we have probably one of

985
00:40:12,990 --> 00:40:10,240
the best views of the earth that

986
00:40:14,640 --> 00:40:13,000
anybody's ever had I think this was the

987
00:40:16,260 --> 00:40:14,650
thing that surprised me most it's hard

988
00:40:17,670 --> 00:40:16,270

to describe although we're going to try

989

00:40:20,880 --> 00:40:17,680

in a little while describe how beautiful

990

00:40:23,609 --> 00:40:20,890

the earth is from 160 miles or 138 miles

991

00:40:24,930 --> 00:40:23,619

up i'm using a Hasselblad 70 millimeter

992

00:40:26,560 --> 00:40:24,940

camera here which is pretty much the

993

00:40:29,290 --> 00:40:26,570

mainstay of the earth

994

00:40:31,840 --> 00:40:29,300

vation camera systems we use and I'm

995

00:40:34,330 --> 00:40:31,850

shooting out of the aft windows of the

996

00:40:38,890 --> 00:40:34,340

flight deck actually out of the overhead

997

00:40:40,570 --> 00:40:38,900

windows here and of course if you're

998

00:40:43,750 --> 00:40:40,580

going to shoot a lot of film you have to

999

00:40:46,780 --> 00:40:43,760

load a lot of film and unfortunately

1000

00:40:49,540 --> 00:40:46,790

there's no dark room in the orbiter so

1001
00:40:51,550 --> 00:40:49,550
we have a dark bag instead and you put

1002
00:40:53,680 --> 00:40:51,560
all the the fresh film and the magazine

1003
00:40:56,290 --> 00:40:53,690
that's been exposed inside of it and you

1004
00:40:58,990 --> 00:40:56,300
pretty much change it by feel and I was

1005
00:41:06,010 --> 00:40:59,000
lucky enough to get to do that about 40

1006
00:41:07,930 --> 00:41:06,020
times but there's a pretty incredible

1007
00:41:09,520 --> 00:41:07,940
experience be able to fly on a vehicle

1008
00:41:11,860 --> 00:41:09,530
like the shuttle and look at this

1009
00:41:13,840 --> 00:41:11,870
beautiful earth of ours and I in this

1010
00:41:15,430 --> 00:41:13,850
view what an added bonus and this flight

1011
00:41:17,080 --> 00:41:15,440
was were in the high end condition orbit

1012
00:41:20,740 --> 00:41:17,090
so we get to see a majority of the earth

1013
00:41:23,080 --> 00:41:20,750

in his fight and this picture here and

1014

00:41:24,490 --> 00:41:23,090

see if you know the shape of a little

1015

00:41:26,860 --> 00:41:24,500

country called ice language where I was

1016

00:41:29,020 --> 00:41:26,870

born it's just off below the horizon

1017

00:41:32,200 --> 00:41:29,030

there just to the right of the orbiters

1018

00:41:34,210 --> 00:41:32,210

tail and to be able to see a country so

1019

00:41:36,790 --> 00:41:34,220

far north of the Equator is really quite

1020

00:41:38,560 --> 00:41:36,800

a quite an amazing thing in very pretty

1021

00:41:41,410 --> 00:41:38,570

colors in the ocean here and it's very

1022

00:41:42,880 --> 00:41:41,420

beautiful view and it's even better when

1023

00:41:47,890 --> 00:41:42,890

you're up there able to see it with your

1024

00:41:50,620 --> 00:41:47,900

own eyes here's a view of my hometown

1025

00:41:53,020 --> 00:41:50,630

which is Montreal in Quebec up in Canada

1026

00:41:54,700 --> 00:41:53,030

the big island in the middle of the st.

1027

00:41:56,290 --> 00:41:54,710

lawrence river that runs a horizontally

1028

00:41:58,810 --> 00:41:56,300

across the lower half of the picture is

1029

00:41:59,770 --> 00:41:58,820

a montreal itself a little bit above

1030

00:42:01,570 --> 00:41:59,780

that right in the middle of the picture

1031

00:42:04,030 --> 00:42:01,580

you can see the Mirabelle International

1032

00:42:07,930 --> 00:42:04,040

Airport you see quite a bit of detail in

1033

00:42:09,400 --> 00:42:07,940

the land from space and a lot of these

1034

00:42:12,090 --> 00:42:09,410

not only are they pretty to look at they

1035

00:42:14,170 --> 00:42:12,100

give java version geologists and

1036

00:42:16,060 --> 00:42:14,180

meteorologist a lot of information that

1037

00:42:20,260 --> 00:42:16,070

they can use to better understand this

1038

00:42:22,180 --> 00:42:20,270

riff that we live on and they shot the

1039

00:42:23,890 --> 00:42:22,190

orbiter is actually brought over the

1040

00:42:26,140 --> 00:42:23,900

middle of British Columbia which is the

1041

00:42:28,630 --> 00:42:26,150

most westerly province in canada and

1042

00:42:30,490 --> 00:42:28,640

we're looking down south from there and

1043

00:42:33,100 --> 00:42:30,500

the lower part of the picture you can

1044

00:42:35,440 --> 00:42:33,110

see this the city of vancouver and some

1045

00:42:36,160 --> 00:42:35,450

of the silk coming out the Fraser River

1046

00:42:38,289 --> 00:42:36,170

into the

1047

00:42:39,609 --> 00:42:38,299

virgin bay vancouver island just to the

1048

00:42:41,500 --> 00:42:39,619

right in the lower half and then the

1049

00:42:44,079 --> 00:42:41,510

Puget Sound the Olympic Peninsula and

1050

00:42:45,970 --> 00:42:44,089

I've just above the center of the

1051

00:42:48,309 --> 00:42:45,980

picture of the Seattle area and right

1052

00:42:50,170 --> 00:42:48,319

near the top the Portland area in the

1053

00:42:53,020 --> 00:42:50,180

portland oregon washington oregon border

1054

00:42:55,660 --> 00:42:53,030

and the moans green reindeer there's

1055

00:42:58,150 --> 00:42:55,670

just in the upper left corner of the of

1056

00:43:00,309 --> 00:42:58,160

the pitcher there there's a lot of very

1057

00:43:05,770 --> 00:43:00,319

incredibly good pretty views of the

1058

00:43:08,920 --> 00:43:05,780

earth that we live on this is actually

1059

00:43:12,819 --> 00:43:08,930

the dancing actually gdansk a city on

1060

00:43:14,260 --> 00:43:12,829

the polish Baltic border and I we passed

1061

00:43:15,970 --> 00:43:14,270

over there's quite a bit it was very

1062

00:43:18,849 --> 00:43:15,980

distinct to islip of land there

1063

00:43:20,410 --> 00:43:18,859

protecting the harbor for Gdansk and I'm

1064

00:43:22,750 --> 00:43:20,420

sorry I took called a dancing but being

1065

00:43:25,120 --> 00:43:22,760

an amateur historian I took this picture

1066

00:43:27,010 --> 00:43:25,130

a lot because of the historical nature

1067

00:43:29,530 --> 00:43:27,020

of the city and the parts it played

1068

00:43:31,839 --> 00:43:29,540

during 22 in the 20th century you can

1069

00:43:36,010 --> 00:43:31,849

also see up in the Baltic towards the

1070

00:43:37,870 --> 00:43:36,020

top of the photo is a large plankton

1071

00:43:40,390 --> 00:43:37,880

bloom in the Baltic Sea which is kind of

1072

00:43:42,370 --> 00:43:40,400

rare for the colder waters up there but

1073

00:43:46,990 --> 00:43:42,380

you can see it as a swirled Brown

1074

00:43:48,640 --> 00:43:47,000

pattern in the water this is a picture

1075

00:43:50,890 --> 00:43:48,650

actually of the Alps you see them

1076

00:43:53,740 --> 00:43:50,900

running in the left-hand corner all the

1077

00:43:56,260 --> 00:43:53,750

white capped mountains and in Austria

1078

00:43:58,180 --> 00:43:56,270

and also southern Germany Bavaria to be

1079

00:43:59,410 --> 00:43:58,190

exact going through the mountains

1080

00:44:01,359 --> 00:43:59,420

through the Alps you can see the in

1081

00:44:03,760 --> 00:44:01,369

river cutting a valley there and you can

1082

00:44:05,950 --> 00:44:03,770

see innsbrook about one-third the way

1083

00:44:07,930 --> 00:44:05,960

down from the left side in there and if

1084

00:44:11,049 --> 00:44:07,940

you see the two lakes that dominate the

1085

00:44:14,020 --> 00:44:11,059

upper center of the picture to the right

1086

00:44:15,819 --> 00:44:14,030

of them is actually a great brown area

1087

00:44:17,650 --> 00:44:15,829

and that's the city of Munich with its

1088

00:44:23,440 --> 00:44:17,660

large international airport to the right

1089

00:44:25,180 --> 00:44:23,450

of it the here's a photo photo the east

1090

00:44:27,010 --> 00:44:25,190

Mediterranean that's the water you're

1091

00:44:30,099 --> 00:44:27,020

looking at and the land portion you see

1092

00:44:31,510 --> 00:44:30,109

is Lebanon and about if you go start at

1093

00:44:33,640 --> 00:44:31,520

the top and come down about a third of

1094

00:44:36,309 --> 00:44:33,650

the way the point that jets out into the

1095

00:44:38,980 --> 00:44:36,319

Mediterranean that's Beirut Lebanon and

1096

00:44:41,530 --> 00:44:38,990

it's interesting just inland from Beirut

1097

00:44:44,140 --> 00:44:41,540

you can see the mountains and the ridges

1098

00:44:46,420 --> 00:44:44,150

and some green some vegetation but if

1099

00:44:48,940 --> 00:44:46,430

you go further a little bit further

1100

00:44:49,540 --> 00:44:48,950

inland from Beirut that's the Bekaa

1101

00:44:51,130 --> 00:44:49,550

Valley

1102

00:44:54,010 --> 00:44:51,140

you can see the shape of the different

1103

00:44:55,300 --> 00:44:54,020

vegetations in that Valley and if you go

1104

00:44:58,180 --> 00:44:55,310

further inland from there then that is

1105

00:45:00,010 --> 00:44:58,190

all a desert area that's in Syria if you

1106

00:45:01,630 --> 00:45:00,020

move to the bottom of the slide the

1107

00:45:05,950 --> 00:45:01,640

about the bottom third of the slide is

1108

00:45:09,730 --> 00:45:05,960

Israel and you can just barely see that

1109

00:45:16,420 --> 00:45:09,740

the tip of the Sea of Galilee in Israel

1110

00:45:18,460 --> 00:45:16,430

as well on this slide on this slide the

1111

00:45:20,170 --> 00:45:18,470

it's interesting that the robotic arm is

1112

00:45:21,610 --> 00:45:20,180

right through the field of view and guys

1113

00:45:24,340 --> 00:45:21,620

like me that we shoot a lot of Earth ops

1114

00:45:25,600 --> 00:45:24,350

photos I was always talking to Janice TV

1115

00:45:28,450 --> 00:45:25,610

and hey can't you move that arm out of

1116

00:45:30,310 --> 00:45:28,460

the way and but the they were pretty

1117

00:45:32,410 --> 00:45:30,320

busy using the arm we were a very busy

1118

00:45:33,850 --> 00:45:32,420

flight and so that is an indicator of

1119

00:45:36,370 --> 00:45:33,860

how much work was going on

1120

00:45:38,260 --> 00:45:36,380

simultaneously on this flight but what

1121

00:45:41,320 --> 00:45:38,270

we're looking at here the right part of

1122

00:45:44,380 --> 00:45:41,330

the slide is Kazakhstan and the the lake

1123

00:45:46,270 --> 00:45:44,390

you see and they put the particular deep

1124

00:45:49,270 --> 00:45:46,280

blue lake about in the middle of the

1125

00:45:51,280 --> 00:45:49,280

slide is a lake baikal sh and win

1126

00:45:54,040 --> 00:45:51,290

kazakhstan if you follow the water down

1127

00:45:57,400 --> 00:45:54,050

it cuts through a ridge and that Ridge

1128

00:45:59,350 --> 00:45:57,410

Mountains is from 10,000 15,000 feet

1129

00:46:01,690 --> 00:45:59,360

high it goes through what's called the

1130

00:46:03,520 --> 00:46:01,700

Sun garion gate and to the left side of

1131

00:46:04,720 --> 00:46:03,530

that gate is a tremendous dust storm and

1132

00:46:06,280 --> 00:46:04,730

that's really what caught our eye on

1133

00:46:10,930 --> 00:46:06,290

this photo was that huge dust storm

1134

00:46:13,450 --> 00:46:10,940

blowing through there into China well

1135

00:46:15,280 --> 00:46:13,460

not only is the geography need to look

1136

00:46:17,440 --> 00:46:15,290

at but meteorology the weather that we

1137

00:46:18,820 --> 00:46:17,450

get to see from orbit we showed you a

1138

00:46:21,850 --> 00:46:18,830

picture of winnie a super typhoon

1139

00:46:23,890 --> 00:46:21,860

earlier in the movie but just to explain

1140

00:46:26,110 --> 00:46:23,900

some of the capability capabilities we

1141

00:46:27,910 --> 00:46:26,120

have onboard nowadays the ground called

1142

00:46:29,470 --> 00:46:27,920

us up and told us about Winnie and asked

1143

00:46:31,960 --> 00:46:29,480

us to try to take a look at it when we

1144

00:46:34,810 --> 00:46:31,970

went by and just so happens we pass

1145

00:46:37,210 --> 00:46:34,820

pretty much right over Winnie just a few

1146

00:46:39,790 --> 00:46:37,220

minutes later and we had a digital

1147

00:46:42,090 --> 00:46:39,800

electronic still camera on board and we

1148

00:46:45,160 --> 00:46:42,100

were able to take a few photos of that

1149

00:46:46,650 --> 00:46:45,170

super typhoon and then it wasn't very

1150

00:46:49,780 --> 00:46:46,660

many minutes later that we had a

1151
00:46:52,000 --> 00:46:49,790
downlink capability to Houston and so we

1152
00:46:53,140 --> 00:46:52,010
sent those images down through one of

1153
00:46:56,230 --> 00:46:53,150
the computers that I showed you earlier

1154
00:46:57,670 --> 00:46:56,240
and it wasn't within an hour so that we

1155
00:46:59,500 --> 00:46:57,680
had that kind of information out to the

1156
00:47:01,390 --> 00:46:59,510
internet into the public so it so we've

1157
00:47:03,069 --> 00:47:01,400
come a long way with our capability on

1158
00:47:08,620 --> 00:47:03,079
the orbiter and we hopefully will

1159
00:47:10,690 --> 00:47:08,630
more that in the future this may be a

1160
00:47:12,609 --> 00:47:10,700
place that some of you folks have been

1161
00:47:15,390 --> 00:47:12,619
before on some vacations but the lake

1162
00:47:17,529 --> 00:47:15,400
directly in the center is Lake Tahoe and

1163
00:47:20,259 --> 00:47:17,539

to the left you can see the Sierra

1164

00:47:22,690 --> 00:47:20,269

Nevada mountains and the lake in the top

1165

00:47:24,219 --> 00:47:22,700

right corner is a pyramid lake it

1166

00:47:25,989 --> 00:47:24,229

actually is on an Indian Reservation but

1167

00:47:28,630 --> 00:47:25,999

if you draw a line between that Lake and

1168

00:47:29,979 --> 00:47:28,640

Lake Tahoe in the center there's kind of

1169

00:47:32,680 --> 00:47:29,989

a gray area sh about halfway between

1170

00:47:35,589 --> 00:47:32,690

them and that's Reno Nevada just to give

1171

00:47:37,660 --> 00:47:35,599

you some idea what green tree type

1172

00:47:40,180 --> 00:47:37,670

mountains look like in space and then

1173

00:47:45,459 --> 00:47:40,190

the desert on the eastern side of the

1174

00:47:48,130 --> 00:47:45,469

mountains also in the United States this

1175

00:47:49,630 --> 00:47:48,140

is the great salt lake in Utah the

1176

00:47:51,579 --> 00:47:49,640

northern part is actually at the bottom

1177

00:47:54,099 --> 00:47:51,589

we're looking south is at the top

1178

00:47:55,599 --> 00:47:54,109

there's a railroad causeway that goes

1179

00:47:58,690 --> 00:47:55,609

right through the middle of this lake

1180

00:48:01,120 --> 00:47:58,700

and actually bisects the two portions of

1181

00:48:03,640 --> 00:48:01,130

the lake the southern part which is a

1182

00:48:06,749 --> 00:48:03,650

dark blue here is very deep and in the

1183

00:48:09,459 --> 00:48:06,759

northern part which is a red is the

1184

00:48:10,900 --> 00:48:09,469

shallow part and the reason it's red

1185

00:48:12,430 --> 00:48:10,910

this time of the year which and it

1186

00:48:15,699 --> 00:48:12,440

really surprised me because on my other

1187

00:48:17,739 --> 00:48:15,709

flights it was a pale blue usually but

1188

00:48:20,199 --> 00:48:17,749

during this time of year brine shrimp

1189

00:48:22,239 --> 00:48:20,209

flourish in the salt water of the salt

1190

00:48:24,400 --> 00:48:22,249

lake and that's what causes the water to

1191

00:48:26,799 --> 00:48:24,410

be red and this time of year there's a

1192

00:48:29,289 --> 00:48:26,809

lot of commercial fishermen out there

1193

00:48:35,640 --> 00:48:29,299

harvesting the brine shrimp to use for

1194

00:48:38,109 --> 00:48:35,650

fish food he had a very busy flight and

1195

00:48:39,759 --> 00:48:38,119

once in a while in fact pretty often

1196

00:48:41,469 --> 00:48:39,769

you'd be working away at something and

1197

00:48:42,880 --> 00:48:41,479

you glanced out the window and see

1198

00:48:45,339 --> 00:48:42,890

something that would just tempt you to

1199

00:48:48,099 --> 00:48:45,349

stop and thank goodness we had lots of

1200

00:48:50,199 --> 00:48:48,109

cameras this is a view looking west as

1201
00:48:52,859 --> 00:48:50,209
we zipped out over the Atlantic back at

1202
00:48:56,589 --> 00:48:52,869
Cape Cod and Martha's Vineyard and

1203
00:48:58,390 --> 00:48:56,599
Nantucket Island you can see the Sun

1204
00:49:00,249 --> 00:48:58,400
reflecting off the water and the various

1205
00:49:03,189 --> 00:49:00,259
current patterns and near the surface

1206
00:49:05,770 --> 00:49:03,199
and the water and you can also clearly

1207
00:49:09,310 --> 00:49:05,780
see all the landlocked water and

1208
00:49:13,300 --> 00:49:09,320
ponds and lakes and also a canal there

1209
00:49:14,950 --> 00:49:13,310
on Cape Cod itself we did have a high

1210
00:49:17,290 --> 00:49:14,960
inclination flight I know this is a dark

1211
00:49:19,680 --> 00:49:17,300
photograph but it's amazing we have it

1212
00:49:22,930 --> 00:49:19,690
at all I think this is the Aurora

1213
00:49:24,820 --> 00:49:22,940

Australis the Southern Lights and down

1214

00:49:26,500 --> 00:49:24,830

over southern Australia or even a little

1215

00:49:28,960 --> 00:49:26,510

south of that it's where most of our

1216

00:49:32,740 --> 00:49:28,970

night passes kind of bottom doubt in our

1217

00:49:34,420 --> 00:49:32,750

orbital trajectory and this was a just a

1218

00:49:37,540 --> 00:49:34,430

wonderful sight to see it was

1219

00:49:39,400 --> 00:49:37,550

fascinating and it was a kind of a

1220

00:49:40,870 --> 00:49:39,410

combination of physics and art sort of

1221

00:49:43,750 --> 00:49:40,880

being held right out there in the sky

1222

00:49:45,960 --> 00:49:43,760

see many of you know when energetic

1223

00:49:48,340 --> 00:49:45,970

electrons come down and clobber

1224

00:49:50,080 --> 00:49:48,350

atmosphere occur not an atmospheric but

1225

00:49:53,050 --> 00:49:50,090

atomic oxygen it's well above the

1226
00:49:54,910 --> 00:49:53,060
atmosphere they will release the energy

1227
00:49:58,420 --> 00:49:54,920
in the form of photons or fluoresce and

1228
00:50:00,670 --> 00:49:58,430
they fluoresce this ghostly green you

1229
00:50:02,740 --> 00:50:00,680
can see the tail of discovery there

1230
00:50:05,520 --> 00:50:02,750
garni managed to get this photograph

1231
00:50:07,930 --> 00:50:05,530
through some diligent effort with long

1232
00:50:13,630 --> 00:50:07,940
exposures and some very high-speed film

1233
00:50:14,950 --> 00:50:13,640
and I'm really glad he got it and will

1234
00:50:17,470 --> 00:50:14,960
transition now from the earth

1235
00:50:19,120 --> 00:50:17,480
observation slides back into the final

1236
00:50:21,700 --> 00:50:19,130
slides that we've got for you today I

1237
00:50:23,950 --> 00:50:21,710
know this is entry day you notice be

1238
00:50:25,570 --> 00:50:23,960

Arnie and Jan or in blue it looks like

1239

00:50:28,360 --> 00:50:25,580

underwear and that's because it is

1240

00:50:30,340 --> 00:50:28,370

underwear it's been modified with liquid

1241

00:50:32,290 --> 00:50:30,350

cooling tubes and we wear that under the

1242

00:50:34,120 --> 00:50:32,300

orange suits that I've got on to keep a

1243

00:50:36,040 --> 00:50:34,130

school and we've come a long ways the

1244

00:50:38,380 --> 00:50:36,050

last few years and keeping crews

1245

00:50:41,140 --> 00:50:38,390

comfortable on the landing and entry day

1246

00:50:43,210 --> 00:50:41,150

I mean my suit did typically the pilots

1247

00:50:45,820 --> 00:50:43,220

are very excited on this day because up

1248

00:50:47,860 --> 00:50:45,830

until now the Space Shuttle has not been

1249

00:50:50,020 --> 00:50:47,870

an airplane or a glider on launch we

1250

00:50:51,850 --> 00:50:50,030

were a rocket and then we transitioned

1251
00:50:53,080 --> 00:50:51,860
into an orbiting spacecraft but now

1252
00:50:55,350 --> 00:50:53,090
we're actually going to become an

1253
00:50:57,820 --> 00:50:55,360
airplane or I guess you'd say the

1254
00:51:02,680 --> 00:50:57,830
fastest heaviest glider in the world on

1255
00:51:04,540 --> 00:51:02,690
this day so we're very excited as I

1256
00:51:07,060 --> 00:51:04,550
mentioned that gave me the easy slides

1257
00:51:09,790 --> 00:51:07,070
and no presentation like this would be

1258
00:51:11,470 --> 00:51:09,800
complete without landing photo we were

1259
00:51:13,000 --> 00:51:11,480
very very happy to be back on the ground

1260
00:51:14,740 --> 00:51:13,010
to see our friends and family

1261
00:51:16,600 --> 00:51:14,750
unfortunately we're already missing our

1262
00:51:18,470 --> 00:51:16,610
home in space and the work we've been

1263
00:52:18,590 --> 00:51:18,480

doing

1264

00:52:21,260 --> 00:52:18,600

we traveled 4725894.html and do the

1265

00:52:23,060 --> 00:52:21,270

things that we we get to do and again

1266

00:52:25,040 --> 00:52:23,070

she came through in great shape and