

Hubble Servicing Mission 1

From the Astronauts' Perspective

From NASA's Goddard Space Flight Center, Greenbelt, MD

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1
00:00:15,190 --> 00:00:13,430
hi we're live from goddard space flight

2
00:00:18,070 --> 00:00:15,200
center i'm erin kislik and today we're

3
00:00:19,910 --> 00:00:18,080
celebrating 25 years of hubble servicing

4
00:00:21,429 --> 00:00:19,920
so you may be wondering what servicing

5
00:00:23,590 --> 00:00:21,439
is it's just like when you take your car

6
00:00:26,150 --> 00:00:23,600
in to get the tires rotated or the oil

7
00:00:28,310 --> 00:00:26,160
change or even just fuel up some tight

8
00:00:29,509 --> 00:00:28,320
satellites in space need a little bit of

9
00:00:31,669 --> 00:00:29,519
help too

10
00:00:34,389 --> 00:00:31,679
with us today we have astronauts who

11
00:00:37,190 --> 00:00:34,399
went on the first servicing mission to

12
00:00:38,229 --> 00:00:37,200
hubble 25 years ago this week and

13
00:00:42,869 --> 00:00:38,239

they're about to tell you a little bit

14

00:00:48,709 --> 00:00:45,830

good morning i'm dr ken carpenter the

15

00:00:49,990 --> 00:00:48,719

operations project scientist for hubble

16

00:00:51,670 --> 00:00:50,000

at the time

17

00:00:53,430 --> 00:00:51,680

of the servicing mission one i was the

18

00:00:56,310 --> 00:00:53,440

operations co-eye for the goddard high

19

00:00:58,549 --> 00:00:56,320

resolution spectrograph and i must say

20

00:01:01,110 --> 00:00:58,559

appreciated the repair to ghrs that was

21

00:01:03,830 --> 00:01:01,120

done in the mission as well

22

00:01:05,350 --> 00:01:03,840

and uh also relatively fresh operations

23

00:01:07,590 --> 00:01:05,360

project scientists for the project

24

00:01:09,109 --> 00:01:07,600

overall at that point

25

00:01:12,149 --> 00:01:09,119

we've heard what the atmosphere was like

26
00:01:14,550 --> 00:01:12,159
during that time and the challenges from

27
00:01:15,910 --> 00:01:14,560
the many previous speakers now we will

28
00:01:18,230 --> 00:01:15,920
hear from the people who actually made

29
00:01:20,149 --> 00:01:18,240
it happen in space

30
00:01:22,950 --> 00:01:20,159
sm lawn was launched on the 2nd of

31
00:01:25,030 --> 00:01:22,960
december 1993. as you know the mission

32
00:01:27,270 --> 00:01:25,040
restored the spaceport observatory's

33
00:01:28,469 --> 00:01:27,280
optical performance correcting for the

34
00:01:32,390 --> 00:01:28,479
spherical collaboration with the

35
00:01:34,310 --> 00:01:32,400
installation of with pic2 and costar

36
00:01:36,550 --> 00:01:34,320
the flight also started installed new

37
00:01:38,870 --> 00:01:36,560
gyros and solar arrays on the telescope

38
00:01:42,389 --> 00:01:38,880

in addition to the ghhs fix

39

00:01:45,030 --> 00:01:42,399

there were seven astronauts on sts-61

40

00:01:48,069 --> 00:01:45,040

richard covey kenneth bowersox catherine

41

00:01:51,109 --> 00:01:48,079

thornton claude nicolier jeffrey hoffman

42

00:01:52,469 --> 00:01:51,119

story musgrave and tom akers

43

00:01:54,870 --> 00:01:52,479

two of these brave and amazing

44

00:01:57,749 --> 00:01:54,880

astronauts are here with us today

45

00:01:59,590 --> 00:01:57,759

to tell of their experiences in orbit on

46

00:02:01,830 --> 00:01:59,600

the mission which save the hubble space

47

00:02:03,350 --> 00:02:01,840

telescope

48

00:02:04,950 --> 00:02:03,360

i'm going to introduce both of them and

49

00:02:06,709 --> 00:02:04,960

then we'll let them get into their

50

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

speeches directly

51
00:02:11,510 --> 00:02:08,640
catherine thornton earned her phd at the

52
00:02:14,790 --> 00:02:11,520
university of virginia in 1979 and

53
00:02:16,550 --> 00:02:14,800
became an astronaut in july 1985.

54
00:02:18,869 --> 00:02:16,560
her initial assignments included flight

55
00:02:21,510 --> 00:02:18,879
software verification in the shuttle

56
00:02:23,510 --> 00:02:21,520
avionics integration laboratory

57
00:02:25,830 --> 00:02:23,520
serving as a member a team member of the

58
00:02:27,990 --> 00:02:25,840
vehicle integration test team at kennedy

59
00:02:29,589 --> 00:02:28,000
and as a spacecraft communicator or

60
00:02:31,589 --> 00:02:29,599
capcom

61
00:02:33,509 --> 00:02:31,599
kathy was a mission specialist on four

62
00:02:36,150 --> 00:02:33,519
shuttle flights her first was the

63
00:02:38,229 --> 00:02:36,160

department of defense classified mission

64

00:02:40,229 --> 00:02:38,239

her second was the maiden voyage of

65

00:02:42,390 --> 00:02:40,239

space shuttle endeavour and helped

66

00:02:44,869 --> 00:02:42,400

repair the intel sat

67

00:02:46,710 --> 00:02:44,879

and also evaluated space station

68

00:02:48,470 --> 00:02:46,720

assembly techniques

69

00:02:50,070 --> 00:02:48,480

on her fourth and final flight dr

70

00:02:52,390 --> 00:02:50,080

thornton served on the as payload

71

00:02:54,150 --> 00:02:52,400

commander on the second u.s microgravity

72

00:02:55,830 --> 00:02:54,160

laboratory mission

73

00:02:57,670 --> 00:02:55,840

but today of course we're concentrating

74

00:02:59,509 --> 00:02:57,680

on our third flight

75

00:03:02,869 --> 00:02:59,519

which on which dr thornton was a mission

76
00:03:05,509 --> 00:03:02,879
specialist for the hst servicing mission

77
00:03:07,670 --> 00:03:05,519
on the flight she installed costar

78
00:03:10,309 --> 00:03:07,680
which you've heard about earlier

79
00:03:11,430 --> 00:03:10,319
also disposed of in a scene worthy of a

80
00:03:13,589 --> 00:03:11,440
ballet

81
00:03:15,670 --> 00:03:13,599
one of the solar arrays

82
00:03:18,790 --> 00:03:15,680
and i still every time i see that video

83
00:03:22,070 --> 00:03:18,800
clip here the blue danube because of a

84
00:03:25,270 --> 00:03:22,080
german ard tv station which set that

85
00:03:28,229 --> 00:03:25,280
scene to that music

86
00:03:30,630 --> 00:03:28,239
she has logged over 975 hours in space

87
00:03:33,190 --> 00:03:30,640
including more than 21 hours of

88
00:03:34,550 --> 00:03:33,200

extra vehicular activity

89

00:03:36,550 --> 00:03:34,560

and is currently a professor of

90

00:03:39,190 --> 00:03:36,560

mechanical and aerospace engineering at

91

00:03:41,509 --> 00:03:39,200

the university of virginia

92

00:03:44,789 --> 00:03:41,519

jeffrey hoffman received a phd from

93

00:03:47,910 --> 00:03:44,799

harvard university in 1971 and became an

94

00:03:49,910 --> 00:03:47,920

astronaut in august 1979

95

00:03:52,229 --> 00:03:49,920

during preparations for the shuttle

96

00:03:54,229 --> 00:03:52,239

orbital test flights he worked in the

97

00:03:56,789 --> 00:03:54,239

flight simulation laboratory at downey

98

00:03:59,350 --> 00:03:56,799

california testing guidance navigation

99

00:04:02,070 --> 00:03:59,360

and flight control systems he served as

100

00:04:05,910 --> 00:04:02,080

a support crew member for sts-5 and as a

101

00:04:07,350 --> 00:04:05,920

capcom for sts-8 and 82.

102

00:04:09,350 --> 00:04:07,360

jeff is a veteran of five shuttle

103

00:04:12,390 --> 00:04:09,360

flights on his first mission he made the

104

00:04:13,990 --> 00:04:12,400

first sts contingency spacewalk

105

00:04:16,390 --> 00:04:14,000

his second flight was a space lab

106

00:04:17,909 --> 00:04:16,400

mission flying the astrowon uv astronomy

107

00:04:20,069 --> 00:04:17,919

package

108

00:04:22,629 --> 00:04:20,079

his third spaceflight was as payload

109

00:04:25,510 --> 00:04:22,639

commander and mission specialist

110

00:04:27,270 --> 00:04:25,520

on sts-46 which deployed the european

111

00:04:29,110 --> 00:04:27,280

retrievable carrier and carried out the

112

00:04:31,909 --> 00:04:29,120

first test flight of the tethered

113

00:04:33,990 --> 00:04:31,919

satellite system

114

00:04:36,150 --> 00:04:34,000

fourth flight was sm-1

115

00:04:39,350 --> 00:04:36,160

on which he conducted three evas

116

00:04:41,629 --> 00:04:39,360

including the installation of with pic2

117

00:04:43,830 --> 00:04:41,639

he did one more flight after sm1 on

118

00:04:46,070 --> 00:04:43,840

sts-75 which did a reflight of the

119

00:04:48,950 --> 00:04:46,080

tethered satellite system and the third

120

00:04:51,909 --> 00:04:48,960

flight of the us microgravity payload he

121

00:04:54,390 --> 00:04:51,919

has logged more than 1200 hours and 21.5

122

00:04:55,830 --> 00:04:54,400

million miles in space

123

00:04:57,110 --> 00:04:55,840

he is currently a professor in the

124

00:04:59,670 --> 00:04:57,120

department of aeronautics and

125

00:05:02,790 --> 00:04:59,680

aeronautics at mit and is the author of

126

00:05:04,110 --> 00:05:02,800

a book titled an astronaut's diary

127

00:05:06,950 --> 00:05:04,120

please join me in

128

00:05:14,230 --> 00:05:06,960

enthusiastically welcoming dr katherine

129

00:05:14,240 --> 00:05:16,870

thanks ken

130

00:05:19,189 --> 00:05:18,390

are we live

131

00:05:20,070 --> 00:05:19,199

good

132

00:05:22,070 --> 00:05:20,080

um

133

00:05:23,670 --> 00:05:22,080

you know just before we start a 25th

134

00:05:26,230 --> 00:05:23,680

anniversary i mean it's great to come

135

00:05:27,110 --> 00:05:26,240

here and see old friends and colleagues

136

00:05:28,710 --> 00:05:27,120

but

137

00:05:30,629 --> 00:05:28,720

you know we're both professors so i

138

00:05:33,749 --> 00:05:30,639

don't know if you have the same

139

00:05:37,029 --> 00:05:33,759

sort of shock that i do when i i talk to

140

00:05:39,990 --> 00:05:37,039

my students now about hubble and realize

141

00:05:42,710 --> 00:05:40,000

they weren't born when we did this yes

142

00:05:44,629 --> 00:05:42,720

yeah it uh sort of makes us remember

143

00:05:46,550 --> 00:05:44,639

where where we are

144

00:05:49,350 --> 00:05:46,560

yeah i think what what we

145

00:05:50,950 --> 00:05:49,360

would like to do um we we have a few

146

00:05:53,430 --> 00:05:50,960

pictures most of which you've probably

147

00:05:56,790 --> 00:05:53,440

seen before but to try to give a sense

148

00:05:58,790 --> 00:05:56,800

of what it was like being the crew

149

00:06:00,230 --> 00:05:58,800

that was going to go up and and do this

150

00:06:02,870 --> 00:06:00,240

and of course

151
00:06:04,870 --> 00:06:02,880
as a crew

152
00:06:07,189 --> 00:06:04,880
we're the people that the public sees

153
00:06:11,749 --> 00:06:07,199
more than anyone else but we're probably

154
00:06:13,830 --> 00:06:11,759
more aware than any of the public of

155
00:06:16,070 --> 00:06:13,840
how many people were involved in the

156
00:06:18,550 --> 00:06:16,080
success of this mission and and that's

157
00:06:21,029 --> 00:06:18,560
why it's great to be here and and that

158
00:06:21,749 --> 00:06:21,039
everybody's had a chance to review all

159
00:06:23,749 --> 00:06:21,759
the

160
00:06:26,150 --> 00:06:23,759
incredible contributions that so many

161
00:06:26,950 --> 00:06:26,160
people made

162
00:06:29,270 --> 00:06:26,960
so

163
00:06:31,510 --> 00:06:29,280

you know when we started out um that

164

00:06:34,309 --> 00:06:31,520

this was one thing that that maybe

165

00:06:35,749 --> 00:06:34,319

uh didn't get mentioned so much that

166

00:06:36,629 --> 00:06:35,759

hubble

167

00:06:38,870 --> 00:06:36,639

you know

168

00:06:41,110 --> 00:06:38,880

a servicing telescope there was so much

169

00:06:42,230 --> 00:06:41,120

new technology involved

170

00:06:47,430 --> 00:06:42,240

um

171

00:06:49,189 --> 00:06:47,440

you know there was a lot of criticism of

172

00:06:50,790 --> 00:06:49,199

of hubble

173

00:06:52,950 --> 00:06:50,800

just like there is now of the webb

174

00:06:56,550 --> 00:06:52,960

telescope which also has so much new

175

00:06:58,710 --> 00:06:56,560

technology it's it's a lesson that i you

176

00:07:01,589 --> 00:06:58,720

know i i don't know how you deal with

177

00:07:03,350 --> 00:07:01,599

with congress and and the political

178

00:07:05,990 --> 00:07:03,360

and budget people

179

00:07:07,749 --> 00:07:06,000

knowing when you set out on trying to do

180

00:07:09,990 --> 00:07:07,759

something that's so new and so

181

00:07:12,070 --> 00:07:10,000

complicated almost certainly you're

182

00:07:14,150 --> 00:07:12,080

going to run into problems but

183

00:07:17,029 --> 00:07:14,160

you know how do you prepare

184

00:07:20,070 --> 00:07:17,039

the people for that um

185

00:07:21,350 --> 00:07:20,080

but anyway um you know we

186

00:07:23,189 --> 00:07:21,360

we were both

187

00:07:25,510 --> 00:07:23,199

flying so you know we weren't really

188

00:07:27,830 --> 00:07:25,520

directly involved with with hubble

189

00:07:30,309 --> 00:07:27,840

uh in the early days but

190

00:07:32,550 --> 00:07:30,319

um that that's an another thing that

191

00:07:34,309 --> 00:07:32,560

that um you know we have to realize

192

00:07:37,110 --> 00:07:34,319

there there were people

193

00:07:39,430 --> 00:07:37,120

even before hubble was uh was launched i

194

00:07:42,870 --> 00:07:39,440

mean bruce mccandless kathy sullivan

195

00:07:46,550 --> 00:07:42,880

they had spent a lot of time working on

196

00:07:48,469 --> 00:07:46,560

what the repair procedures would be

197

00:07:50,629 --> 00:07:48,479

and uh

198

00:07:52,469 --> 00:07:50,639

and of course there was the big shock

199

00:07:55,990 --> 00:07:52,479

and again we weren't

200

00:07:57,110 --> 00:07:56,000

directly involved in any of this until

201
00:08:00,550 --> 00:07:57,120
we got

202
00:08:01,749 --> 00:08:00,560
you know people figured out what the

203
00:08:03,749 --> 00:08:01,759
problems

204
00:08:05,749 --> 00:08:03,759
were and and how we were going to fix

205
00:08:08,469 --> 00:08:05,759
them and then of course within the

206
00:08:11,990 --> 00:08:08,479
astronaut office um

207
00:08:14,390 --> 00:08:12,000
we we as as nasa people had to bear the

208
00:08:15,670 --> 00:08:14,400
brunt as as well as as all the

209
00:08:17,589 --> 00:08:15,680
astronomers

210
00:08:21,430 --> 00:08:17,599
and you know i was originally trained as

211
00:08:23,430 --> 00:08:21,440
an astronomer so i i kept getting

212
00:08:25,189 --> 00:08:23,440
messages from astronomer friends telling

213
00:08:27,270 --> 00:08:25,199

me that even that summer they were

214

00:08:29,589 --> 00:08:27,280

embarrassed when you you know you'd go

215

00:08:31,189 --> 00:08:29,599

away in the summer and people would you

216

00:08:32,870 --> 00:08:31,199

meet new people you know what do you do

217

00:08:34,389 --> 00:08:32,880

for a living they say i don't want to

218

00:08:36,230 --> 00:08:34,399

say that i'm an astronomer because

219

00:08:37,509 --> 00:08:36,240

somehow they hold me responsible for

220

00:08:38,790 --> 00:08:37,519

hubble so

221

00:08:40,709 --> 00:08:38,800

you know we all lived through that

222

00:08:42,790 --> 00:08:40,719

together but then

223

00:08:45,190 --> 00:08:42,800

once we were getting ready

224

00:08:48,310 --> 00:08:45,200

this was the the big question around the

225

00:08:52,630 --> 00:08:48,320

astronaut office and

226

00:08:54,150 --> 00:08:52,640

because it was so critical to any any

227

00:08:56,389 --> 00:08:54,160

thing you could think of that would

228

00:08:59,509 --> 00:08:56,399

reduce the risk of failure

229

00:09:01,350 --> 00:08:59,519

nasa was ready to do and so they made

230

00:09:03,110 --> 00:09:01,360

this decision this was for the first

231

00:09:05,590 --> 00:09:03,120

servicing mission that

232

00:09:06,790 --> 00:09:05,600

was relaxed later on

233

00:09:08,870 --> 00:09:06,800

but um

234

00:09:10,949 --> 00:09:08,880

you know i'll i'll tell my story and

235

00:09:12,470 --> 00:09:10,959

then you can uh

236

00:09:15,110 --> 00:09:12,480

take it but

237

00:09:15,990 --> 00:09:15,120

um as was mentioned on on my first

238

00:09:23,190 --> 00:09:16,000

flight

239

00:09:25,590 --> 00:09:23,200

just deploying two satellites

240

00:09:30,070 --> 00:09:25,600

i always remember

241

00:09:32,949 --> 00:09:30,080

as we got out of the water tank before

242

00:09:35,750 --> 00:09:32,959

this was the last eva training session

243

00:09:38,150 --> 00:09:35,760

before our flight and just as a joke i

244

00:09:39,430 --> 00:09:38,160

said to all of the technicians around

245

00:09:41,430 --> 00:09:39,440

there said

246

00:09:43,670 --> 00:09:41,440

well guys if we actually get to do an

247

00:09:46,790 --> 00:09:43,680

eva there's a beer party at the outpost

248

00:09:48,470 --> 00:09:46,800

on us and sure enough

249

00:09:49,350 --> 00:09:48,480

one of the satellites didn't turn off

250

00:09:51,509 --> 00:09:49,360

and they

251
00:09:54,070 --> 00:09:51,519
sent us up to attach those fly swatters

252
00:09:56,870 --> 00:09:54,080
to the end of the arm using that same

253
00:09:59,030 --> 00:09:56,880
strapping tool by the way that

254
00:10:00,550 --> 00:09:59,040
people ask me what's my favorite tool so

255
00:10:02,150 --> 00:10:00,560
this was our

256
00:10:03,910 --> 00:10:02,160
strapping tool here and then of course

257
00:10:06,389 --> 00:10:03,920
you heard about the strapping tool for

258
00:10:09,910 --> 00:10:06,399
closing the doors same thing so no

259
00:10:11,590 --> 00:10:09,920
question that was my favorite tool and

260
00:10:13,110 --> 00:10:11,600
we did give the beer party when we came

261
00:10:14,550 --> 00:10:13,120
back it was well worth it and the

262
00:10:17,670 --> 00:10:14,560
critical thing was

263
00:10:20,470 --> 00:10:17,680

i had my eva union card and so you know

264

00:10:23,829 --> 00:10:20,480

you you had your own eba experience

265

00:10:25,750 --> 00:10:23,839

yeah i was on the um first flight of

266

00:10:27,670 --> 00:10:25,760

endeavor where we went up to capture the

267

00:10:29,829 --> 00:10:27,680

intelsat satellite strap a new booster

268

00:10:32,310 --> 00:10:29,839

motor on it and send it on its way and

269

00:10:34,710 --> 00:10:32,320

that one is memorable and remarkable for

270

00:10:37,670 --> 00:10:34,720

all the things that went wrong before we

271

00:10:40,389 --> 00:10:37,680

finally successfully did get it deployed

272

00:10:41,750 --> 00:10:40,399

and that satellite this was in may of 92

273

00:10:44,630 --> 00:10:41,760

and that satellite carried the summer

274

00:10:47,190 --> 00:10:44,640

olympics from barcelona that same summer

275

00:10:49,829 --> 00:10:47,200

we we did the first and only three

276
00:10:51,430 --> 00:10:49,839
person eva sending three guys out the to

277
00:10:53,110 --> 00:10:51,440
to grab it with their hands because the

278
00:10:55,269 --> 00:10:53,120
capture bar for lots of reasons didn't

279
00:10:59,030 --> 00:10:55,279
work and it was ultimately successful

280
00:11:01,350 --> 00:10:59,040
but it was considered to be um

281
00:11:02,870 --> 00:11:01,360
we were called the cowboy eva crew

282
00:11:05,030 --> 00:11:02,880
because we did things that were somewhat

283
00:11:07,269 --> 00:11:05,040
unconventional and number one nasa

284
00:11:08,630 --> 00:11:07,279
headquarters was determined that

285
00:11:11,269 --> 00:11:08,640
they were not going to have any cowboy

286
00:11:13,190 --> 00:11:11,279
evas on this hst mission and number two

287
00:11:15,590 --> 00:11:13,200
they wanted only experienced eva crew

288
00:11:17,670 --> 00:11:15,600

members on it well as it turns out the

289

00:11:20,470 --> 00:11:17,680

eba experience in the office was kind of

290

00:11:23,030 --> 00:11:20,480

thin at that time so they got me and tom

291

00:11:25,030 --> 00:11:23,040

akers from the cowboy eva group on the

292

00:11:27,269 --> 00:11:25,040

mission

293

00:11:28,470 --> 00:11:27,279

i love this picture we look so young

294

00:11:31,190 --> 00:11:28,480

i love it

295

00:11:34,150 --> 00:11:31,200

yeah zero gravity helps that a lot yeah

296

00:11:36,470 --> 00:11:34,160

much better than botox actually um yeah

297

00:11:38,389 --> 00:11:36,480

the four of us with mustaches try to to

298

00:11:39,190 --> 00:11:38,399

convince story and claude to grow one

299

00:11:41,430 --> 00:11:39,200

but

300

00:11:44,230 --> 00:11:41,440

unsuccessful no we didn't give we didn't

301
00:11:45,269 --> 00:11:44,240
give kathy any any grief but in in any

302
00:11:46,310 --> 00:11:45,279
case

303
00:11:48,470 --> 00:11:46,320
um

304
00:11:50,150 --> 00:11:48,480
you know a tremendous amount of time

305
00:11:52,629 --> 00:11:50,160
training um

306
00:11:54,470 --> 00:11:52,639
you know claude nicolier who was a

307
00:11:57,829 --> 00:11:54,480
european astronaut because of course the

308
00:12:00,470 --> 00:11:57,839
the europeans had contributed to hubble

309
00:12:01,430 --> 00:12:00,480
and it was great and claude had

310
00:12:03,829 --> 00:12:01,440
uh

311
00:12:05,670 --> 00:12:03,839
flown actually with me on on my third

312
00:12:07,750 --> 00:12:05,680
flight his first flight and and had

313
00:12:10,310 --> 00:12:07,760

operated the arm for the deployment of

314

00:12:13,350 --> 00:12:10,320

eureka and and was you know he did it

315

00:12:16,150 --> 00:12:13,360

with the precision of a swiss watchmaker

316

00:12:17,670 --> 00:12:16,160

and uh so he he was it was great to have

317

00:12:18,949 --> 00:12:17,680

him on the flight

318

00:12:20,870 --> 00:12:18,959

um

319

00:12:23,269 --> 00:12:20,880

and

320

00:12:25,430 --> 00:12:23,279

we we actually introduced virtual

321

00:12:27,430 --> 00:12:25,440

reality as a training tool for the first

322

00:12:29,590 --> 00:12:27,440

time it was

323

00:12:32,790 --> 00:12:29,600

pretty clunky and the scenes only

324

00:12:35,350 --> 00:12:32,800

updated about once a second so you had

325

00:12:37,190 --> 00:12:35,360

to move really slowly as you moved

326
00:12:39,990 --> 00:12:37,200
around but you know you move pretty

327
00:12:41,269 --> 00:12:40,000
slowly when you're out doing eva

328
00:12:43,670 --> 00:12:41,279
um for

329
00:12:45,190 --> 00:12:43,680
the the spacewalkers of course the the

330
00:12:48,069 --> 00:12:45,200
main

331
00:12:49,829 --> 00:12:48,079
work goes on underwater

332
00:12:53,269 --> 00:12:49,839
um

333
00:12:54,550 --> 00:12:53,279
we were kind of unique here because

334
00:12:56,870 --> 00:12:54,560
we did our

335
00:12:58,310 --> 00:12:56,880
most of our eva training at the marshall

336
00:13:00,710 --> 00:12:58,320
space flight center because they had a

337
00:13:03,190 --> 00:13:00,720
really deep pool and the neutral

338
00:13:04,949 --> 00:13:03,200

buoyancy facility had not yet been built

339

00:13:08,470 --> 00:13:04,959

at johnson

340

00:13:10,310 --> 00:13:08,480

so it was it was really unique

341

00:13:13,590 --> 00:13:10,320

you remember we we would be away for a

342

00:13:16,230 --> 00:13:13,600

long time and and instead of training in

343

00:13:17,910 --> 00:13:16,240

houston going home every night we were

344

00:13:19,670 --> 00:13:17,920

staying at the resident and we'd get up

345

00:13:21,829 --> 00:13:19,680

early in the morning

346

00:13:24,310 --> 00:13:21,839

after breakfast we'd go and we'd all sit

347

00:13:25,910 --> 00:13:24,320

around the table with our trainers and

348

00:13:27,670 --> 00:13:25,920

you know they'd have the hubble models

349

00:13:29,110 --> 00:13:27,680

we'd go through in great detail this is

350

00:13:31,030 --> 00:13:29,120

what we're going to do today this is

351

00:13:33,110 --> 00:13:31,040

what we want to learn this is what we're

352

00:13:34,870 --> 00:13:33,120

investigating and then we

353

00:13:37,269 --> 00:13:34,880

do the uh

354

00:13:38,150 --> 00:13:37,279

the water run and and the two of us who

355

00:13:41,189 --> 00:13:38,160

were

356

00:13:45,269 --> 00:13:41,199

not in space suits would usually scuba

357

00:13:47,910 --> 00:13:45,279

for part of it and then afterwards we'd

358

00:13:49,590 --> 00:13:47,920

sit around and have a debrief then we'd

359

00:13:51,189 --> 00:13:49,600

all go to the gym then we'd have dinner

360

00:13:52,870 --> 00:13:51,199

and then we'd sit around in the hot tub

361

00:13:54,310 --> 00:13:52,880

and talk about what we were going to do

362

00:13:56,550 --> 00:13:54,320

the next day we were speaking in

363

00:13:58,310 --> 00:13:56,560

acronyms and waving our hands and anyone

364

00:13:59,670 --> 00:13:58,320

who wasn't connected with us left yeah

365

00:14:01,670 --> 00:13:59,680

the other people in the hot tub they

366

00:14:04,629 --> 00:14:01,680

never lasted

367

00:14:07,350 --> 00:14:04,639

but it really did build up a team and

368

00:14:09,030 --> 00:14:07,360

and um you know i'm i'm not saying that

369

00:14:11,910 --> 00:14:09,040

it was pleasant being away from the

370

00:14:13,670 --> 00:14:11,920

families for all that time but um

371

00:14:15,910 --> 00:14:13,680

it it was certainly

372

00:14:19,350 --> 00:14:15,920

it was the first mission and we knew how

373

00:14:21,590 --> 00:14:19,360

unique and important it was

374

00:14:25,189 --> 00:14:21,600

uh

375

00:14:28,230 --> 00:14:25,199

yeah you've all you've all seen this um

376

00:14:30,389 --> 00:14:28,240

the practicing on on the whiff pick and

377

00:14:32,710 --> 00:14:30,399

and you know just how to get yourself in

378

00:14:34,870 --> 00:14:32,720

in just the right position

379

00:14:37,750 --> 00:14:34,880

uh story referred to what we were doing

380

00:14:40,069 --> 00:14:37,760

as choreography which uh which we we

381

00:14:40,870 --> 00:14:40,079

kind of liked that idea that you know

382

00:14:41,990 --> 00:14:40,880

just

383

00:14:43,509 --> 00:14:42,000

to be

384

00:14:45,910 --> 00:14:43,519

one or two inches in a different

385

00:14:47,430 --> 00:14:45,920

position so you can't quite reach what

386

00:14:49,430 --> 00:14:47,440

you're trying to get to could make all

387

00:14:51,509 --> 00:14:49,440

the difference

388

00:14:54,230 --> 00:14:51,519

and of course we wanted to get uh

389

00:14:56,829 --> 00:14:54,240

experience with the actual hardware so

390

00:15:00,150 --> 00:14:56,839

we we spent a lot of time up up here at

391

00:15:05,189 --> 00:15:03,030

you know this this was hubble and and

392

00:15:06,790 --> 00:15:05,199

one of the incredible things working on

393

00:15:08,949 --> 00:15:06,800

it was

394

00:15:10,949 --> 00:15:08,959

everybody was working in the same

395

00:15:13,350 --> 00:15:10,959

direction um

396

00:15:15,430 --> 00:15:13,360

i know i had had experience

397

00:15:16,710 --> 00:15:15,440

working with marshall and johnson and

398

00:15:18,870 --> 00:15:16,720

there were always

399

00:15:20,790 --> 00:15:18,880

certain you know conflicts i don't know

400

00:15:22,870 --> 00:15:20,800

about your experience with with the

401
00:15:25,350 --> 00:15:22,880
military or whatever

402
00:15:28,310 --> 00:15:25,360
but um but none of that

403
00:15:29,430 --> 00:15:28,320
you know here everybody was was whatever

404
00:15:30,870 --> 00:15:29,440
it took

405
00:15:31,990 --> 00:15:30,880
um

406
00:15:33,910 --> 00:15:32,000
you know you've heard about the

407
00:15:35,990 --> 00:15:33,920
development of the new tools i mean we

408
00:15:37,269 --> 00:15:36,000
we could be in the water tank

409
00:15:40,389 --> 00:15:37,279
um

410
00:15:42,389 --> 00:15:40,399
you know if if my wrench had a you know

411
00:15:44,949 --> 00:15:42,399
instead of a 10 degree bend

412
00:15:46,870 --> 00:15:44,959
a 20 degree bend i could save a little

413
00:15:48,629 --> 00:15:46,880

time and have an easier access to that

414

00:15:50,870 --> 00:15:48,639

bolt and darned if the next week you'd

415

00:15:53,110 --> 00:15:50,880

come in and sure enough you'd have a new

416

00:15:55,110 --> 00:15:53,120

tool i mean the the

417

00:15:57,430 --> 00:15:55,120

it was just phenomenal

418

00:15:59,509 --> 00:15:57,440

and everything here remember we test

419

00:16:01,110 --> 00:15:59,519

every tool we had we had to test on

420

00:16:03,030 --> 00:16:01,120

every bolt

421

00:16:05,110 --> 00:16:03,040

and when we worked in the water tank the

422

00:16:06,389 --> 00:16:05,120

things didn't go as smoothly as they

423

00:16:08,949 --> 00:16:06,399

would in real life because it's been

424

00:16:10,230 --> 00:16:08,959

corroding in a chlorine pool forever and

425

00:16:11,269 --> 00:16:10,240

and you still have the weight even

426
00:16:13,030 --> 00:16:11,279
though you're floating in the pool you

427
00:16:14,550 --> 00:16:13,040
still have the weight of everything so

428
00:16:17,269 --> 00:16:14,560
pushing in the whiff pick and pushing in

429
00:16:19,590 --> 00:16:17,279
the co-star was really a muscular event

430
00:16:21,269 --> 00:16:19,600
you had to put a lot of effort behind it

431
00:16:22,870 --> 00:16:21,279
and we knew that wasn't going to be real

432
00:16:24,550 --> 00:16:22,880
and then we came up here and did fit

433
00:16:26,310 --> 00:16:24,560
checks and we watched those instruments

434
00:16:28,790 --> 00:16:26,320
being put into the high fidelity

435
00:16:30,310 --> 00:16:28,800
simulator but but they're then suspended

436
00:16:32,150 --> 00:16:30,320
from cranes because they're heavy

437
00:16:34,069 --> 00:16:32,160
they're not going to float here

438
00:16:35,829 --> 00:16:34,079

and so it's a combination of those two

439

00:16:37,430 --> 00:16:35,839

that made the mission successful

440

00:16:39,990 --> 00:16:37,440

and in particular the high fidelity

441

00:16:41,829 --> 00:16:40,000

simulator up here that we got a chance

442

00:16:43,749 --> 00:16:41,839

to fit everything that we could possibly

443

00:16:48,230 --> 00:16:43,759

fit on and get confidence it was going

444

00:16:52,790 --> 00:16:50,550

the first time we put

445

00:16:54,790 --> 00:16:52,800

the with pick in

446

00:16:56,470 --> 00:16:54,800

you know it's suspended and and we're

447

00:16:58,069 --> 00:16:56,480

we're pushing it in and it got about

448

00:16:59,829 --> 00:16:58,079

halfway in

449

00:17:01,590 --> 00:16:59,839

wouldn't go any further

450

00:17:02,790 --> 00:17:01,600

and you know they took it out it turned

451

00:17:05,590 --> 00:17:02,800

out that the

452

00:17:08,630 --> 00:17:05,600

the thermal covering on it uh the

453

00:17:10,230 --> 00:17:08,640

thermal uh you know the the kapton

454

00:17:12,789 --> 00:17:10,240

um

455

00:17:14,549 --> 00:17:12,799

with pick was sort of like that and they

456

00:17:17,510 --> 00:17:14,559

had put the

457

00:17:19,510 --> 00:17:17,520

covering at a on a diagonal

458

00:17:21,909 --> 00:17:19,520

and that's why it wouldn't wouldn't fit

459

00:17:24,710 --> 00:17:21,919

in and and they went back and and sure

460

00:17:27,189 --> 00:17:24,720

enough it turned out that with pick one

461

00:17:29,350 --> 00:17:27,199

had had that same problem because that's

462

00:17:31,110 --> 00:17:29,360

the way the drawing had been and so they

463

00:17:33,909 --> 00:17:31,120

fixed with pick one but they had never

464

00:17:35,990 --> 00:17:33,919

changed the drawing so we've picked two

465

00:17:37,830 --> 00:17:36,000

so they they quickly fixed that and and

466

00:17:39,909 --> 00:17:37,840

it went in and then whenever we tried to

467

00:17:41,510 --> 00:17:39,919

put co-stars remember co-star we'd hit a

468

00:17:43,590 --> 00:17:41,520

hard stop as well and it turned out

469

00:17:45,750 --> 00:17:43,600

there was a bolt head or something that

470

00:17:47,430 --> 00:17:45,760

was a 1g thing

471

00:17:49,110 --> 00:17:47,440

we didn't know if it was one g i mean

472

00:17:53,750 --> 00:17:49,120

the the

473

00:17:55,430 --> 00:17:53,760

to be a recessed bolt but everybody said

474

00:17:58,630 --> 00:17:55,440

well we built the high fidelity

475

00:18:00,150 --> 00:17:58,640

simulator to the same specs as as we

476
00:18:02,470 --> 00:18:00,160
built the original telescope so we

477
00:18:04,630 --> 00:18:02,480
didn't really know i guess when you took

478
00:18:07,190 --> 00:18:04,640
out the the first coaster then

479
00:18:09,909 --> 00:18:07,200
the photometer you could see that

480
00:18:11,510 --> 00:18:09,919
the bolt was recessed but

481
00:18:13,909 --> 00:18:11,520
you know when when you think about

482
00:18:15,990 --> 00:18:13,919
neither the weft pick nor the co-star

483
00:18:17,750 --> 00:18:16,000
went into the high fidelity simulator

484
00:18:19,750 --> 00:18:17,760
the first time we we

485
00:18:21,190 --> 00:18:19,760
went to install them

486
00:18:23,190 --> 00:18:21,200
and the other thing

487
00:18:24,789 --> 00:18:23,200
remember we had our helmets and and we

488
00:18:26,390 --> 00:18:24,799

wanted to see

489

00:18:28,630 --> 00:18:26,400

what would it look like at night how

490

00:18:31,350 --> 00:18:28,640

much visibility would we have at night

491

00:18:32,710 --> 00:18:31,360

so could you turn out all the lights in

492

00:18:35,110 --> 00:18:32,720

the room

493

00:18:36,950 --> 00:18:35,120

oh boy the safety people no way you

494

00:18:39,350 --> 00:18:36,960

can't possibly do that much too

495

00:18:40,950 --> 00:18:39,360

dangerous but this was hubble and and

496

00:18:43,110 --> 00:18:40,960

they did it and

497

00:18:45,510 --> 00:18:43,120

it was little things like that

498

00:18:46,470 --> 00:18:45,520

the other thing that i remember

499

00:18:48,870 --> 00:18:46,480

from

500

00:18:50,549 --> 00:18:48,880

on one of our our meetings

501
00:18:53,110 --> 00:18:50,559
one of our trips up here to goddard we

502
00:18:55,029 --> 00:18:53,120
got a message we we were to go down to

503
00:18:57,190 --> 00:18:55,039
nasa headquarters to meet with dan

504
00:19:00,070 --> 00:18:57,200
golden remember that

505
00:19:02,870 --> 00:19:00,080
so there were the seven of us

506
00:19:05,029 --> 00:19:02,880
in in his office facing him behind his

507
00:19:05,909 --> 00:19:05,039
desk and he just looked at us and he

508
00:19:07,909 --> 00:19:05,919
said

509
00:19:10,310 --> 00:19:07,919
i hope you realize that the future of

510
00:19:12,710 --> 00:19:10,320
nasa's human space flight program

511
00:19:15,990 --> 00:19:12,720
depends on the success of your mission

512
00:19:18,070 --> 00:19:16,000
so you know no pressure right

513
00:19:19,590 --> 00:19:18,080

people sort of asked us did we find

514

00:19:22,470 --> 00:19:19,600

extra prey i don't know how you felt

515

00:19:25,990 --> 00:19:22,480

about it i felt like we as the crew were

516

00:19:27,270 --> 00:19:26,000

shielded by milt and by other folks from

517

00:19:29,110 --> 00:19:27,280

a lot of the

518

00:19:30,870 --> 00:19:29,120

independent reviews and things that were

519

00:19:32,789 --> 00:19:30,880

going on outside of our training and we

520

00:19:33,669 --> 00:19:32,799

were largely left alone at least i felt

521

00:19:35,510 --> 00:19:33,679

we were

522

00:19:37,669 --> 00:19:35,520

to to train to learn what we needed to

523

00:19:39,830 --> 00:19:37,679

do to accomplish the mission

524

00:19:41,590 --> 00:19:39,840

yeah that's the thing the first thing

525

00:19:43,590 --> 00:19:41,600

that that any of these independent

526

00:19:45,110 --> 00:19:43,600

reviews would want to do is oh we got to

527

00:19:47,590 --> 00:19:45,120

go talk with the crew and after the

528

00:19:49,590 --> 00:19:47,600

first two or three we that was just

529

00:19:52,870 --> 00:19:49,600

going to take too much time so yeah we

530

00:19:55,110 --> 00:19:52,880

we were pretty well shielded

531

00:19:57,029 --> 00:19:55,120

let's move along

532

00:19:58,630 --> 00:19:57,039

so yeah this is all that always that

533

00:20:00,630 --> 00:19:58,640

exciting moment when by the way you're

534

00:20:03,270 --> 00:20:00,640

not normally planes are not allowed to

535

00:20:05,190 --> 00:20:03,280

fly over the uh the launch pad but they

536

00:20:07,350 --> 00:20:05,200

always make an exception when

537

00:20:09,750 --> 00:20:07,360

the astronauts come down in the t-38s

538

00:20:11,669 --> 00:20:09,760

they they love to see a circle around

539

00:20:13,750 --> 00:20:11,679

the launch pad

540

00:20:16,390 --> 00:20:13,760

and and uh

541

00:20:18,549 --> 00:20:16,400

yeah we did try on the first of december

542

00:20:20,710 --> 00:20:18,559

but the winds were too high it there was

543

00:20:23,110 --> 00:20:20,720

a total eclipse of the moon remember

544

00:20:25,510 --> 00:20:23,120

that night which well i'm an astronomer

545

00:20:27,750 --> 00:20:25,520

so i pay attention but what's that thing

546

00:20:30,149 --> 00:20:27,760

up there yeah

547

00:20:32,470 --> 00:20:30,159

so uh

548

00:20:34,710 --> 00:20:32,480

whether that was a bad omen for the

549

00:20:37,190 --> 00:20:34,720

first of december or a good omen for the

550

00:20:40,310 --> 00:20:37,200

success of our mission who knows but uh

551

00:20:42,149 --> 00:20:40,320

we did go up and um

552

00:20:45,110 --> 00:20:42,159

yeah i mean

553

00:20:48,630 --> 00:20:45,120

we were um we had all been in space

554

00:20:50,870 --> 00:20:48,640

before and and so we could really get

555

00:20:52,470 --> 00:20:50,880

right to work we knew what we were doing

556

00:20:53,830 --> 00:20:52,480

there's one moment that i remember

557

00:20:55,590 --> 00:20:53,840

vividly and that's when we were in

558

00:20:57,590 --> 00:20:55,600

quarantine in houston

559

00:20:59,830 --> 00:20:57,600

just before we left we were on a sleep

560

00:21:00,950 --> 00:20:59,840

shift so we were up it got up at like

561

00:21:02,789 --> 00:21:00,960

two o'clock in the morning was our

562

00:21:04,630 --> 00:21:02,799

normal wake-up and it was the morning

563

00:21:06,230 --> 00:21:04,640

that we left to fly to the cape we all

564

00:21:07,990 --> 00:21:06,240

went outside at about three o'clock in

565

00:21:10,070 --> 00:21:08,000

the morning and watched hubble fly over

566

00:21:12,390 --> 00:21:10,080

remember that and thinking in three days

567

00:21:14,630 --> 00:21:12,400

we're going to be right there

568

00:21:16,870 --> 00:21:14,640

well the other story about that was when

569

00:21:18,950 --> 00:21:16,880

we were waiting uh

570

00:21:20,950 --> 00:21:18,960

we were up we were in the shuttle but

571

00:21:23,270 --> 00:21:20,960

all the the spectators were waiting and

572

00:21:25,270 --> 00:21:23,280

my brother who's a space nut told me

573

00:21:27,510 --> 00:21:25,280

about this he said shortly before i

574

00:21:29,029 --> 00:21:27,520

launched they all saw hubble fly over

575

00:21:30,710 --> 00:21:29,039

and they said that gave them a good

576

00:21:32,390 --> 00:21:30,720

feeling because they figured nasa knew

577

00:21:33,750 --> 00:21:32,400

what they were doing you know

578

00:21:36,230 --> 00:21:33,760

everything worked

579

00:21:38,070 --> 00:21:36,240

but yeah we had we had four space suits

580

00:21:40,950 --> 00:21:38,080

because we were all different sizes so

581

00:21:44,630 --> 00:21:40,960

we really couldn't and so

582

00:21:47,590 --> 00:21:44,640

the airlock was was pretty uh crammed up

583

00:21:48,549 --> 00:21:47,600

we talked a lot about tools and and the

584

00:21:50,789 --> 00:21:48,559

tools

585

00:21:53,029 --> 00:21:50,799

you know just absolutely uh

586

00:21:54,789 --> 00:21:53,039

extraordinary and and you you heard the

587

00:21:57,270 --> 00:21:54,799

story about how

588

00:21:59,350 --> 00:21:57,280

um not too many months before the flight

589

00:22:01,830 --> 00:21:59,360

we we had the idea

590

00:22:03,430 --> 00:22:01,840

you know instead of having to go out to

591

00:22:06,310 --> 00:22:03,440

the after the shuttle

592

00:22:08,710 --> 00:22:06,320

load up with the tools do our work go

593

00:22:11,110 --> 00:22:08,720

back put the tools in the tool chest and

594

00:22:14,149 --> 00:22:11,120

then come back in wouldn't it be easier

595

00:22:15,669 --> 00:22:14,159

if we had all the tools inside

596

00:22:17,590 --> 00:22:15,679

and

597

00:22:19,190 --> 00:22:17,600

normally the response would have been no

598

00:22:21,190 --> 00:22:19,200

way we've done the weight and balance

599

00:22:23,190 --> 00:22:21,200

everything is checked we can't all the

600

00:22:25,029 --> 00:22:23,200

drawings are done but again this was

601
00:22:25,750 --> 00:22:25,039
hubble and darned if they didn't do it

602
00:22:27,190 --> 00:22:25,760
and

603
00:22:29,110 --> 00:22:27,200
that first day when we couldn't get the

604
00:22:30,470 --> 00:22:29,120
doors closed that really made a

605
00:22:32,470 --> 00:22:30,480
difference because

606
00:22:34,630 --> 00:22:32,480
we were out over eight hours and i know

607
00:22:37,590 --> 00:22:34,640
my electrical power was starting to go

608
00:22:39,669 --> 00:22:37,600
off the the curve so

609
00:22:41,909 --> 00:22:39,679
uh but one thing we made sure is that

610
00:22:43,909 --> 00:22:41,919
that every tool from that was inside the

611
00:22:46,310 --> 00:22:43,919
crew module that we would need was moved

612
00:22:48,149 --> 00:22:46,320
into the airlock before we depressed it

613
00:22:49,669 --> 00:22:48,159

so we did have access to every single

614

00:22:51,350 --> 00:22:49,679

tool it made a little crowded in the

615

00:22:53,350 --> 00:22:51,360

airlock but we made sure that that was

616

00:22:54,950 --> 00:22:53,360

the case every single day

617

00:22:56,310 --> 00:22:54,960

and of course every one of those tools

618

00:22:58,470 --> 00:22:56,320

has to be

619

00:23:01,350 --> 00:22:58,480

tethered and just learning how to do all

620

00:23:03,190 --> 00:23:01,360

that was a big difference

621

00:23:04,310 --> 00:23:03,200

taking care of our suits

622

00:23:06,470 --> 00:23:04,320

[Music]

623

00:23:08,470 --> 00:23:06,480

i guess you had already been trained on

624

00:23:09,590 --> 00:23:08,480

multiple evas i i

625

00:23:11,270 --> 00:23:09,600

had

626

00:23:12,950 --> 00:23:11,280

there are a lot of special procedures

627

00:23:15,590 --> 00:23:12,960

when you have to use your spacesuits

628

00:23:17,350 --> 00:23:15,600

more than once on a mission

629

00:23:19,270 --> 00:23:17,360

and

630

00:23:21,990 --> 00:23:19,280

the other thing you know after they they

631

00:23:24,390 --> 00:23:22,000

were very interested in

632

00:23:27,270 --> 00:23:24,400

it had been determined that doing five

633

00:23:29,669 --> 00:23:27,280

evas in a row was too much for just a

634

00:23:31,110 --> 00:23:29,679

normal two-person crew that's why there

635

00:23:34,549 --> 00:23:31,120

were four of us and

636

00:23:37,270 --> 00:23:34,559

two eva crews but the evas were so well

637

00:23:38,950 --> 00:23:37,280

designed you know the the tasks that we

638

00:23:41,190 --> 00:23:38,960

had to do

639

00:23:43,510 --> 00:23:41,200

i know i i felt probably you at the end

640

00:23:45,269 --> 00:23:43,520

of every eva if i think if i had had to

641

00:23:47,830 --> 00:23:45,279

go out the next day i could have done it

642

00:23:49,669 --> 00:23:47,840

i think we all felt that way

643

00:23:51,750 --> 00:23:49,679

ed mentioned that story was anxious to

644

00:23:54,470 --> 00:23:51,760

get out early on the first day and we

645

00:23:56,630 --> 00:23:54,480

did every single day because as designed

646

00:23:58,310 --> 00:23:56,640

our eva we would have been going eva

647

00:24:00,230 --> 00:23:58,320

during the time the shuttle passed

648

00:24:01,669 --> 00:24:00,240

through the south atlantic anomaly which

649

00:24:04,710 --> 00:24:01,679

would have increased our radiation

650

00:24:06,390 --> 00:24:04,720

exposure significantly and so every

651
00:24:08,070 --> 00:24:06,400
single day we got up and tried to get

652
00:24:10,310 --> 00:24:08,080
out earlier than the flight plan called

653
00:24:11,909 --> 00:24:10,320
for which i'm sure drove milton's teams

654
00:24:13,990 --> 00:24:11,919
crazy because they then had to replay in

655
00:24:16,230 --> 00:24:14,000
all the maneuvers as we were leaving but

656
00:24:17,750 --> 00:24:16,240
we did manage to get out do all the evas

657
00:24:20,070 --> 00:24:17,760
and get back in before we pass through

658
00:24:23,029 --> 00:24:20,080
that south atlantic anomaly the crews

659
00:24:24,710 --> 00:24:23,039
that were not going eva did try to do

660
00:24:26,310 --> 00:24:24,720
everything in the morning so the eva

661
00:24:28,470 --> 00:24:26,320
team only had to get up eat their

662
00:24:30,470 --> 00:24:28,480
breakfast get dressed and then climb in

663
00:24:32,789 --> 00:24:30,480

the suits they were prepared for them

664

00:24:34,470 --> 00:24:32,799

no one else even had a chance to eat

665

00:24:36,789 --> 00:24:34,480

so we were very busy in trying to do

666

00:24:38,789 --> 00:24:36,799

that and i think for those five days we

667

00:24:40,070 --> 00:24:38,799

overall as a crew didn't eat very well

668

00:24:42,149 --> 00:24:40,080

and didn't take care of ourselves very

669

00:24:44,149 --> 00:24:42,159

well because we were totally focused on

670

00:24:45,990 --> 00:24:44,159

on that timeline and getting things done

671

00:24:48,390 --> 00:24:46,000

we did rest a little bit after we got it

672

00:24:50,630 --> 00:24:48,400

deployed we got a day i think to sort of

673

00:24:52,470 --> 00:24:50,640

recoup before we de-orbited but it was a

674

00:24:54,549 --> 00:24:52,480

busy busy time up there for everybody

675

00:24:57,029 --> 00:24:54,559

well i'll take exception to the eating i

676

00:25:00,070 --> 00:24:57,039

i always ate ate a lot jeff ain't fine

677

00:25:01,750 --> 00:25:00,080

especially rest of us did not um i i

678

00:25:03,029 --> 00:25:01,760

always eat a big breakfast and i knew i

679

00:25:04,789 --> 00:25:03,039

wasn't going to get anything to eat for

680

00:25:06,549 --> 00:25:04,799

the next eight hours so i always made

681

00:25:08,149 --> 00:25:06,559

sure that that i that i got a good

682

00:25:09,029 --> 00:25:08,159

breakfast

683

00:25:10,149 --> 00:25:09,039

um

684

00:25:11,990 --> 00:25:10,159

yeah we

685

00:25:15,190 --> 00:25:12,000

kathy mentioned radiation you know

686

00:25:17,269 --> 00:25:15,200

hubble hubble is uh higher than than any

687

00:25:19,350 --> 00:25:17,279

other shuttle orbit so

688

00:25:21,909 --> 00:25:19,360

we were sort of scraping the inner edge

689

00:25:23,750 --> 00:25:21,919

of the radiation belts and it was

690

00:25:26,310 --> 00:25:23,760

predicted we were going to get about 10

691

00:25:29,029 --> 00:25:26,320

times the normal dose which is still

692

00:25:30,950 --> 00:25:29,039

nothing to get concerned about but they

693

00:25:33,269 --> 00:25:30,960

they did have us wear special uh

694

00:25:34,310 --> 00:25:33,279

radiation monitors at various places in

695

00:25:36,310 --> 00:25:34,320

our body

696

00:25:38,549 --> 00:25:36,320

just so that we could um

697

00:25:41,510 --> 00:25:38,559

that they they could get a better sense

698

00:25:44,070 --> 00:25:41,520

of of what the dosage really was

699

00:25:45,269 --> 00:25:44,080

and then the typical process of of going

700

00:25:56,549 --> 00:25:45,279

in

701

00:25:58,310 --> 00:25:56,559

get pretty cold so we wore

702

00:25:59,909 --> 00:25:58,320

underneath that a set of thermal

703

00:26:01,590 --> 00:25:59,919

underwear sort of sort of like you wear

704

00:26:03,510 --> 00:26:01,600

when you go skiing except it's made of

705

00:26:05,510 --> 00:26:03,520

nomex because of course the the

706

00:26:08,470 --> 00:26:05,520

atmosphere inside a spacesuit is pure

707

00:26:10,070 --> 00:26:08,480

oxygen and so flammability is is a big

708

00:26:12,310 --> 00:26:10,080

concern

709

00:26:15,830 --> 00:26:12,320

and then you know getting in the suits

710

00:26:18,630 --> 00:26:15,840

uh it's a it's a kind of a squeeze

711

00:26:20,470 --> 00:26:18,640

um you get some sense there of of how

712

00:26:22,310 --> 00:26:20,480

many tools we had to carry out and of

713

00:26:24,470 --> 00:26:22,320

course you have to do a pre-breathe of

714

00:26:26,950 --> 00:26:24,480

pure oxygen for 40 minutes before you

715

00:26:30,950 --> 00:26:26,960

can depress your suit

716

00:26:36,950 --> 00:26:32,470

the movie was supposed to start

717

00:26:44,549 --> 00:26:38,230

i don't think we'll show the entire

718

00:26:50,789 --> 00:26:46,310

just maybe take us through the first two

719

00:26:56,310 --> 00:26:53,750

um

720

00:26:57,909 --> 00:26:56,320

nasa graphics get more and more fancy

721

00:27:00,630 --> 00:26:57,919

but anyway yeah

722

00:27:02,630 --> 00:27:00,640

4am launch um

723

00:27:08,310 --> 00:27:02,640

it's like watching a

724

00:27:14,789 --> 00:27:13,029

and that's the earth from 600 kilometers

725

00:27:16,310 --> 00:27:14,799

starting right away kathy was having a

726

00:27:18,310 --> 00:27:16,320

bad hair day

727

00:27:21,190 --> 00:27:18,320

every day every day is better than his

728

00:27:25,190 --> 00:27:21,200

story does as well yeah power tools of

729

00:27:29,190 --> 00:27:26,870

pilot and commander they've got to do

730

00:27:31,110 --> 00:27:29,200

the rendezvous find hubble

731

00:27:32,789 --> 00:27:31,120

capture it

732

00:27:34,470 --> 00:27:32,799

yeah it's really exciting when you first

733

00:27:36,630 --> 00:27:34,480

see it as a little point of light and

734

00:27:40,549 --> 00:27:36,640

then it gets bigger and bigger

735

00:27:44,389 --> 00:27:42,310

and of course we didn't have the hd

736

00:27:47,350 --> 00:27:44,399

cameras that they take up nowadays so

737

00:27:50,310 --> 00:27:47,360

this is all uh old-fashioned resolution

738

00:27:56,950 --> 00:27:50,320

but now getting

739

00:27:59,269 --> 00:27:57,620

and then

740

00:28:01,510 --> 00:27:59,279

[Music]

741

00:28:03,590 --> 00:28:01,520

you know at this point

742

00:28:05,430 --> 00:28:03,600

is when it sort of hits you

743

00:28:09,190 --> 00:28:05,440

all that preparation

744

00:28:11,029 --> 00:28:09,200

and now the very first day of the first

745

00:28:12,549 --> 00:28:11,039

eva

746

00:28:17,430 --> 00:28:12,559

and

747

00:28:20,070 --> 00:28:17,440

changed the procedure that was

748

00:28:22,549 --> 00:28:20,080

originally recommended for for doing the

749

00:28:25,430 --> 00:28:22,559

uh the gyros where

750

00:28:27,350 --> 00:28:25,440

instead of having to remove the the sun

751

00:28:28,310 --> 00:28:27,360

shades which would have taken a lot more

752

00:28:31,750 --> 00:28:28,320

time

753

00:28:32,630 --> 00:28:31,760

i sort of inserted story underneath and

754

00:28:35,029 --> 00:28:32,640

and then

755

00:28:38,470 --> 00:28:35,039

i would loosen the bolts he would remove

756

00:28:39,350 --> 00:28:38,480

the the rsu package and

757

00:28:40,310 --> 00:28:39,360

um

758

00:28:41,909 --> 00:28:40,320

then

759

00:28:44,230 --> 00:28:41,919

hand it to me i'd hand him the new one

760

00:28:46,310 --> 00:28:44,240

he'd put it in place i'd i'd put the

761

00:28:48,630 --> 00:28:46,320

bolts on and then when we're all

762

00:28:50,230 --> 00:28:48,640

finished very gently because remember he

763

00:28:53,190 --> 00:28:50,240

can't see what's behind him and he's

764

00:28:55,430 --> 00:28:53,200

inside all of this complex machinery and

765

00:28:57,029 --> 00:28:55,440

none of us wanted to be known as someone

766

00:28:58,950 --> 00:28:57,039

who broke something on hubble that

767

00:29:01,590 --> 00:28:58,960

wasn't already broken that would be a

768

00:29:03,669 --> 00:29:01,600

bad deal

769

00:29:05,830 --> 00:29:03,679

and those are the the thermal enclosures

770

00:29:07,830 --> 00:29:05,840

that that you heard about

771

00:29:11,510 --> 00:29:07,840

this is now putting the old

772

00:29:16,470 --> 00:29:13,830

we all cross train for every single task

773

00:29:18,710 --> 00:29:16,480

so if during the night and and this is

774

00:29:20,710 --> 00:29:18,720

the door problem by the way we'll we'll

775

00:29:22,310 --> 00:29:20,720

talk about that in detail i think maybe

776

00:29:25,350 --> 00:29:22,320

this afternoon okay

777

00:29:27,029 --> 00:29:25,360

if the team had decided to reschedule

778

00:29:28,389 --> 00:29:27,039

events for the next day and say oh we're

779

00:29:30,310 --> 00:29:28,399

not doing solar rays today we're doing

780

00:29:36,870 --> 00:29:30,320

something else we were all prepared to

781

00:29:41,750 --> 00:29:38,070

um

782

00:29:43,750 --> 00:29:41,760

yeah i just you know milt described his

783

00:29:47,590 --> 00:29:43,760

feeling when he heard that the doors

784

00:29:50,389 --> 00:29:47,600

didn't close when um when i i

785

00:29:51,669 --> 00:29:50,399

my son my two sons said jeff you missed

786

00:29:53,430 --> 00:29:51,679

a real opportunity you should have

787

00:29:55,430 --> 00:29:53,440

called down houston we have a problem

788

00:29:57,350 --> 00:29:55,440

but i didn't think of that at the time

789

00:29:59,029 --> 00:29:57,360

you you take the solar array so you just

790

00:30:01,269 --> 00:29:59,039

saw the first solar array roll up

791

00:30:03,430 --> 00:30:01,279

correctly and this is the second one and

792

00:30:05,990 --> 00:30:03,440

as soon as covey saw the bla the bank

793

00:30:07,750 --> 00:30:06,000

blankets go kind of slack he stopped the

794

00:30:09,269 --> 00:30:07,760

retraction it's because the there was a

795

00:30:11,750 --> 00:30:09,279

kink in the buy stem that wouldn't let

796

00:30:13,190 --> 00:30:11,760

it roll up so tom and i knew before we

797

00:30:15,430 --> 00:30:13,200

went out that day that we were going to

798

00:30:17,110 --> 00:30:15,440

be jettisoning that solar array but it

799

00:30:18,630 --> 00:30:17,120

was in the plan and we had probably

800

00:30:20,070 --> 00:30:18,640

thought of that before

801
00:30:21,269 --> 00:30:20,080
we knew it yeah we had a plan to do it

802
00:30:23,909 --> 00:30:21,279
we knew for certain that it was going to

803
00:30:26,310 --> 00:30:23,919
happen so we disconnected the solar ray

804
00:30:28,149 --> 00:30:26,320
in darkness because that

805
00:30:30,149 --> 00:30:28,159
made the connection dead and then had to

806
00:30:31,750 --> 00:30:30,159
release it in light i did take the

807
00:30:33,190 --> 00:30:31,760
tether off and i made that call to the

808
00:30:35,029 --> 00:30:33,200
ground tether is off so you wouldn't

809
00:30:37,190 --> 00:30:35,039
think i was going to be

810
00:30:39,110 --> 00:30:37,200
tied to it i just released it i didn't

811
00:30:41,269 --> 00:30:39,120
push it off i just let it go we backed

812
00:30:43,750 --> 00:30:41,279
away from it and then you can see when

813
00:30:46,470 --> 00:30:43,760

uh sox fired the jets to move us away

814

00:30:49,029 --> 00:30:46,480

from it that it uh impinged on the array

815

00:30:51,669 --> 00:30:49,039

and it just started flapping cruising it

816

00:30:53,669 --> 00:30:51,679

was incredible we were mesmerized it was

817

00:30:55,669 --> 00:30:53,679

turning somersaults i remember finally

818

00:30:57,110 --> 00:30:55,679

tom called up from the cargo bay said

819

00:31:00,230 --> 00:30:57,120

hey aren't we supposed to be doing some

820

00:31:01,990 --> 00:31:00,240

useful work oh yeah snap out

821

00:31:04,149 --> 00:31:02,000

so we installed the new solo arrays on

822

00:31:05,830 --> 00:31:04,159

and one of the connections we drove by

823

00:31:08,070 --> 00:31:05,840

hand because it was so critical that we

824

00:31:11,350 --> 00:31:08,080

didn't cross thread it and totally

825

00:31:13,750 --> 00:31:11,360

kill the telescope yeah and this is the

826

00:31:16,870 --> 00:31:13,760

the first of the optical

827

00:31:20,070 --> 00:31:16,880

corrections uh putting in the the wiff

828

00:31:21,990 --> 00:31:20,080

pick and for all of the potential

829

00:31:23,830 --> 00:31:22,000

problems that

830

00:31:27,110 --> 00:31:23,840

we were prepared for

831

00:31:29,430 --> 00:31:27,120

it just worked beautifully and and

832

00:31:31,029 --> 00:31:29,440

by and large that was true about the

833

00:31:32,549 --> 00:31:31,039

whole mission we did have those few

834

00:31:34,549 --> 00:31:32,559

snags and

835

00:31:36,789 --> 00:31:34,559

uh again if we have a chance later we'll

836

00:31:39,110 --> 00:31:36,799

talk about the great screw chase on on

837

00:31:40,630 --> 00:31:39,120

the final eva day that was that was

838

00:31:41,750 --> 00:31:40,640

pretty exciting

839

00:31:43,430 --> 00:31:41,760

um

840

00:31:45,029 --> 00:31:43,440

but bringing this up

841

00:31:48,950 --> 00:31:45,039

and i think we'll we'll show co-star and

842

00:31:52,789 --> 00:31:50,950

i would have bet money that at least one

843

00:31:54,630 --> 00:31:52,799

of these instruments wouldn't have gone

844

00:31:56,070 --> 00:31:54,640

in on the first attempt and that we'd be

845

00:31:57,990 --> 00:31:56,080

do some we would be doing some

846

00:32:00,310 --> 00:31:58,000

macgyvering up there to make it work but

847

00:32:01,909 --> 00:32:00,320

they were all i mean we had hacksaws and

848

00:32:04,950 --> 00:32:01,919

hammers and whatever it was going to

849

00:32:07,190 --> 00:32:04,960

take we were ready

850

00:32:08,389 --> 00:32:07,200

and i actually had had a call from

851
00:32:10,389 --> 00:32:08,399
someone i

852
00:32:12,549 --> 00:32:10,399
won't name but high up at the space

853
00:32:15,430 --> 00:32:12,559
telescope science institute

854
00:32:18,149 --> 00:32:15,440
a fellow astronomer telling me uh you

855
00:32:20,470 --> 00:32:18,159
know if you can only get in either with

856
00:32:22,470 --> 00:32:20,480
pick or co-star we'll consider the

857
00:32:24,549 --> 00:32:22,480
mission a success but don't tell anyone

858
00:32:27,029 --> 00:32:24,559
i said that

859
00:32:28,870 --> 00:32:27,039
and we didn't and we did them both

860
00:32:30,710 --> 00:32:28,880
and then the magnetometers of course

861
00:32:32,789 --> 00:32:30,720
simple magnetometers they're never going

862
00:32:34,630 --> 00:32:32,799
to fail and there's two of them anyway

863
00:32:36,710 --> 00:32:34,640

and they both failed and you couldn't

864

00:32:38,549 --> 00:32:36,720

remove them so we had to put new ones on

865

00:32:40,630 --> 00:32:38,559

top of the old ones disconnect the

866

00:32:43,029 --> 00:32:40,640

wiring from the old ones wire up the new

867

00:32:45,430 --> 00:32:43,039

ones and now kathy and tom are going to

868

00:32:48,389 --> 00:32:45,440

complete the optical repairs

869

00:32:51,110 --> 00:32:48,399

this is eva day four when i came in from

870

00:32:52,600 --> 00:32:51,120

eva 2 i ended up with an ear block

871

00:32:53,990 --> 00:32:52,610

and so i was sort of a

872

00:32:55,909 --> 00:32:54,000

[Music]

873

00:32:57,269 --> 00:32:55,919

on the injured reserve for the next day

874

00:32:59,750 --> 00:32:57,279

and it wasn't clear what i was whether i

875

00:33:01,029 --> 00:32:59,760

was going to get eba for but um they did

876

00:33:02,950 --> 00:33:01,039

let me go out

877

00:33:06,149 --> 00:33:02,960

tom is inside the telescope and he's

878

00:33:08,789 --> 00:33:06,159

directing mostly claude but also me on

879

00:33:10,310 --> 00:33:08,799

uh how to hold it and up down right left

880

00:33:12,070 --> 00:33:10,320

in order to get it in i mean it's a

881

00:33:13,909 --> 00:33:12,080

tight fit look

882

00:33:15,509 --> 00:33:13,919

and it just it just floated in it didn't

883

00:33:17,430 --> 00:33:15,519

have to do anything to it i just sort of

884

00:33:19,029 --> 00:33:17,440

put my hands on it and it just sort of

885

00:33:20,870 --> 00:33:19,039

it wanted to go in it just floated

886

00:33:23,110 --> 00:33:20,880

straight in there and then tom latched

887

00:33:25,269 --> 00:33:23,120

it down

888

00:33:26,950 --> 00:33:25,279

we also put some new memory on the

889

00:33:29,509 --> 00:33:26,960

computers

890

00:33:31,669 --> 00:33:29,519

up there and some other cats and dogs

891

00:33:34,070 --> 00:33:31,679

some other small things that we did

892

00:33:36,389 --> 00:33:34,080

while we were up there

893

00:33:37,509 --> 00:33:36,399

so i think we'll we'll move on

894

00:33:39,990 --> 00:33:37,519

um

895

00:33:42,149 --> 00:33:40,000

after installing with pick uh we we had

896

00:33:44,870 --> 00:33:42,159

to wait you don't get too much free time

897

00:33:46,950 --> 00:33:44,880

out out there but uh we we had enough

898

00:33:48,230 --> 00:33:46,960

time that i asked claude to fly me out

899

00:33:50,549 --> 00:33:48,240

over the um

900

00:33:52,470 --> 00:33:50,559

the wing and and they had let us take

901
00:33:54,470 --> 00:33:52,480
one of the apollo hasselblad i think

902
00:33:56,710 --> 00:33:54,480
that may have been the last time one of

903
00:33:59,590 --> 00:33:56,720
those hustle bloods flew but we wanted

904
00:34:01,669 --> 00:33:59,600
to take one outside so

905
00:34:04,149 --> 00:34:01,679
just to share with people what it what

906
00:34:06,470 --> 00:34:04,159
it looked like to be outside servicing

907
00:34:08,950 --> 00:34:06,480
hubble you can see story up there on the

908
00:34:11,030 --> 00:34:08,960
other side and of course it's a real

909
00:34:14,230 --> 00:34:11,040
wide angle camera so it's all distorted

910
00:34:15,510 --> 00:34:14,240
the earth is not flat believe me

911
00:34:17,750 --> 00:34:15,520
and the orbiter's not shaped like a

912
00:34:20,069 --> 00:34:17,760
banana right

913
00:34:21,909 --> 00:34:20,079

although i i will say from our orbit

914

00:34:24,869 --> 00:34:21,919

normally we talk about going around

915

00:34:27,510 --> 00:34:24,879

every every 90 minutes 16 orbits a day

916

00:34:29,669 --> 00:34:27,520

but we we went around every 95 minutes

917

00:34:32,310 --> 00:34:29,679

because of kepler's laws it they really

918

00:34:33,589 --> 00:34:32,320

work and you know 15 orbits a day but

919

00:34:36,149 --> 00:34:33,599

still

920

00:34:37,909 --> 00:34:36,159

and every once in a while it's just so

921

00:34:39,589 --> 00:34:37,919

beautiful up there i mean the sun i

922

00:34:41,909 --> 00:34:39,599

don't know if this is a sunrise or a

923

00:34:43,829 --> 00:34:41,919

sunset but you just gotta

924

00:34:45,750 --> 00:34:43,839

you know i can't say smell the roses

925

00:34:47,990 --> 00:34:45,760

because you couldn't smell anything but

926
00:34:48,869 --> 00:34:48,000
just watch watch some of the beauty up

927
00:34:50,869 --> 00:34:48,879
there

928
00:34:53,510 --> 00:34:50,879
and that's that's the uh kind of the

929
00:34:55,430 --> 00:34:53,520
image that um

930
00:34:58,630 --> 00:34:55,440
hubble is big and particularly when

931
00:35:01,270 --> 00:34:58,640
you're looking at it from the bottom

932
00:35:02,790 --> 00:35:01,280
and uh you know to when story and i got

933
00:35:05,190 --> 00:35:02,800
to go up to the very top of the

934
00:35:07,270 --> 00:35:05,200
telescope that was just um

935
00:35:09,589 --> 00:35:07,280
you know 50 feet may not sound like a

936
00:35:11,430 --> 00:35:09,599
long way from the orbiter but it sure

937
00:35:12,790 --> 00:35:11,440
sure felt that way and it's not not

938
00:35:14,150 --> 00:35:12,800

where you want to be if you have a sense

939

00:35:16,710 --> 00:35:14,160

of vertigo

940

00:35:19,910 --> 00:35:16,720

long long way down

941

00:35:21,990 --> 00:35:19,920

um yeah just extraordinary experiences

942

00:35:24,230 --> 00:35:22,000

that i think none of us will forget for

943

00:35:25,190 --> 00:35:24,240

the rest of our lives

944

00:35:27,109 --> 00:35:25,200

and

945

00:35:29,030 --> 00:35:27,119

we call this our finished jewel it sat

946

00:35:30,710 --> 00:35:29,040

in the cargo bay for a full day or more

947

00:35:32,069 --> 00:35:30,720

before we deployed it

948

00:35:33,270 --> 00:35:32,079

so we would just go up to the mid deck

949

00:35:35,270 --> 00:35:33,280

and the flight deck and just look out

950

00:35:37,270 --> 00:35:35,280

the back window and just stare at it so

951

00:35:39,430 --> 00:35:37,280

the only the only other thing i'll share

952

00:35:41,829 --> 00:35:39,440

you know you you heard from from ed

953

00:35:43,349 --> 00:35:41,839

about when when they discovered that the

954

00:35:45,430 --> 00:35:43,359

pictures

955

00:35:47,510 --> 00:35:45,440

we're coming back and we're working but

956

00:35:49,750 --> 00:35:47,520

but we didn't know that

957

00:35:51,589 --> 00:35:49,760

but i'll never forget it was it was new

958

00:35:53,910 --> 00:35:51,599

year's eve and so no public

959

00:35:55,670 --> 00:35:53,920

announcements had been made but

960

00:35:57,030 --> 00:35:55,680

we were cleaning up from a party it was

961

00:35:59,430 --> 00:35:57,040

about one o'clock in the morning the

962

00:36:01,270 --> 00:35:59,440

phone rang it was a an old astronomer

963

00:36:02,790 --> 00:36:01,280

friend at the at the space telescope

964

00:36:04,470 --> 00:36:02,800

science institute

965

00:36:06,230 --> 00:36:04,480

uh and after

966

00:36:08,069 --> 00:36:06,240

you know wishing each other and uh happy

967

00:36:09,510 --> 00:36:08,079

new year he said you know jeff you have

968

00:36:11,349 --> 00:36:09,520

any champagne

969

00:36:13,750 --> 00:36:11,359

and yeah we had half a bottle still in

970

00:36:15,030 --> 00:36:13,760

the in the refrigerator so i said well

971

00:36:17,030 --> 00:36:15,040

we're really not supposed to tell

972

00:36:19,270 --> 00:36:17,040

anybody because a certain politician

973

00:36:21,510 --> 00:36:19,280

wants to make an announcement publicly

974

00:36:23,670 --> 00:36:21,520

in a few days but we figured that the

975

00:36:26,950 --> 00:36:23,680

crew ought to know that you know we've

976
00:36:28,230 --> 00:36:26,960
got the pictures back and it works which

977
00:36:29,430 --> 00:36:28,240
of course

978
00:36:32,310 --> 00:36:29,440
uh

979
00:36:34,470 --> 00:36:32,320
we all knew but that was the

980
00:36:36,710 --> 00:36:34,480
because we of course knew that that we

981
00:36:38,950 --> 00:36:36,720
had gone up and done our job

982
00:36:41,589 --> 00:36:38,960
uh and many people had felt that this

983
00:36:42,950 --> 00:36:41,599
was such a complex mission that i mean

984
00:36:44,950 --> 00:36:42,960
at one point they were talking you know

985
00:36:46,390 --> 00:36:44,960
maybe they should split it into two

986
00:36:49,589 --> 00:36:46,400
missions because there were so many

987
00:36:51,190 --> 00:36:49,599
things we had to do and uh you know but

988
00:36:53,910 --> 00:36:51,200

but we knew that

989

00:36:55,990 --> 00:36:53,920

all everything we had done worked and

990

00:36:57,589 --> 00:36:56,000

would the optics actually work and so

991

00:36:59,430 --> 00:36:57,599

that was um

992

00:37:01,510 --> 00:36:59,440

you know the rest as they say is is

993

00:37:03,510 --> 00:37:01,520

history it's um

994

00:37:05,349 --> 00:37:03,520

something i think uh

995

00:37:08,069 --> 00:37:05,359

you know i look back on it both as an

996

00:37:09,829 --> 00:37:08,079

astronomer and an astronaut as to have

997

00:37:12,870 --> 00:37:09,839

been able to put my

998

00:37:14,390 --> 00:37:12,880

two hands on hubble in space uh

999

00:37:15,520 --> 00:37:14,400

you know one of the high points of my

1000

00:37:17,109 --> 00:37:15,530

life

1001
00:37:19,430 --> 00:37:17,119

[Music]

1002
00:37:21,670 --> 00:37:19,440

that's it's nurtured a generation of

1003
00:37:24,470 --> 00:37:21,680

young scientists ed mentioned to me one

1004
00:37:26,390 --> 00:37:24,480

night this morning that reminded me that

1005
00:37:27,990 --> 00:37:26,400

while i was in orbit he was shepherding

1006
00:37:30,630 --> 00:37:28,000

my family my husband and three young

1007
00:37:32,870 --> 00:37:30,640

daughters through early morning live

1008
00:37:34,790 --> 00:37:32,880

interview on good morning america

1009
00:37:36,630 --> 00:37:34,800

well the oldest of those who was 11 at

1010
00:37:38,870 --> 00:37:36,640

that time when we flew this mission got

1011
00:37:40,790 --> 00:37:38,880

her phd using hubble data

1012
00:37:42,390 --> 00:37:40,800

some years later so she's one of the

1013
00:37:46,230 --> 00:37:42,400

thousands of young scientists that have

1014

00:37:48,630 --> 00:37:46,240

been nurtured by hubble in its time

1015

00:37:49,990 --> 00:37:48,640

perfect time and

1016

00:37:51,990 --> 00:37:50,000

i think we have some time for some

1017

00:37:54,950 --> 00:37:52,000

questions so

1018

00:37:57,910 --> 00:37:54,960

it the one thing i'll say is um

1019

00:38:00,310 --> 00:37:57,920

so many so many people particularly my

1020

00:38:03,270 --> 00:38:00,320

astronomer friends uh

1021

00:38:05,430 --> 00:38:03,280

over the years have come up and you know

1022

00:38:07,270 --> 00:38:05,440

i have to shake your hand and and thank

1023

00:38:09,190 --> 00:38:07,280

you for fixing hubble

1024

00:38:11,910 --> 00:38:09,200

and all i could say was

1025

00:38:13,910 --> 00:38:11,920

it's it was a pleasure truly call us

1026
00:38:15,430 --> 00:38:13,920
again

1027
00:38:19,250 --> 00:38:15,440
it would be like space cowboys meets the

1028
00:38:31,109 --> 00:38:19,260
hst it would be awesome there we go

1029
00:38:33,750 --> 00:38:32,790
five four

1030
00:38:34,710 --> 00:38:33,760
three

1031
00:38:35,510 --> 00:38:34,720
two

1032
00:38:37,510 --> 00:38:35,520
one

1033
00:38:39,349 --> 00:38:37,520
and liftoff of the space shuttle

1034
00:38:43,760 --> 00:38:39,359
discovery with the hubble space

1035
00:38:54,120 --> 00:38:43,770
telescope our window on the universe

1036
00:40:07,030 --> 00:39:42,640
[Music]

1037
00:40:08,069 --> 00:40:07,040
bubble isn't just a satellite

1038
00:40:10,550 --> 00:40:08,079

it's

1039

00:40:12,069 --> 00:40:10,560

about humanity's quest for knowledge the

1040

00:40:13,349 --> 00:40:12,079

only way of finding the limits of the

1041

00:40:15,589 --> 00:40:13,359

possible

1042

00:40:17,109 --> 00:40:15,599

is by going beyond them into the

1043

00:40:19,030 --> 00:40:17,119

impossible

1044

00:40:21,829 --> 00:40:19,040

i want to wish hubble its own set of

1045

00:40:28,780 --> 00:40:21,839

adventures that it may unlock further

1046

00:42:08,069 --> 00:40:39,560

[Music]

1047

00:42:08,079 --> 00:42:12,230

so

1048

00:44:44,590 --> 00:42:28,810

[Music]

1049

00:44:51,750 --> 00:44:44,600

hmm

1050

00:44:52,840 --> 00:44:51,760

[Music]

1051
00:45:10,870 --> 00:44:52,850
boys

1052
00:45:33,990 --> 00:45:12,410
me

1053
00:47:43,030 --> 00:45:34,000
[Music]

1054
00:47:43,040 --> 00:47:46,980
uh

1055
00:48:53,430 --> 00:48:13,829
[Music]

1056
00:48:53,440 --> 00:48:58,890
so

1057
00:48:58,900 --> 00:49:08,710
[Music]

1058
00:49:08,720 --> 00:49:13,850
so

1059
00:49:13,860 --> 00:49:21,270
[Music]

1060
00:49:21,280 --> 00:49:32,260
so

1061
00:50:33,589 --> 00:49:59,800
[Music]

1062
00:50:51,280 --> 00:50:34,950
so

1063
00:51:53,349 --> 00:51:11,860

[Music]

1064

00:51:53,359 --> 00:51:59,460

so

1065

00:58:50,670 --> 00:52:10,470

[Music]