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SENIOR PROJECT SCIENTIST, GODDARD SPACE FLIGHT CENTER

1
00:00:07,749 --> 00:00:05,430
good morning

2
00:00:10,150 --> 00:00:07,759
my name's amber stron i'm an

3
00:00:11,749 --> 00:00:10,160
astrophysicist at nasa headquarters in

4
00:00:13,910 --> 00:00:11,759
washington dc

5
00:00:15,990 --> 00:00:13,920
and today's program is coming from the

6
00:00:17,670 --> 00:00:16,000
newseum right here in our nation's

7
00:00:20,630 --> 00:00:17,680
capital

8
00:00:23,990 --> 00:00:20,640
so tomorrow we get to say happy birthday

9
00:00:27,109 --> 00:00:24,000
to a cosmic celebration 25 years in the

10
00:00:29,669 --> 00:00:27,119
making but before that we need to share

11
00:00:32,549 --> 00:00:29,679
an important gift for that celebration

12
00:00:36,150 --> 00:00:32,559
to you and everyone around the world

13
00:00:38,150 --> 00:00:36,160

so before we begin unwrapping that gift

14
00:00:40,630 --> 00:00:38,160
i want to first acknowledge some very

15
00:00:41,750 --> 00:00:40,640
special guests in our audience

16
00:00:44,150 --> 00:00:41,760
some

17
00:00:46,389 --> 00:00:44,160
astronaut heroes that are a key reason

18
00:00:48,470 --> 00:00:46,399
we can celebrate 25 years of hubble

19
00:00:50,229 --> 00:00:48,480
being in space in addition to the two

20
00:00:52,229 --> 00:00:50,239
hubble astronauts on stage there are a

21
00:01:03,670 --> 00:00:52,239
few more in our audience here would you

22
00:01:07,910 --> 00:01:05,509
and now would you all join me in

23
00:01:13,670 --> 00:01:07,920
welcoming nasa administrator charlie

24
00:01:17,190 --> 00:01:15,590
thanks very much amber and uh thanks to

25
00:01:19,590 --> 00:01:17,200
all of you for coming out this morning

26
00:01:22,070 --> 00:01:19,600
it it's great to be here with you it's

27
00:01:24,070 --> 00:01:22,080
really great to be with you because um i

28
00:01:26,550 --> 00:01:24,080
was surprised to see my former commander

29
00:01:28,070 --> 00:01:26,560
lauren traver walk through the door and

30
00:01:29,190 --> 00:01:28,080
that makes it really really really

31
00:01:33,510 --> 00:01:29,200
special

32
00:01:36,230 --> 00:01:33,520
to our host here the newseum

33
00:01:38,630 --> 00:01:36,240
and to everyone here who is a part of a

34
00:01:41,270 --> 00:01:38,640
shining light of the magic of hubble the

35
00:01:43,670 --> 00:01:41,280
people's telescope i was in colorado

36
00:01:44,630 --> 00:01:43,680
last week and and i told folks with whom

37
00:01:46,630 --> 00:01:44,640
i met

38
00:01:48,710 --> 00:01:46,640

that uh this hubble anniversary is

39
00:01:51,590 --> 00:01:48,720
really bittersweet for me

40
00:01:54,469 --> 00:01:51,600
uh it's bitter because

41
00:01:57,510 --> 00:01:54,479
25 years is a long time and and i hate

42
00:02:00,230 --> 00:01:57,520
admitting that i'm that mature

43
00:02:02,389 --> 00:02:00,240
well not mature just plain old old

44
00:02:04,789 --> 00:02:02,399
it's sweet because of all that hubble

45
00:02:07,590 --> 00:02:04,799
has allowed humanity to see and learn

46
00:02:09,510 --> 00:02:07,600
over this past quarter century

47
00:02:12,390 --> 00:02:09,520
i had the honor of being part of the

48
00:02:14,390 --> 00:02:12,400
crew that deployed hubble in 1990 and

49
00:02:16,309 --> 00:02:14,400
i'll let you in on a little secret

50
00:02:18,150 --> 00:02:16,319
i had the easy job

51
00:02:20,390 --> 00:02:18,160
i was assigned as the pilot of that

52
00:02:22,390 --> 00:02:20,400
mission and uh contrary to what most of

53
00:02:23,910 --> 00:02:22,400
you think that's actually a nasa speak

54
00:02:26,309 --> 00:02:23,920
for co-pilot

55
00:02:28,710 --> 00:02:26,319
so it means i kind of lurk around and

56
00:02:30,550 --> 00:02:28,720
watch everybody else do their stuff

57
00:02:31,990 --> 00:02:30,560
lauren shriver who i just just mentioned

58
00:02:34,710 --> 00:02:32,000
was our commander and he had the

59
00:02:37,190 --> 00:02:34,720
responsibility of maneuvering discovery

60
00:02:38,869 --> 00:02:37,200
throughout the deploy evolutions

61
00:02:41,430 --> 00:02:38,879
dr steve hawley

62
00:02:43,350 --> 00:02:41,440
uh we used to call dr stevie

63
00:02:45,270 --> 00:02:43,360

was the was the one with his hands on

64
00:02:47,350 --> 00:02:45,280
the controls of the remote manipulator

65
00:02:49,509 --> 00:02:47,360
system or the rms

66
00:02:50,949 --> 00:02:49,519
he was tasked with getting the telescope

67
00:02:53,270 --> 00:02:50,959
out of the payload bay of the space

68
00:02:55,190 --> 00:02:53,280
shuttle discovery and released at the

69
00:02:57,830 --> 00:02:55,200
appropriate time

70
00:02:59,350 --> 00:02:57,840
dr kathy sullivan and bruce mccandless

71
00:03:02,790 --> 00:02:59,360
had been suited up for a possible

72
00:03:04,790 --> 00:03:02,800
contingency spacewalk or an eva

73
00:03:07,830 --> 00:03:04,800
when we had some initial problems with

74
00:03:10,149 --> 00:03:07,840
deployment of the hubble solar arrays

75
00:03:11,430 --> 00:03:10,159
while i'd love to tell you that whole

76
00:03:13,670 --> 00:03:11,440
story

77
00:03:15,190 --> 00:03:13,680
we're on a tight clock here and so i

78
00:03:17,350 --> 00:03:15,200
won't catch me

79
00:03:19,910 --> 00:03:17,360
you know as we walk around after this or

80
00:03:21,830 --> 00:03:19,920
catch lauren and we'll compare notes as

81
00:03:23,430 --> 00:03:21,840
to whether or not i really remember what

82
00:03:25,350 --> 00:03:23,440
happened that day

83
00:03:27,509 --> 00:03:25,360
suffice it to say

84
00:03:29,509 --> 00:03:27,519
that our colleagues at the goddard space

85
00:03:32,309 --> 00:03:29,519
flight center came up with an ingenious

86
00:03:34,070 --> 00:03:32,319
11th hour solution from the ground and a

87
00:03:36,470 --> 00:03:34,080
quarter of a century later

88
00:03:38,789 --> 00:03:36,480

the rest is history

89
00:03:41,190 --> 00:03:38,799
during the run-up to the mission i got

90
00:03:43,430 --> 00:03:41,200
the sense that all of us in fact lauren

91
00:03:44,949 --> 00:03:43,440
steve kathy bruce and i

92
00:03:46,789 --> 00:03:44,959
we all sensed

93
00:03:48,390 --> 00:03:46,799
somehow that hubble was going to be

94
00:03:50,789 --> 00:03:48,400
something special

95
00:03:52,710 --> 00:03:50,799
what we didn't realize was how special

96
00:03:54,949 --> 00:03:52,720
it really was going to be

97
00:03:57,429 --> 00:03:54,959
frankly we never even thought that the

98
00:03:59,270 --> 00:03:57,439
telescope would last this long

99
00:04:02,149 --> 00:03:59,280
the original plan for hubble we were

100
00:04:04,470 --> 00:04:02,159
told was maybe 15 years

101
00:04:06,309 --> 00:04:04,480
the fact that we're still going strong a

102
00:04:08,149 --> 00:04:06,319
quarter century later is thanks to the

103
00:04:10,070 --> 00:04:08,159
hubble heroes some of whom were

104
00:04:12,070 --> 00:04:10,080
introduced to you a little bit earlier

105
00:04:14,630 --> 00:04:12,080
many of whom you will never see or never

106
00:04:17,189 --> 00:04:14,640
know the scientists the engineers and

107
00:04:19,590 --> 00:04:17,199
the astronauts who flew five missions to

108
00:04:22,629 --> 00:04:19,600
service hubble in space

109
00:04:25,510 --> 00:04:22,639
even the most optimistic person to whom

110
00:04:27,510 --> 00:04:25,520
you could have spoken back in 1990

111
00:04:29,030 --> 00:04:27,520
couldn't have predicted the degree to

112
00:04:31,189 --> 00:04:29,040
which hubble would rewrite our

113
00:04:32,710 --> 00:04:31,199

astrophysics and planetary science

114
00:04:34,710 --> 00:04:32,720
textbooks

115
00:04:36,950 --> 00:04:34,720
a quarter century later

116
00:04:39,749 --> 00:04:36,960
hubble has fundamentally changed our

117
00:04:43,590 --> 00:04:39,759
human understanding of our universe

118
00:04:46,310 --> 00:04:43,600
and our place in it

119
00:04:48,230 --> 00:04:46,320
every year hubble science data

120
00:04:51,110 --> 00:04:48,240
processes

121
00:04:53,830 --> 00:04:51,120
data processing generates 10 terabytes

122
00:04:56,070 --> 00:04:53,840
of new data and discovery

123
00:04:58,710 --> 00:04:56,080
that's enough data to fill the entire

124
00:05:01,110 --> 00:04:58,720
collection of the library of congress

125
00:05:03,350 --> 00:05:01,120
in each and every year

126
00:05:05,510 --> 00:05:03,360
the telescope continues to provide us

127
00:05:08,310 --> 00:05:05,520
with the intellectual foundation for

128
00:05:11,189 --> 00:05:08,320
future robotic and human expeditions

129
00:05:13,270 --> 00:05:11,199
including our journey to mars

130
00:05:15,189 --> 00:05:13,280
all things considered

131
00:05:17,350 --> 00:05:15,199
i think it's fair to say that hubble is

132
00:05:19,350 --> 00:05:17,360
one of the most influential and

133
00:05:21,990 --> 00:05:19,360
important scientific instruments and

134
00:05:24,550 --> 00:05:22,000
achievements ever devised

135
00:05:27,110 --> 00:05:24,560
i think that a piece by tracy watson in

136
00:05:28,310 --> 00:05:27,120
usa today's fantastic special edition

137
00:05:30,150 --> 00:05:28,320
about hubble

138
00:05:32,390 --> 00:05:30,160

sums it up well

139
00:05:33,909 --> 00:05:32,400
she writes that quote

140
00:05:35,909 --> 00:05:33,919
it's likely

141
00:05:38,469 --> 00:05:35,919
that no other modern day scientific

142
00:05:40,710 --> 00:05:38,479
instrument has stirred as many passions

143
00:05:42,150 --> 00:05:40,720
as the hubble space telescope

144
00:05:44,870 --> 00:05:42,160
before hubble

145
00:05:48,310 --> 00:05:44,880
few of us had any notion about the

146
00:05:51,510 --> 00:05:48,320
cosmos how the cosmos looked now

147
00:05:54,550 --> 00:05:51,520
we all know pinwheel of stars gauzy

148
00:05:56,870 --> 00:05:54,560
pillars of gas and dust bright galaxies

149
00:05:58,390 --> 00:05:56,880
scattered across the dark backdrop end

150
00:06:00,790 --> 00:05:58,400
quote

151
00:06:02,629 --> 00:06:00,800
as frank sinatra used to sing the best

152
00:06:04,469 --> 00:06:02,639
is yet to come

153
00:06:06,150 --> 00:06:04,479
thanks to the last servicing mission in

154
00:06:07,909 --> 00:06:06,160
2009

155
00:06:10,870 --> 00:06:07,919
hubble is expected to continue to

156
00:06:12,550 --> 00:06:10,880
provide valuable data until 2020 and

157
00:06:14,550 --> 00:06:12,560
beyond

158
00:06:16,150 --> 00:06:14,560
with two and a half decades of historic

159
00:06:17,430 --> 00:06:16,160
trailblazing science already

160
00:06:19,670 --> 00:06:17,440
accomplished

161
00:06:21,909 --> 00:06:19,680
we've come to realize and expect that

162
00:06:23,590 --> 00:06:21,919
there is still much more out there to

163
00:06:25,990 --> 00:06:23,600

discover

164
00:06:27,830 --> 00:06:26,000
five years ago president obama laid out

165
00:06:29,430 --> 00:06:27,840
a vision for space exploration at the

166
00:06:31,430 --> 00:06:29,440
kennedy space center

167
00:06:33,670 --> 00:06:31,440
as part of his vision he called for nasa

168
00:06:36,230 --> 00:06:33,680
to build on hubble's legacy with an

169
00:06:38,230 --> 00:06:36,240
advanced telescope that will allow us to

170
00:06:40,230 --> 00:06:38,240
peer deeper into the universe than ever

171
00:06:42,309 --> 00:06:40,240
before and many of you will remember

172
00:06:43,990 --> 00:06:42,319
that's the james webb space telescope on

173
00:06:45,670 --> 00:06:44,000
which we had already embarked but we

174
00:06:47,430 --> 00:06:45,680
were having trouble

175
00:06:49,909 --> 00:06:47,440
and it was questionable as to whether we

176
00:06:51,670 --> 00:06:49,919
were going to even be able to do it

177
00:06:53,749 --> 00:06:51,680
in 2018

178
00:06:55,990 --> 00:06:53,759
we'll do just that when we launch the

179
00:06:57,350 --> 00:06:56,000
james webb space telescope

180
00:06:58,950 --> 00:06:57,360
it will be placed in orbit about a

181
00:07:00,870 --> 00:06:58,960
million miles from earth and it will

182
00:07:03,029 --> 00:07:00,880
allow us to observe the most distant

183
00:07:05,510 --> 00:07:03,039
objects in the universe

184
00:07:07,110 --> 00:07:05,520
and to see unexplored planets around

185
00:07:09,029 --> 00:07:07,120
distant stars

186
00:07:11,430 --> 00:07:09,039
it will shed light on the birth of

187
00:07:13,510 --> 00:07:11,440
galaxies and expand our search for

188
00:07:14,870 --> 00:07:13,520

undiscovered planets beyond our solar

189
00:07:16,550 --> 00:07:14,880
system

190
00:07:19,189 --> 00:07:16,560
i leave you today however with some

191
00:07:21,430 --> 00:07:19,199
words from edwin powell hubble

192
00:07:23,990 --> 00:07:21,440
the telescope's namesake

193
00:07:26,870 --> 00:07:24,000
he said that and i quote the history of

194
00:07:28,830 --> 00:07:26,880
astronomy is a history of receding

195
00:07:31,589 --> 00:07:28,840
horizons

196
00:07:34,230 --> 00:07:31,599
unquote hubble has played a critical

197
00:07:35,430 --> 00:07:34,240
role in shrinking the horizon of our

198
00:07:36,550 --> 00:07:35,440
universe

199
00:07:38,070 --> 00:07:36,560
today

200
00:07:39,909 --> 00:07:38,080
we are on the threshold of sending

201
00:07:42,950 --> 00:07:39,919
humans farther into the solar system

202
00:07:45,430 --> 00:07:42,960
than ever before and thanks to hubble

203
00:07:47,430 --> 00:07:45,440
our vision is now farther than ever

204
00:07:50,230 --> 00:07:47,440
imagined possible

205
00:07:51,589 --> 00:07:50,240
i'm now going to invite the chief hubble

206
00:07:53,510 --> 00:07:51,599
handyman

207
00:07:55,270 --> 00:07:53,520
our associate administrator for the

208
00:07:56,550 --> 00:07:55,280
science mission directorate dr john

209
00:07:59,270 --> 00:07:56,560
grunsfeld

210
00:08:01,110 --> 00:07:59,280
to come up for our special unveiling uh

211
00:08:03,270 --> 00:08:01,120
that we're going to do for you here in

212
00:08:05,029 --> 00:08:03,280
about five minutes but john please come

213
00:08:07,270 --> 00:08:05,039

up and join me and give us a little of

214
00:08:14,790 --> 00:08:07,280
your recollections of your time with

215
00:08:19,270 --> 00:08:16,550
well i'm really thrilled to be here

216
00:08:20,550 --> 00:08:19,280
today for the 25th anniversary unveiling

217
00:08:22,390 --> 00:08:20,560
of hubble's

218
00:08:25,430 --> 00:08:22,400
uh what i hope you will all find

219
00:08:26,790 --> 00:08:25,440
spectacular anniversary image

220
00:08:28,790 --> 00:08:26,800
and one of the reasons i'm thrilled to

221
00:08:31,510 --> 00:08:28,800
be here is because you know with

222
00:08:33,110 --> 00:08:31,520
my fellow astronauts once we service the

223
00:08:34,709 --> 00:08:33,120
telescope or launch the telescope

224
00:08:36,310 --> 00:08:34,719
there's always a question you know will

225
00:08:40,149 --> 00:08:36,320
it work

226
00:08:42,389 --> 00:08:40,159
we're here otherwise we'd all be in

227
00:08:43,509 --> 00:08:42,399
exile in countries like bolivia or

228
00:08:45,590 --> 00:08:43,519
elsewhere

229
00:08:49,030 --> 00:08:45,600
so just happy to be here

230
00:08:50,790 --> 00:08:49,040
nasa's science and nasa at large our

231
00:08:52,150 --> 00:08:50,800
mission is to innovate

232
00:08:54,470 --> 00:08:52,160
explore

233
00:08:56,630 --> 00:08:54,480
discover and inspire

234
00:08:59,110 --> 00:08:56,640
and there's no better characterization

235
00:09:00,389 --> 00:08:59,120
of that than the imagery and the science

236
00:09:01,590 --> 00:09:00,399
that comes from the hubble space

237
00:09:03,430 --> 00:09:01,600
telescope

238
00:09:06,150 --> 00:09:03,440

we would never be able to be here

239
00:09:08,630 --> 00:09:06,160
talking about hubble 25 years after its

240
00:09:11,750 --> 00:09:08,640
spectacular launch if it wasn't for the

241
00:09:13,509 --> 00:09:11,760
innovative ideas and engineering that

242
00:09:15,509 --> 00:09:13,519
went into the tools into the new

243
00:09:17,509 --> 00:09:15,519
scientific instruments

244
00:09:19,670 --> 00:09:17,519
the reason why hubble is making such

245
00:09:21,590 --> 00:09:19,680
great discoveries today is that we've

246
00:09:23,430 --> 00:09:21,600
been able to use the remarkable space

247
00:09:25,910 --> 00:09:23,440
shuttle to put new instruments in to

248
00:09:27,910 --> 00:09:25,920
take advantage of new detectors i see a

249
00:09:30,310 --> 00:09:27,920
lot of digital cameras out here i see a

250
00:09:32,550 --> 00:09:30,320
lot of smartphones the detectors in

251
00:09:34,630 --> 00:09:32,560
those cameras the ccds the cmos

252
00:09:36,870 --> 00:09:34,640
detectors were developed by pushing the

253
00:09:39,190 --> 00:09:36,880
frontiers of astronomy and specifically

254
00:09:41,110 --> 00:09:39,200
the hubble space telescope

255
00:09:43,910 --> 00:09:41,120
when we explore

256
00:09:45,750 --> 00:09:43,920
we look out into the cosmos

257
00:09:48,389 --> 00:09:45,760
and that's exactly what hubble has done

258
00:09:50,550 --> 00:09:48,399
it has shown us an amazing story of the

259
00:09:52,710 --> 00:09:50,560
history of the universe it has literally

260
00:09:54,870 --> 00:09:52,720
unraveled the mysteries of the universe

261
00:09:56,550 --> 00:09:54,880
especially with the new detectors and

262
00:09:59,030 --> 00:09:56,560
cameras that we put on on this last

263
00:10:04,389 --> 00:10:01,269

when we explore we discover things

264
00:10:07,269 --> 00:10:04,399
hubble was designed to discover a few

265
00:10:09,430 --> 00:10:07,279
specific things it was to determine how

266
00:10:11,829 --> 00:10:09,440
fast the universe was expanding prove

267
00:10:13,910 --> 00:10:11,839
the existence of black holes and look at

268
00:10:15,829 --> 00:10:13,920
where you know stars were forming and

269
00:10:17,509 --> 00:10:15,839
dying

270
00:10:19,030 --> 00:10:17,519
many of the discoveries in fact most of

271
00:10:21,110 --> 00:10:19,040
the discoveries from hubble were things

272
00:10:22,790 --> 00:10:21,120
we never expected

273
00:10:24,790 --> 00:10:22,800
things like the origin of gamma-ray

274
00:10:26,389 --> 00:10:24,800
bursts the most energetic explosions in

275
00:10:28,949 --> 00:10:26,399
the universe other than the

276
00:10:31,030 --> 00:10:28,959
origin of the universe itself

277
00:10:32,870 --> 00:10:31,040
that every galaxy has a massive

278
00:10:34,870 --> 00:10:32,880
supermassive black hole in its center

279
00:10:37,269 --> 00:10:34,880
including our own

280
00:10:39,509 --> 00:10:37,279
and amazingly that the

281
00:10:41,269 --> 00:10:39,519
theory of the origin of the universe and

282
00:10:44,310 --> 00:10:41,279
the expanding universe the evolution of

283
00:10:47,110 --> 00:10:44,320
stars and galaxies and planets and us is

284
00:10:50,150 --> 00:10:47,120
a story that we've been able to unfold

285
00:10:51,829 --> 00:10:50,160
for almost the entire 13.72 billion year

286
00:10:53,350 --> 00:10:51,839
history of the universe and in fact even

287
00:10:55,190 --> 00:10:53,360
that age is something that hubble

288
00:10:56,310 --> 00:10:55,200

determined and it wasn't sure that it

289
00:10:58,550 --> 00:10:56,320
would be able to do that when we

290
00:11:01,750 --> 00:10:58,560
launched it

291
00:11:02,550 --> 00:11:01,760
we've known about the expanding universe

292
00:11:04,790 --> 00:11:02,560
for

293
00:11:05,829 --> 00:11:04,800
well since hubble's time

294
00:11:07,509 --> 00:11:05,839
and

295
00:11:09,509 --> 00:11:07,519
there are a lot of ideas about what what

296
00:11:11,350 --> 00:11:09,519
is our future in fact science is trying

297
00:11:14,230 --> 00:11:11,360
to ask questions about where did we come

298
00:11:16,230 --> 00:11:14,240
from where are we going and one that is

299
00:11:19,110 --> 00:11:16,240
particularly interesting to me and many

300
00:11:20,790 --> 00:11:19,120
people is are we alone in the universe

301
00:11:23,110 --> 00:11:20,800
hubble has shown us where we've come

302
00:11:24,790 --> 00:11:23,120
from and remarkably it's now told us

303
00:11:27,030 --> 00:11:24,800
where we're going and it's not what we

304
00:11:29,030 --> 00:11:27,040
expected the universe is expanding we

305
00:11:31,670 --> 00:11:29,040
expected it to be slowing down but in

306
00:11:32,790 --> 00:11:31,680
fact it's speeding up it's accelerating

307
00:11:34,710 --> 00:11:32,800
and that's

308
00:11:36,310 --> 00:11:34,720
caused astronomers to invent a new term

309
00:11:38,069 --> 00:11:36,320
called dark energy which really means we

310
00:11:39,670 --> 00:11:38,079
don't know anything about it

311
00:11:42,470 --> 00:11:39,680
but it's this mysterious force that's

312
00:11:43,990 --> 00:11:42,480
causing the universe to expand when we

313
00:11:46,630 --> 00:11:44,000

launched hubble we knew about nine

314
00:11:48,710 --> 00:11:46,640
planets in the so in the universe

315
00:11:50,150 --> 00:11:48,720
then we were demoted to eight planets

316
00:11:52,630 --> 00:11:50,160
and i have to remind you that on july

317
00:11:55,590 --> 00:11:52,640
14th the pluto new horizons spacecraft

318
00:11:57,509 --> 00:11:55,600
will zip by pluto uh dwarf planet give

319
00:11:59,030 --> 00:11:57,519
us our first view of the pluto system

320
00:12:00,870 --> 00:11:59,040
it's going to be very exciting we'll

321
00:12:03,110 --> 00:12:00,880
have another celebration for that i'm

322
00:12:05,430 --> 00:12:03,120
sure

323
00:12:07,110 --> 00:12:05,440
but after those eight planets suddenly

324
00:12:08,550 --> 00:12:07,120
uh the kepler space telescope

325
00:12:10,389 --> 00:12:08,560
ground-based observatory started

326
00:12:13,509 --> 00:12:10,399
discovering hundreds and thousands of

327
00:12:15,190 --> 00:12:13,519
planets out in the cosmos in our galaxy

328
00:12:17,990 --> 00:12:15,200
hubble was able to look at the

329
00:12:20,629 --> 00:12:18,000
atmosphere of a planet around a nearby

330
00:12:22,230 --> 00:12:20,639
star something that nobody ever imagined

331
00:12:24,389 --> 00:12:22,240
an earth-based telescope or an earth

332
00:12:27,430 --> 00:12:24,399
orbiting telescope could do

333
00:12:29,269 --> 00:12:27,440
really incredibly exciting

334
00:12:30,870 --> 00:12:29,279
but this day

335
00:12:33,190 --> 00:12:30,880
almost didn't happen

336
00:12:35,430 --> 00:12:33,200
for numerous reasons the hubble story

337
00:12:38,389 --> 00:12:35,440
itself is a story about people

338
00:12:40,230 --> 00:12:38,399

overcoming extraordinary challenges

339
00:12:41,910 --> 00:12:40,240
and one of the challenges was the

340
00:12:44,389 --> 00:12:41,920
misshapen mirror that was discovered

341
00:12:47,670 --> 00:12:44,399
after launch and in fact all of nasa was

342
00:12:50,550 --> 00:12:47,680
at risk whether we could fix it or not

343
00:12:52,310 --> 00:12:50,560
then in 1999 all of the gyros failed on

344
00:12:54,310 --> 00:12:52,320
hubble and we had to go up and fix it

345
00:12:56,629 --> 00:12:54,320
kind of a rescue mission and then in

346
00:12:58,550 --> 00:12:56,639
2002 we had this problem with the power

347
00:13:03,190 --> 00:12:58,560
on hubble and we had to go up and do

348
00:13:07,030 --> 00:13:05,190
i love being in space

349
00:13:08,629 --> 00:13:07,040
i'm really happy in space i wish i was

350
00:13:10,470 --> 00:13:08,639
up with the crew on the international

351
00:13:12,389 --> 00:13:10,480
space station right now you know not a

352
00:13:13,910 --> 00:13:12,399
one year mission i'd go up i'd like to

353
00:13:16,150 --> 00:13:13,920
live in space

354
00:13:18,629 --> 00:13:16,160
but there was one moment in space that i

355
00:13:22,230 --> 00:13:18,639
really wasn't very happy and that was in

356
00:13:24,550 --> 00:13:22,240
2009 may just six years ago when we went

357
00:13:26,389 --> 00:13:24,560
up to put the new super duper digital

358
00:13:27,750 --> 00:13:26,399
camera into the hubble space telescope

359
00:13:30,150 --> 00:13:27,760
an image you're going to see today was

360
00:13:32,069 --> 00:13:30,160
taken with that digital camera

361
00:13:35,430 --> 00:13:32,079
and when we went to take the old camera

362
00:13:37,269 --> 00:13:35,440
out it was stuck the bolt to remove it

363
00:13:39,670 --> 00:13:37,279

wouldn't turn

364
00:13:41,910 --> 00:13:39,680
and i wasn't smiling then

365
00:13:42,870 --> 00:13:41,920
at all in fact i was very concerned

366
00:13:44,470 --> 00:13:42,880
that we were going to break the

367
00:13:46,710 --> 00:13:44,480
telescope and that the old camera would

368
00:13:48,389 --> 00:13:46,720
never come out and that we'd done all of

369
00:13:50,550 --> 00:13:48,399
this work including a cancellation of

370
00:13:52,870 --> 00:13:50,560
the hubble mission itself

371
00:13:54,790 --> 00:13:52,880
after the tragic loss of colombia but we

372
00:13:56,949 --> 00:13:54,800
were up there we had the tools we had

373
00:13:58,710 --> 00:13:56,959
the people and fortunately we got that

374
00:14:00,550 --> 00:13:58,720
camera out put the new one in and ever

375
00:14:03,670 --> 00:14:00,560
since then hubble has indeed been

376
00:14:05,430 --> 00:14:03,680
unraveling the mysteries of the universe

377
00:14:07,990 --> 00:14:05,440
so in just under a minute charlie and i

378
00:14:09,829 --> 00:14:08,000
are going to virtually unveil uh this

379
00:14:11,430 --> 00:14:09,839
spectacular image

380
00:14:13,350 --> 00:14:11,440
we spent a lot of time thinking about

381
00:14:14,790 --> 00:14:13,360
what kind of image should we show and of

382
00:14:16,870 --> 00:14:14,800
course i thought well we should have a

383
00:14:18,310 --> 00:14:16,880
new picture of mars

384
00:14:19,990 --> 00:14:18,320
we have lots of pictures of mars and we

385
00:14:22,710 --> 00:14:20,000
have a fleet of spacecraft exploring

386
00:14:24,949 --> 00:14:22,720
mars today and that's our destiny

387
00:14:28,710 --> 00:14:24,959
nasa's is exploring mars

388
00:14:29,670 --> 00:14:28,720

preparing for sending humans to mars

389
00:14:31,509 --> 00:14:29,680
well

390
00:14:34,069 --> 00:14:31,519
in the end we came up with a really

391
00:14:36,150 --> 00:14:34,079
spectacular image hubble imaged it it

392
00:14:37,910 --> 00:14:36,160
was even better than we thought there's

393
00:14:39,670 --> 00:14:37,920
a team here that helps prepare these

394
00:14:41,269 --> 00:14:39,680
images from the space telescope science

395
00:14:44,310 --> 00:14:41,279
institute jennifer's going to tell you

396
00:14:46,310 --> 00:14:44,320
more about the science for that image

397
00:14:48,470 --> 00:14:46,320
but i think you'll all find it really

398
00:14:50,470 --> 00:14:48,480
compelling it's something that we do

399
00:14:52,310 --> 00:14:50,480
when we celebrate

400
00:14:54,629 --> 00:14:52,320
and uh

401
00:14:57,590 --> 00:14:54,639
yep is that ten or nine are you ready

402
00:14:59,990 --> 00:14:57,600
charlie okay i i've got this side you

403
00:15:01,750 --> 00:15:00,000
take that side let's grab it

404
00:15:12,870 --> 00:15:01,760
a virtual screen

405
00:15:17,910 --> 00:15:14,629
this is uh the exciting name of

406
00:15:19,350 --> 00:15:17,920
westerlund ii but this is a gaggle of

407
00:15:22,870 --> 00:15:19,360
young stars

408
00:15:25,910 --> 00:15:22,880
embedded in their star-forming cloud

409
00:15:28,790 --> 00:15:25,920
watching fireworks in a star cluster of

410
00:15:32,150 --> 00:15:28,800
very bright young stars

411
00:15:33,670 --> 00:15:32,160
celebrating hubble's 25th anniversary

412
00:15:35,829 --> 00:15:33,680
now the fact that it's taken thousands

413
00:15:37,670 --> 00:15:35,839

of years for the light to get to us just

414
00:15:39,269 --> 00:15:37,680
means that they planned really far in

415
00:15:41,750 --> 00:15:39,279
advance

416
00:15:44,230 --> 00:15:41,760
but this spectacular image shows a cloud

417
00:15:46,230 --> 00:15:44,240
of dense gas and dust the gas is

418
00:15:48,069 --> 00:15:46,240
collapsing forming new stars jennifer

419
00:15:50,230 --> 00:15:48,079
will tell you much more about it but

420
00:15:52,230 --> 00:15:50,240
this image is one that you know numerous

421
00:15:54,069 --> 00:15:52,240
times over we didn't get

422
00:15:56,470 --> 00:15:54,079
because of the struggles with the

423
00:15:58,470 --> 00:15:56,480
technical part of hubble and struggles

424
00:16:01,110 --> 00:15:58,480
of people on the ground and the tens of

425
00:16:04,150 --> 00:16:01,120
thousands of people at nasa at our nasa

426
00:16:06,790 --> 00:16:04,160
contractors scientists engineers people

427
00:16:09,189 --> 00:16:06,800
who support our space shuttle mission

428
00:16:11,910 --> 00:16:09,199
our nasa mission our science mission all

429
00:16:14,629 --> 00:16:11,920
coming together around a common purpose

430
00:16:16,470 --> 00:16:14,639
to try and understand how the universe

431
00:16:18,710 --> 00:16:16,480
works and where our place in the

432
00:16:21,590 --> 00:16:18,720
universe is and this has had just

433
00:16:23,110 --> 00:16:21,600
extraordinary uh reach not only into the

434
00:16:25,189 --> 00:16:23,120
scientific community of course and

435
00:16:26,550 --> 00:16:25,199
rewriting the science textbooks and our

436
00:16:28,629 --> 00:16:26,560
understanding

437
00:16:31,030 --> 00:16:28,639
but into schools around america in fact

438
00:16:33,269 --> 00:16:31,040

around the world hubble inspires the

439
00:16:37,430 --> 00:16:33,279
world and with that i'd like to invite

440
00:16:39,269 --> 00:16:37,440
jennifer weissman to come up and she's

441
00:16:41,110 --> 00:16:39,279
the hubble project scientist at the

442
00:16:43,110 --> 00:16:41,120
goddard space flight center to tell you

443
00:16:52,870 --> 00:16:43,120
a little bit more about the science in

444
00:16:56,389 --> 00:16:54,470
and i may have to tap dance while she

445
00:16:59,110 --> 00:16:56,399
gets to the page that i turned away from

446
00:17:02,790 --> 00:16:59,120
on her ipad so okay it's a little

447
00:17:06,470 --> 00:17:02,800
exercise and uh freewheeling

448
00:17:09,029 --> 00:17:06,480
this is really an exciting week for

449
00:17:11,750 --> 00:17:09,039
astronomers and people who love

450
00:17:14,949 --> 00:17:11,760
astronomy all over the world because as

451
00:17:17,590 --> 00:17:14,959
we celebrate hubble's 25th anniversary

452
00:17:19,829 --> 00:17:17,600
we're celebrating some of the forefront

453
00:17:21,829 --> 00:17:19,839
science and the forefront discoveries

454
00:17:24,069 --> 00:17:21,839
we've made about the universe through

455
00:17:25,110 --> 00:17:24,079
all those years and hopefully for years

456
00:17:26,870 --> 00:17:25,120
to come

457
00:17:29,270 --> 00:17:26,880
this is an example of one of these

458
00:17:31,510 --> 00:17:29,280
spectacular images that

459
00:17:34,070 --> 00:17:31,520
we can get with hubble the image that

460
00:17:38,230 --> 00:17:34,080
we're looking at is a giant cluster of

461
00:17:40,630 --> 00:17:38,240
stars in the gum 29 interstellar cloud

462
00:17:43,909 --> 00:17:40,640
nebula in this region of the sky we call

463
00:17:46,549 --> 00:17:43,919

carina it's a very vigorous breeding

464
00:17:48,710 --> 00:17:46,559
ground for new stars it's about twenty

465
00:17:50,549 --> 00:17:48,720
thousand light years away from us as we

466
00:17:51,669 --> 00:17:50,559
look toward at the center of our own

467
00:17:53,830 --> 00:17:51,679
galaxy

468
00:17:56,310 --> 00:17:53,840
and the central cluster here is about

469
00:17:58,950 --> 00:17:56,320
ten light years across there's about

470
00:18:02,150 --> 00:17:58,960
three thousand stars in that central

471
00:18:05,430 --> 00:18:02,160
cluster and they're very young this is a

472
00:18:07,909 --> 00:18:05,440
really new birthplace of stars the the

473
00:18:09,750 --> 00:18:07,919
the cluster is only about 2 million

474
00:18:12,390 --> 00:18:09,760
years old which in

475
00:18:14,470 --> 00:18:12,400
stellar terms is very young

476
00:18:15,669 --> 00:18:14,480
and it contains some of the galaxy's

477
00:18:18,630 --> 00:18:15,679
hottest

478
00:18:20,789 --> 00:18:18,640
brightest and most massive stars that we

479
00:18:22,789 --> 00:18:20,799
know of so it's a very vigorous

480
00:18:25,990 --> 00:18:22,799
star-forming region

481
00:18:27,510 --> 00:18:26,000
what's great about hubble's sharp

482
00:18:30,230 --> 00:18:27,520
resolution

483
00:18:32,870 --> 00:18:30,240
is that we can differentiate star from

484
00:18:35,909 --> 00:18:32,880
star even in crowded regions like this

485
00:18:38,549 --> 00:18:35,919
cluster so this helps us scientifically

486
00:18:40,470 --> 00:18:38,559
to be able to understand what kinds of

487
00:18:42,230 --> 00:18:40,480
stars are in this cluster how they're

488
00:18:44,310 --> 00:18:42,240

different from one another how the

489
00:18:46,789 --> 00:18:44,320
population may have formed in the first

490
00:18:49,750 --> 00:18:46,799
place we can study the characteristics

491
00:18:52,789 --> 00:18:49,760
because of hubble's uh exquisite

492
00:18:54,950 --> 00:18:52,799
sensitivity and resolution

493
00:18:57,350 --> 00:18:54,960
what's also great about hubble is that

494
00:19:00,230 --> 00:18:57,360
we can look at regions like this

495
00:19:02,070 --> 00:19:00,240
in multiple colors or wavelengths of

496
00:19:05,029 --> 00:19:02,080
light and that gives us a lot of

497
00:19:07,590 --> 00:19:05,039
information the visible light filters

498
00:19:10,310 --> 00:19:07,600
that we used in this image were from the

499
00:19:12,870 --> 00:19:10,320
advanced camera for surveys and it's

500
00:19:15,029 --> 00:19:12,880
showing us light not only from the stars

501
00:19:17,909 --> 00:19:15,039
but also from this colorful emission and

502
00:19:20,789 --> 00:19:17,919
the ionized gas surrounding the stars

503
00:19:23,430 --> 00:19:20,799
that little moon shaped cloud trough

504
00:19:26,150 --> 00:19:23,440
in these colors the red is representing

505
00:19:29,270 --> 00:19:26,160
a lot of emission from hydrogen gas the

506
00:19:31,190 --> 00:19:29,280
blues and greens are coming from oxygen

507
00:19:33,750 --> 00:19:31,200
all of this is telling us that those

508
00:19:36,150 --> 00:19:33,760
bright vigorous stars in the core

509
00:19:40,070 --> 00:19:36,160
are having an impact on the surrounding

510
00:19:42,150 --> 00:19:40,080
gas around them both the light and the

511
00:19:44,549 --> 00:19:42,160
stellar winds coming off the stars are

512
00:19:46,789 --> 00:19:44,559
impacting that surrounding material of

513
00:19:48,549 --> 00:19:46,799

surrounding clouds they're chiseling

514
00:19:50,549 --> 00:19:48,559
into them and they're also iron the

515
00:19:52,390 --> 00:19:50,559
light is ionizing the gas which creates

516
00:19:54,950 --> 00:19:52,400
these spectacular colors when

517
00:19:57,909 --> 00:19:54,960
astronomers see these lit up nebulae we

518
00:20:00,870 --> 00:19:57,919
say aha that's a region of active star

519
00:20:02,630 --> 00:20:00,880
formation and this region is truly very

520
00:20:05,430 --> 00:20:02,640
very active

521
00:20:06,710 --> 00:20:05,440
also in this image we have data from the

522
00:20:09,029 --> 00:20:06,720
infrared

523
00:20:11,029 --> 00:20:09,039
channel on the wide field camera three

524
00:20:13,830 --> 00:20:11,039
this is the spectacular camera that was

525
00:20:16,630 --> 00:20:13,840
installed by astronauts thank you very

526
00:20:18,470 --> 00:20:16,640
much on this last servicing mission in

527
00:20:20,950 --> 00:20:18,480
2009

528
00:20:23,590 --> 00:20:20,960
and with this new capability we can

529
00:20:26,230 --> 00:20:23,600
actually see into some of the dusty

530
00:20:28,310 --> 00:20:26,240
veils that might have otherwise uh

531
00:20:30,070 --> 00:20:28,320
enshrouded some of the stars that we can

532
00:20:32,630 --> 00:20:30,080
actually see so if you look around this

533
00:20:34,549 --> 00:20:32,640
picture you'll see some reddish colored

534
00:20:36,310 --> 00:20:34,559
stars those are stars that might have

535
00:20:38,630 --> 00:20:36,320
been invisible were it not for the

536
00:20:41,110 --> 00:20:38,640
infrared capabilities of the wide field

537
00:20:43,590 --> 00:20:41,120
camera 3. we can also see a whole lot of

538
00:20:46,470 --> 00:20:43,600

stars both in the center and embedded in

539
00:20:48,950 --> 00:20:46,480
that surrounding gas

540
00:20:50,710 --> 00:20:48,960
that embedded region of star formation

541
00:20:52,870 --> 00:20:50,720
is really important as well because

542
00:20:55,909 --> 00:20:52,880
regions like this tell us that star

543
00:20:58,149 --> 00:20:55,919
formation is active and ongoing the big

544
00:21:00,390 --> 00:20:58,159
massive stars form first that's what's

545
00:21:03,110 --> 00:21:00,400
happening in that central cluster

546
00:21:05,270 --> 00:21:03,120
but all that activity all that radiation

547
00:21:07,909 --> 00:21:05,280
and the wind activity from those central

548
00:21:10,470 --> 00:21:07,919
stars is impacting the surrounding gas

549
00:21:13,909 --> 00:21:10,480
and that actually incites subsequent

550
00:21:15,830 --> 00:21:13,919
star formation in those dense clouds so

551
00:21:18,390 --> 00:21:15,840
as we peer into those clouds we see

552
00:21:21,029 --> 00:21:18,400
evidence of younger stars still on their

553
00:21:23,029 --> 00:21:21,039
way to forming kind of the subsequent

554
00:21:25,190 --> 00:21:23,039
wave of star formation

555
00:21:27,350 --> 00:21:25,200
with future telescopes in particular the

556
00:21:30,149 --> 00:21:27,360
james webb space telescope will be able

557
00:21:33,029 --> 00:21:30,159
to peer better into those dense dark

558
00:21:33,990 --> 00:21:33,039
clouds and see young protostars as they

559
00:21:35,750 --> 00:21:34,000
form

560
00:21:37,669 --> 00:21:35,760
we're so excited about seeing the

561
00:21:39,669 --> 00:21:37,679
activity like this and i think that's

562
00:21:42,950 --> 00:21:39,679
one thing that hubble has revealed to us

563
00:21:44,390 --> 00:21:42,960

all along is that our universe is active

564
00:21:46,230 --> 00:21:44,400
it's not stagnant

565
00:21:48,630 --> 00:21:46,240
things are going on in our own solar

566
00:21:50,470 --> 00:21:48,640
system star formation in regions like

567
00:21:52,950 --> 00:21:50,480
this all around our galaxy and other

568
00:21:55,909 --> 00:21:52,960
galaxies and we also see activity going

569
00:21:57,750 --> 00:21:55,919
on in in so many other galaxies so

570
00:21:59,909 --> 00:21:57,760
we're very appreciative of hubble this

571
00:22:01,909 --> 00:21:59,919
week and i think this beautiful image is

572
00:22:03,590 --> 00:22:01,919
a wonderful example of the kinds of

573
00:22:06,070 --> 00:22:03,600
things we can study and learn with

574
00:22:08,230 --> 00:22:06,080
hubble and with that i'd like to welcome

575
00:22:10,070 --> 00:22:08,240
dr kathy flanagan up to tell us a little

576
00:22:24,950 --> 00:22:10,080
bit about the broader context of the

577
00:22:29,190 --> 00:22:27,029
the spectacular new hubble image that

578
00:22:30,870 --> 00:22:29,200
we've unveiled is the result of science

579
00:22:32,950 --> 00:22:30,880
and engineering community

580
00:22:34,950 --> 00:22:32,960
that challenges itself to maximize the

581
00:22:35,909 --> 00:22:34,960
productivity of this flagship nasa

582
00:22:37,990 --> 00:22:35,919
mission

583
00:22:40,230 --> 00:22:38,000
the crisp and multi-wavelength quality

584
00:22:42,149 --> 00:22:40,240
of this remarkable nebula underscores

585
00:22:43,909 --> 00:22:42,159
how far we've come since the launch in

586
00:22:45,110 --> 00:22:43,919
1990

587
00:22:47,430 --> 00:22:45,120
hubble has become the most

588
00:22:48,230 --> 00:22:47,440

scientifically prolific telescope of our

589
00:22:50,310 --> 00:22:48,240
time

590
00:22:51,830 --> 00:22:50,320
thanks to the courageous astronauts who

591
00:22:53,350 --> 00:22:51,840
serviced it and the expertise of

592
00:22:55,350 --> 00:22:53,360
hubble's dedicated technical and

593
00:22:57,110 --> 00:22:55,360
scientific support teams

594
00:22:59,350 --> 00:22:57,120
it has been a privilege for the space

595
00:23:01,909 --> 00:22:59,360
telescope science institute to help

596
00:23:04,390 --> 00:23:01,919
enable the immense scientific return

597
00:23:06,230 --> 00:23:04,400
in the past quarter century hubble has

598
00:23:08,630 --> 00:23:06,240
engaged a significant fraction of the

599
00:23:11,830 --> 00:23:08,640
worldwide astronomical community

600
00:23:14,950 --> 00:23:11,840
producing nearly 13 000 refereed science

601
00:23:17,029 --> 00:23:14,960
papers in fact hubble has inspired and

602
00:23:19,190 --> 00:23:17,039
energized a whole new generation of

603
00:23:21,669 --> 00:23:19,200
young and diverse astronomers

604
00:23:23,830 --> 00:23:21,679
and the scientific users of hubble come

605
00:23:26,470 --> 00:23:23,840
from everywhere anyone with a great

606
00:23:28,549 --> 00:23:26,480
scientific idea can get observing time

607
00:23:31,909 --> 00:23:28,559
on hubble and often we team up with our

608
00:23:33,590 --> 00:23:31,919
peers in europe asia africa australia

609
00:23:35,510 --> 00:23:33,600
and south america to identify

610
00:23:37,750 --> 00:23:35,520
cutting-edge science that keeps hubble

611
00:23:40,149 --> 00:23:37,760
on the forefront of discovery

612
00:23:43,270 --> 00:23:40,159
nasa in partnership with the european

613
00:23:46,070 --> 00:23:43,280

space agency has given the world this

614
00:23:47,830 --> 00:23:46,080
scientific treasure

615
00:23:50,390 --> 00:23:47,840
hubble's reach goes far beyond the

616
00:23:52,310 --> 00:23:50,400
scientific user community

617
00:23:54,310 --> 00:23:52,320
in the 25 years hubble has been

618
00:23:57,350 --> 00:23:54,320
operating it has indeed become the

619
00:24:00,070 --> 00:23:57,360
people's telescope hubble images no

620
00:24:02,710 --> 00:24:00,080
known national political or ideological

621
00:24:05,029 --> 00:24:02,720
boundaries they are a subtle reminder

622
00:24:06,070 --> 00:24:05,039
that we are a common species on a small

623
00:24:07,990 --> 00:24:06,080
planet

624
00:24:10,070 --> 00:24:08,000
there are no language or cultural

625
00:24:11,669 --> 00:24:10,080
barriers to being awestruck by hubble

626
00:24:15,269 --> 00:24:11,679
images

627
00:24:17,909 --> 00:24:15,279
been transformative for the public's

628
00:24:20,549 --> 00:24:17,919
perception of the cosmos the images have

629
00:24:24,870 --> 00:24:20,559
become a cultural icon found on coffee

630
00:24:26,549 --> 00:24:24,880
cups record albums and even tattoos

631
00:24:29,510 --> 00:24:26,559
through the institute's education

632
00:24:31,430 --> 00:24:29,520
program hubble has excited engaged

633
00:24:33,430 --> 00:24:31,440
inspired an entire generation of

634
00:24:34,470 --> 00:24:33,440
students across the country and around

635
00:24:37,190 --> 00:24:34,480
the world

636
00:24:39,830 --> 00:24:37,200
hubble posters adorn innumerable science

637
00:24:41,750 --> 00:24:39,840
classrooms in fact tomorrow the

638
00:24:44,070 --> 00:24:41,760

institute is hosting a coast-to-coast

639
00:24:45,350 --> 00:24:44,080
teach-in for students from elementary

640
00:24:46,870 --> 00:24:45,360
through high school

641
00:24:49,190 --> 00:24:46,880
students will learn some of hubble's

642
00:24:51,029 --> 00:24:49,200
remarkable scientific achievements and

643
00:24:53,190 --> 00:24:51,039
explore some of the most evocative

644
00:24:55,190 --> 00:24:53,200
images ever made of the universe

645
00:24:55,990 --> 00:24:55,200
administrator bolden will participate in

646
00:24:58,149 --> 00:24:56,000
this

647
00:25:00,789 --> 00:24:58,159
at our institute we are also working

648
00:25:03,110 --> 00:25:00,799
hard to expand our audience these

649
00:25:05,190 --> 00:25:03,120
two-dimensional images are now being

650
00:25:06,310 --> 00:25:05,200
rendered in 3d

651
00:25:08,230 --> 00:25:06,320
format

652
00:25:09,190 --> 00:25:08,240
we have for example as a companion

653
00:25:12,230 --> 00:25:09,200
release

654
00:25:14,390 --> 00:25:12,240
a movie showing a fly through of how

655
00:25:17,110 --> 00:25:14,400
scientifically realistically

656
00:25:18,630 --> 00:25:17,120
the elements of this image actually come

657
00:25:21,510 --> 00:25:18,640
together

658
00:25:22,310 --> 00:25:21,520
in addition we are working hard to bring

659
00:25:27,909 --> 00:25:22,320
our

660
00:25:30,230 --> 00:25:27,919
have interactive ibooks now and tactile

661
00:25:35,269 --> 00:25:30,240
images and working to prepare

662
00:25:37,029 --> 00:25:35,279
3d printing capability for hubble images

663
00:25:38,310 --> 00:25:37,039

our celebration of hubble's silver

664
00:25:41,190 --> 00:25:38,320
anniversary

665
00:25:43,350 --> 00:25:41,200
is not really retrospective however

666
00:25:45,669 --> 00:25:43,360
hubble is today at the peak of its

667
00:25:47,029 --> 00:25:45,679
performance with her most productive

668
00:25:49,669 --> 00:25:47,039
years ahead

669
00:25:51,909 --> 00:25:49,679
hubble will have powerful synergy with a

670
00:25:54,230 --> 00:25:51,919
new generation of large ground-based

671
00:25:56,390 --> 00:25:54,240
telescopes and the next great nasa

672
00:25:57,909 --> 00:25:56,400
astrophysics mission the james webb

673
00:26:00,390 --> 00:25:57,919
space telescope

674
00:26:02,630 --> 00:26:00,400
in fact the hubble experience has laid

675
00:26:03,909 --> 00:26:02,640
the groundwork for the future of space

676
00:26:07,029 --> 00:26:03,919
astronomy

677
00:26:09,510 --> 00:26:07,039
nasa was born to do great things it is

678
00:26:11,510 --> 00:26:09,520
the agency that delivers dreams

679
00:26:13,750 --> 00:26:11,520
enriching the whole world

680
00:26:23,190 --> 00:26:13,760
what amazing wonders await us over the

681
00:26:27,750 --> 00:26:25,510
so before we take a few questions today

682
00:26:28,870 --> 00:26:27,760
we have a very special video that we

683
00:26:31,110 --> 00:26:28,880
want to show

684
00:26:32,870 --> 00:26:31,120
that's going to show a 3d flyby through

685
00:26:38,470 --> 00:26:32,880
the image john if you'd like to come up

686
00:26:38,480 --> 00:26:43,750
thanks amber why don't you stay up

687
00:26:48,149 --> 00:26:46,230
when we launched hubble

688
00:26:50,230 --> 00:26:48,159

we had no idea

689
00:26:51,750 --> 00:26:50,240
how amazing the images would be i mean

690
00:26:52,390 --> 00:26:51,760
truly people really hadn't thought about

691
00:26:54,230 --> 00:26:52,400
it

692
00:26:55,990 --> 00:26:54,240
uh when the first images came out of

693
00:26:58,710 --> 00:26:56,000
course they were spectacular things like

694
00:27:02,230 --> 00:26:58,720
the eagle nebula the pillars of creation

695
00:27:04,789 --> 00:27:02,240
and those early images told us how truly

696
00:27:06,470 --> 00:27:04,799
beautiful the universe is and rich the

697
00:27:09,190 --> 00:27:06,480
fabric of the universe

698
00:27:11,510 --> 00:27:09,200
well now we have high def hubble images

699
00:27:13,669 --> 00:27:11,520
with these new cameras and

700
00:27:15,350 --> 00:27:13,679
combining that high definition the way

701
00:27:17,350 --> 00:27:15,360
our human eyes see

702
00:27:19,510 --> 00:27:17,360
with our scientific knowledge of what

703
00:27:21,909 --> 00:27:19,520
these objects actually are like in the

704
00:27:24,149 --> 00:27:21,919
universe we're able to create 3d

705
00:27:27,510 --> 00:27:24,159
fly-throughs and so if we can go ahead

706
00:27:28,310 --> 00:27:27,520
and start the the movie

707
00:27:30,470 --> 00:27:28,320
like

708
00:27:32,549 --> 00:27:30,480
the voyagers and star trek we are now

709
00:27:34,390 --> 00:27:32,559
able to fly through of course at super

710
00:27:36,549 --> 00:27:34,400
luminal speeds

711
00:27:37,830 --> 00:27:36,559
as if in warp drive actually fly through

712
00:27:40,390 --> 00:27:37,840
this nebula

713
00:27:42,950 --> 00:27:40,400

we're going past stars that are in the

714
00:27:44,390 --> 00:27:42,960
foreground as we approach the nebula and

715
00:27:45,830 --> 00:27:44,400
hopefully what you'll see in this is

716
00:27:49,430 --> 00:27:45,840
that these are not two-dimensional

717
00:27:50,870 --> 00:27:49,440
paintings these are real 3d objects

718
00:27:52,230 --> 00:27:50,880
and i have to mention at this point that

719
00:27:54,230 --> 00:27:52,240
if you want you can actually print out a

720
00:27:56,950 --> 00:27:54,240
little 3d hubble

721
00:27:58,710 --> 00:27:56,960
25th anniversary telescope and there's a

722
00:28:00,549 --> 00:27:58,720
few in the audience at least one that we

723
00:28:02,389 --> 00:28:00,559
couldn't do but we're going by these

724
00:28:04,470 --> 00:28:02,399
pillars where there's dense dust and new

725
00:28:07,190 --> 00:28:04,480
stars are embedded inside and here we're

726
00:28:09,430 --> 00:28:07,200
coming on that cluster of brand new very

727
00:28:11,269 --> 00:28:09,440
bright stars

728
00:28:14,870 --> 00:28:11,279
so i encourage you all to look at this

729
00:28:18,950 --> 00:28:17,190
or hubblesite.org it's a fantastic thing

730
00:28:20,710 --> 00:28:18,960
to look at there's a much slower version

731
00:28:21,750 --> 00:28:20,720
too that'll allow you to appreciate it

732
00:28:23,909 --> 00:28:21,760
more

733
00:28:25,830 --> 00:28:23,919
but this is you know one indication of

734
00:28:28,070 --> 00:28:25,840
the many thousands and thousands of

735
00:28:30,549 --> 00:28:28,080
images that we have on the web of hubble

736
00:28:35,669 --> 00:28:30,559
that you can all appreciate

737
00:28:38,950 --> 00:28:36,950
awesome

738
00:28:41,110 --> 00:28:38,960

all right we have time for a few

739
00:28:48,710 --> 00:28:41,120
questions and we do have a mic so raise

740
00:28:48,720 --> 00:28:52,710
they like the flagstream that's good

741
00:28:56,149 --> 00:28:54,310
my name is arsenio menendez and i'm

742
00:28:58,630 --> 00:28:56,159
curious as to what are the mirrors made

743
00:28:59,590 --> 00:28:58,640
out of

744
00:29:01,190 --> 00:28:59,600
sweater

745
00:29:04,070 --> 00:29:01,200
oh what are the mirrors made out of the

746
00:29:06,470 --> 00:29:04,080
mirrors are made out of glass

747
00:29:08,950 --> 00:29:06,480
hubble is relatively old technology it

748
00:29:10,950 --> 00:29:08,960
was you know started in the 1970s and

749
00:29:13,750 --> 00:29:10,960
built the mirror was built by perkin

750
00:29:15,830 --> 00:29:13,760
elmer and it's actually a very

751
00:29:17,750 --> 00:29:15,840
thick piece of glass it's been light

752
00:29:19,830 --> 00:29:17,760
weighted and then it took you know

753
00:29:29,190 --> 00:29:19,840
months and months and months to

754
00:29:37,190 --> 00:29:30,710
question of it

755
00:29:42,710 --> 00:29:40,549
uh hi my name is matthew diazio and i

756
00:29:43,590 --> 00:29:42,720
was wondering i was talking to people

757
00:29:45,750 --> 00:29:43,600
what are

758
00:29:47,190 --> 00:29:45,760
some of the biggest misconceptions

759
00:29:49,190 --> 00:29:47,200
people have about the hubble space

760
00:29:53,190 --> 00:29:49,200
telescope

761
00:29:57,830 --> 00:29:55,909
well one one misconception that i hear

762
00:30:00,149 --> 00:29:57,840
sometimes is that people think that the

763
00:30:01,750 --> 00:30:00,159

hubble is actually going to visit places

764
00:30:03,990 --> 00:30:01,760
in space and actually

765
00:30:06,950 --> 00:30:04,000
hubble is in in what we call low earth

766
00:30:08,710 --> 00:30:06,960
orbit it's it's about what 340 miles

767
00:30:11,350 --> 00:30:08,720
above the surface of the earth in orbit

768
00:30:14,310 --> 00:30:11,360
that's why astronauts could access it

769
00:30:15,590 --> 00:30:14,320
easily i know it wasn't easy but

770
00:30:17,669 --> 00:30:15,600
but

771
00:30:20,870 --> 00:30:17,679
it's there just to get above the

772
00:30:21,750 --> 00:30:20,880
atmosphere so we can get sharp images

773
00:30:23,269 --> 00:30:21,760
but

774
00:30:25,830 --> 00:30:23,279
really we are

775
00:30:27,510 --> 00:30:25,840
uh receiving light that travels to us

776
00:30:29,669 --> 00:30:27,520
from the distant regions of space so

777
00:30:31,909 --> 00:30:29,679
that's one

778
00:30:33,190 --> 00:30:31,919
i think another misconception is that if

779
00:30:35,029 --> 00:30:33,200
you were

780
00:30:36,389 --> 00:30:35,039
uh looking out into the universe if you

781
00:30:39,669 --> 00:30:36,399
were above the earth's atmosphere even

782
00:30:41,590 --> 00:30:39,679
if you were very close to this object uh

783
00:30:44,070 --> 00:30:41,600
that you would see it as it's shown on

784
00:30:45,430 --> 00:30:44,080
the screen and as jennifer said first

785
00:30:47,990 --> 00:30:45,440
well first of all

786
00:30:50,470 --> 00:30:48,000
hubble has this amazing light collection

787
00:30:52,389 --> 00:30:50,480
100 billion times better than the human

788
00:30:54,070 --> 00:30:52,399

eyeball so if you were there

789
00:30:56,310 --> 00:30:54,080
you would see the bright stars but not

790
00:30:58,149 --> 00:30:56,320
very much else hubble is able to

791
00:31:00,549 --> 00:30:58,159
selectively look

792
00:31:02,870 --> 00:31:00,559
at the colors of light that different

793
00:31:04,549 --> 00:31:02,880
types of atoms are emitting and so it's

794
00:31:07,350 --> 00:31:04,559
very sensitive in those ranges and able

795
00:31:09,269 --> 00:31:07,360
to bring out uh these exquisite details

796
00:31:10,710 --> 00:31:09,279
that we wouldn't see in fact some of the

797
00:31:12,870 --> 00:31:10,720
light the ultraviolet light and the

798
00:31:14,470 --> 00:31:12,880
infrared light our eyeballs can't see at

799
00:31:19,430 --> 00:31:14,480
all but the other colors are in the

800
00:31:23,909 --> 00:31:21,510
hi um i was just wondering you've

801
00:31:26,310 --> 00:31:23,919
mentioned how hubble is contributing

802
00:31:27,750 --> 00:31:26,320
towards the journey to mars uh the

803
00:31:29,350 --> 00:31:27,760
information you're gathering could you

804
00:31:33,430 --> 00:31:29,360
speak a little bit more to that and tell

805
00:31:38,310 --> 00:31:35,830
i'm sorry could you repeat that uh could

806
00:31:40,470 --> 00:31:38,320
you speak to uh what kind of information

807
00:31:42,389 --> 00:31:40,480
hubble is contributing towards nasa's

808
00:31:45,669 --> 00:31:42,399
goal to get to mars

809
00:31:49,509 --> 00:31:47,430
well i can speak a little bit i mean we

810
00:31:51,350 --> 00:31:49,519
are very interested in understanding the

811
00:31:53,430 --> 00:31:51,360
science of the solar system we want to

812
00:31:56,549 --> 00:31:53,440
understand how the planets in our solar

813
00:31:58,470 --> 00:31:56,559

system form including planet earth and

814
00:32:01,190 --> 00:31:58,480
mars we'd like to know

815
00:32:02,870 --> 00:32:01,200
how planets become habitable you know

816
00:32:04,389 --> 00:32:02,880
there's life on earth

817
00:32:06,470 --> 00:32:04,399
we don't know if there has ever been

818
00:32:08,070 --> 00:32:06,480
life on mars we know the climate has

819
00:32:11,110 --> 00:32:08,080
changed drastically on mars so we're

820
00:32:14,549 --> 00:32:11,120
using hubble to understand both mars but

821
00:32:16,310 --> 00:32:14,559
but also the the solar system as a whole

822
00:32:17,990 --> 00:32:16,320
and i think that helps us understand

823
00:32:19,190 --> 00:32:18,000
what we would want to learn if we sent

824
00:32:21,350 --> 00:32:19,200
humans there and what kind of

825
00:32:24,710 --> 00:32:21,360
environment they might encounter

826
00:32:27,110 --> 00:32:24,720
now hubble does regularly image mars

827
00:32:28,950 --> 00:32:27,120
now that we have spacecraft at mars we

828
00:32:31,590 --> 00:32:28,960
have several orbiters including the

829
00:32:33,750 --> 00:32:31,600
recently arrived maven orbiter

830
00:32:35,750 --> 00:32:33,760
that's studying the upper atmosphere but

831
00:32:37,430 --> 00:32:35,760
hubble has observed different types of

832
00:32:38,710 --> 00:32:37,440
weather and clouds and surface

833
00:32:41,669 --> 00:32:38,720
structures

834
00:32:43,110 --> 00:32:41,679
back a few years ago a team led by jim

835
00:32:44,950 --> 00:32:43,120
bell

836
00:32:47,110 --> 00:32:44,960
who's now at arizona state university

837
00:32:49,190 --> 00:32:47,120
did a series of observations of mars to

838
00:32:50,230 --> 00:32:49,200

try and look for signs of methane on

839
00:32:51,669 --> 00:32:50,240
mars

840
00:32:53,590 --> 00:32:51,679
and there have been ground-based

841
00:32:55,509 --> 00:32:53,600
observations of methane on mars but it

842
00:32:57,269 --> 00:32:55,519
was very speculative because in order to

843
00:32:58,230 --> 00:32:57,279
look with a ground-based telescope at

844
00:32:59,990 --> 00:32:58,240
mars you have to look through the

845
00:33:01,750 --> 00:33:00,000
earth's atmosphere which of course has

846
00:33:03,750 --> 00:33:01,760
lots of methane in it so it's a very

847
00:33:05,430 --> 00:33:03,760
tricky observation to do from the ground

848
00:33:07,509 --> 00:33:05,440
hubble has the advantage it's above the

849
00:33:09,110 --> 00:33:07,519
earth's atmosphere and so it had a clear

850
00:33:11,190 --> 00:33:09,120
unobstructed view unfortunately they

851
00:33:12,870 --> 00:33:11,200
didn't really find any signs of it

852
00:33:15,190 --> 00:33:12,880
we now have the curiosity rover on the

853
00:33:16,870 --> 00:33:15,200
surface of mars and when it first

854
00:33:18,789 --> 00:33:16,880
arrived it started looking for methane

855
00:33:20,789 --> 00:33:18,799
and didn't see it and then for a couple

856
00:33:22,710 --> 00:33:20,799
of months this year we saw a sign of

857
00:33:24,470 --> 00:33:22,720
methane on mars which is one of the

858
00:33:27,430 --> 00:33:24,480
indicators of life

859
00:33:28,950 --> 00:33:27,440
or some kind of geochemistry so we still

860
00:33:30,789 --> 00:33:28,960
don't know what the source is but we now

861
00:33:32,789 --> 00:33:30,799
know there's methane on mars and so

862
00:33:33,590 --> 00:33:32,799
hubble is part of all of the tools we

863
00:33:35,830 --> 00:33:33,600

use

864
00:33:37,509 --> 00:33:35,840
to put together the knowledge we need to

865
00:33:38,950 --> 00:33:37,519
to learn about mars from a science

866
00:33:41,190 --> 00:33:38,960
perspective but also for future

867
00:33:44,630 --> 00:33:41,200
explorers but there's a more fundamental

868
00:33:47,029 --> 00:33:44,640
way that i think hubble has contributed

869
00:33:48,950 --> 00:33:47,039
to our efforts to send humans to mars

870
00:33:50,549 --> 00:33:48,960
and in the same way that hubble

871
00:33:52,470 --> 00:33:50,559
contributed to the international space

872
00:33:54,389 --> 00:33:52,480
station

873
00:33:56,470 --> 00:33:54,399
virtually every spacewalk that's done on

874
00:33:59,110 --> 00:33:56,480
the international space station carries

875
00:34:01,909 --> 00:33:59,120
tools that were developed for servicing

876
00:34:04,149 --> 00:34:01,919
the hubble space telescope

877
00:34:06,389 --> 00:34:04,159
hubble is really hard to fix and hard to

878
00:34:09,829 --> 00:34:06,399
upgrade and we had to invent new tools

879
00:34:11,430 --> 00:34:09,839
and new techniques and in 1993

880
00:34:13,349 --> 00:34:11,440
when the crew went up to do that first

881
00:34:15,510 --> 00:34:13,359
servicing mission in the three years

882
00:34:17,430 --> 00:34:15,520
prior to that they had to invent almost

883
00:34:20,069 --> 00:34:17,440
all of the things that we now know about

884
00:34:21,430 --> 00:34:20,079
modern space walking and space repair

885
00:34:23,589 --> 00:34:21,440
that we're using on the international

886
00:34:24,950 --> 00:34:23,599
space station and i'm convinced that

887
00:34:27,349 --> 00:34:24,960
when we

888
00:34:28,869 --> 00:34:27,359

leave our you know home environment go

889
00:34:31,190 --> 00:34:28,879
out to the proving ground and then go

890
00:34:36,470 --> 00:34:31,200
out to mars that those same hubble tools

891
00:34:41,349 --> 00:34:38,869
good morning my name is john tullock

892
00:34:43,270 --> 00:34:41,359
you have talked a little bit about

893
00:34:46,629 --> 00:34:43,280
the

894
00:34:49,109 --> 00:34:46,639
astronauts who've worked with hubble and

895
00:34:51,430 --> 00:34:49,119
how you just mr dr gunsfeld talked about

896
00:34:53,510 --> 00:34:51,440
the tools that were were used and

897
00:34:56,310 --> 00:34:53,520
created for this but how

898
00:34:58,150 --> 00:34:56,320
has hubble and the human space flight

899
00:35:00,870 --> 00:34:58,160
program work together and how has hubble

900
00:35:02,790 --> 00:35:00,880
benefited the human space flight program

901
00:35:05,109 --> 00:35:02,800
i'll take a shot at it real quickly and

902
00:35:06,870 --> 00:35:05,119
it's you know hubble

903
00:35:08,630 --> 00:35:06,880
i i was privileged to lead the

904
00:35:11,670 --> 00:35:08,640
independent review panel for what was

905
00:35:13,510 --> 00:35:11,680
this what became sts-125 and and the

906
00:35:15,349 --> 00:35:13,520
panel was put together much to the

907
00:35:17,829 --> 00:35:15,359
credit of senator barbara mikulski when

908
00:35:20,230 --> 00:35:17,839
we talk about hubble being the people's

909
00:35:22,470 --> 00:35:20,240
telescope and that is a misconception

910
00:35:25,109 --> 00:35:22,480
hubble is not a telescope hubble is an

911
00:35:27,589 --> 00:35:25,119
observatory it is a rich observatory

912
00:35:29,829 --> 00:35:27,599
that today has six instruments that are

913
00:35:31,829 --> 00:35:29,839

unprecedented and probably will not be

914
00:35:34,710 --> 00:35:31,839
repeated again so the

915
00:35:37,510 --> 00:35:34,720
the richness of hubble is in the breadth

916
00:35:40,470 --> 00:35:37,520
of its ability to see across across the

917
00:35:43,349 --> 00:35:40,480
electronic electromagnetic spectrum but

918
00:35:45,190 --> 00:35:43,359
the things that we had to do to service

919
00:35:46,230 --> 00:35:45,200
hubble

920
00:35:50,950 --> 00:35:46,240
were

921
00:35:53,510 --> 00:35:50,960
to have been able to do robotically it

922
00:35:54,870 --> 00:35:53,520
is not these guys have fun

923
00:35:56,630 --> 00:35:54,880
when they go out

924
00:35:58,790 --> 00:35:56,640
it is not fun

925
00:36:01,270 --> 00:35:58,800
to be a member of a crew inside the

926
00:36:03,670 --> 00:36:01,280
spacecraft who has just put somebody in

927
00:36:05,270 --> 00:36:03,680
a spacesuit to see your friend go out

928
00:36:06,950 --> 00:36:05,280
into the vacuum of space because there

929
00:36:07,990 --> 00:36:06,960
are all kinds of really bad things that

930
00:36:10,310 --> 00:36:08,000
can happen

931
00:36:12,550 --> 00:36:10,320
so if you want to try to limit the risk

932
00:36:15,109 --> 00:36:12,560
to human beings we need to develop much

933
00:36:16,550 --> 00:36:15,119
more robotic technologies than we have

934
00:36:18,710 --> 00:36:16,560
today hubble

935
00:36:21,030 --> 00:36:18,720
was the was the impetus for that you

936
00:36:23,190 --> 00:36:21,040
know when when we convened our study

937
00:36:25,030 --> 00:36:23,200
group and the national research council

938
00:36:26,390 --> 00:36:25,040

looked at how you how you think about

939
00:36:27,990 --> 00:36:26,400
saving hubble

940
00:36:30,710 --> 00:36:28,000
we went in with the intention of

941
00:36:33,270 --> 00:36:30,720
identifying a robotic method to do that

942
00:36:35,510 --> 00:36:33,280
and the technology just wasn't there yet

943
00:36:37,510 --> 00:36:35,520
today because of the preparation for

944
00:36:39,349 --> 00:36:37,520
hubble and and trying to answer that

945
00:36:41,510 --> 00:36:39,359
question about technology

946
00:36:43,750 --> 00:36:41,520
we now have robotic capabilities that

947
00:36:47,109 --> 00:36:43,760
were un that are unheralded and unheard

948
00:36:48,870 --> 00:36:47,119
of before so we find from hubble that

949
00:36:50,550 --> 00:36:48,880
you know you can send a you can send a

950
00:36:52,470 --> 00:36:50,560
robot out john

951
00:36:55,349 --> 00:36:52,480
i'll go back to landing curiosity on

952
00:36:57,270 --> 00:36:55,359
mars the the night that that it landed

953
00:36:58,710 --> 00:36:57,280
we had a press conference and john got

954
00:37:00,870 --> 00:36:58,720
up to the podium and he said i have a

955
00:37:02,950 --> 00:37:00,880
prediction bad

956
00:37:05,430 --> 00:37:02,960
uh we should never be predicting stuff

957
00:37:07,510 --> 00:37:05,440
he said my prediction is curiosity will

958
00:37:10,230 --> 00:37:07,520
discover nothing

959
00:37:12,470 --> 00:37:10,240
and i fainted almost and and then he

960
00:37:14,390 --> 00:37:12,480
said the reason it will discover nothing

961
00:37:16,470 --> 00:37:14,400
is because it's a robot

962
00:37:18,470 --> 00:37:16,480
and what it does is it sends data down

963
00:37:22,310 --> 00:37:18,480

to earth for human beings to interpret

964
00:37:25,589 --> 00:37:22,320
and things hubble as incredible as it is

965
00:37:27,829 --> 00:37:25,599
the real hubble heroes are the people at

966
00:37:30,550 --> 00:37:27,839
the space telescope science institute at

967
00:37:33,270 --> 00:37:30,560
goddard all around the world who take

968
00:37:35,829 --> 00:37:33,280
the data that hubble provides for us and

969
00:37:37,829 --> 00:37:35,839
interpret it and make it meaningful and

970
00:37:40,310 --> 00:37:37,839
make these kinds of images because as

971
00:37:43,030 --> 00:37:40,320
john said that's not the way stuff comes

972
00:37:44,470 --> 00:37:43,040
down from hubble it's ones and zeros and

973
00:37:46,950 --> 00:37:44,480
so somebody's got to take it and

974
00:37:48,630 --> 00:37:46,960
transform it back into the image that

975
00:37:51,349 --> 00:37:48,640
hubble sees so

976
00:37:53,750 --> 00:37:51,359
just hubble has been the the forefront

977
00:37:57,030 --> 00:37:53,760
of getting us to understand how

978
00:37:59,430 --> 00:37:57,040
interdependent humans and robots are

979
00:38:01,510 --> 00:37:59,440
good morning um so these days we get a

980
00:38:02,310 --> 00:38:01,520
cell phone and it seems obsolete after a

981
00:38:04,710 --> 00:38:02,320
month

982
00:38:07,190 --> 00:38:04,720
so you mentioned earlier that upgrades

983
00:38:09,510 --> 00:38:07,200
to hubble it's not the easiest process

984
00:38:11,750 --> 00:38:09,520
to do so i was curious you know it's

985
00:38:14,230 --> 00:38:11,760
been 25 years is there a technology or a

986
00:38:15,750 --> 00:38:14,240
scientific process that wasn't included

987
00:38:19,589 --> 00:38:15,760
then now you kind of wish

988
00:38:21,030 --> 00:38:19,599

it was included in the original design

989
00:38:22,950 --> 00:38:21,040
so when hubble was first launched in

990
00:38:24,550 --> 00:38:22,960
1990 there were lots of things that we

991
00:38:26,710 --> 00:38:24,560
would have liked

992
00:38:28,710 --> 00:38:26,720
to have in the telescope but it had to

993
00:38:31,349 --> 00:38:28,720
be put together over a period of you

994
00:38:34,069 --> 00:38:31,359
know 15 to 18 years of work on the

995
00:38:35,750 --> 00:38:34,079
detectors so even when it was launched

996
00:38:37,990 --> 00:38:35,760
it was known that there was better

997
00:38:39,349 --> 00:38:38,000
technology for better detectors better

998
00:38:40,950 --> 00:38:39,359
cameras

999
00:38:42,710 --> 00:38:40,960
and that was sort of the whole point of

1000
00:38:45,950 --> 00:38:42,720
building a serviceable telescope is so

1001
00:38:49,510 --> 00:38:45,960
it could be upgraded and so in

1002
00:38:51,109 --> 00:38:49,520
1997 the first uh flight that put in a

1003
00:38:53,270 --> 00:38:51,119
whole new generation of instruments they

1004
00:38:55,670 --> 00:38:53,280
were state-of-the-art instruments

1005
00:38:58,870 --> 00:38:55,680
of course technology marches on so in

1006
00:39:01,670 --> 00:38:58,880
2009 uh when we put in the cosmic origin

1007
00:39:02,790 --> 00:39:01,680
spectrograph and the wide field camera

1008
00:39:04,470 --> 00:39:02,800
three we were putting in

1009
00:39:07,109 --> 00:39:04,480
state-of-the-art technology and it's

1010
00:39:09,430 --> 00:39:07,119
still pretty close to state of the art

1011
00:39:10,950 --> 00:39:09,440
the next generation though is what we're

1012
00:39:12,950 --> 00:39:10,960
putting into the james webb space

1013
00:39:14,390 --> 00:39:12,960

telescope and in fact at the goddard

1014
00:39:16,950 --> 00:39:14,400
space flight center in maryland we've

1015
00:39:19,030 --> 00:39:16,960
just installed the new detectors into

1016
00:39:20,790 --> 00:39:19,040
the cameras that will be launched in

1017
00:39:23,109 --> 00:39:20,800
three years and those detectors are

1018
00:39:24,390 --> 00:39:23,119
absolutely state of the art today

1019
00:39:26,550 --> 00:39:24,400
but even as we're doing that we're

1020
00:39:28,710 --> 00:39:26,560
talking about future telescopes and

1021
00:39:30,150 --> 00:39:28,720
developing technology in partnership

1022
00:39:32,790 --> 00:39:30,160
with the space technology mission

1023
00:39:34,870 --> 00:39:32,800
directorate at nasa and science we're

1024
00:39:37,510 --> 00:39:34,880
putting effort into finding out what are

1025
00:39:40,630 --> 00:39:37,520
those detectors that in the 2020s will

1026
00:39:42,630 --> 00:39:40,640
be putting into telescopes

1027
00:39:44,230 --> 00:39:42,640
okay well ladies and gentlemen and folks

1028
00:39:45,270 --> 00:39:44,240
watching on some tv

1029
00:39:46,870 --> 00:39:45,280
there's nothing wrong with your

1030
00:39:48,630 --> 00:39:46,880
television i'm not amber strong i'm

1031
00:39:50,550 --> 00:39:48,640
dwayne brown from the office of

1032
00:39:52,230 --> 00:39:50,560
communications you know at nasa we talk

1033
00:39:53,510 --> 00:39:52,240
about teamwork so we're going to team up

1034
00:39:56,230 --> 00:39:53,520
here and i'm going to close out for

1035
00:39:57,990 --> 00:39:56,240
amber i want to thank everyone and i

1036
00:40:00,950 --> 00:39:58,000
want to thank the museum for this

1037
00:40:01,990 --> 00:40:00,960
magnificent day as we celebrate 25 years

1038
00:40:03,030 --> 00:40:02,000

tomorrow

1039
00:40:04,470 --> 00:40:03,040
a gift

1040
00:40:06,069 --> 00:40:04,480
that keeps on giving from the hubble

1041
00:40:08,710 --> 00:40:06,079
space telescope

1042
00:40:10,950 --> 00:40:08,720
this photo the video and any other of

1043
00:40:13,150 --> 00:40:10,960
the incredible images and information

1044
00:40:15,990 --> 00:40:13,160
are available online at

1045
00:40:18,310 --> 00:40:16,000
www.nasa.gov and the official

1046
00:40:23,349 --> 00:40:18,320
hubble 25th anniversary

1047
00:40:27,829 --> 00:40:24,390
i want to thank

1048
00:40:31,030 --> 00:40:27,839
everyone i want to say happy birthday