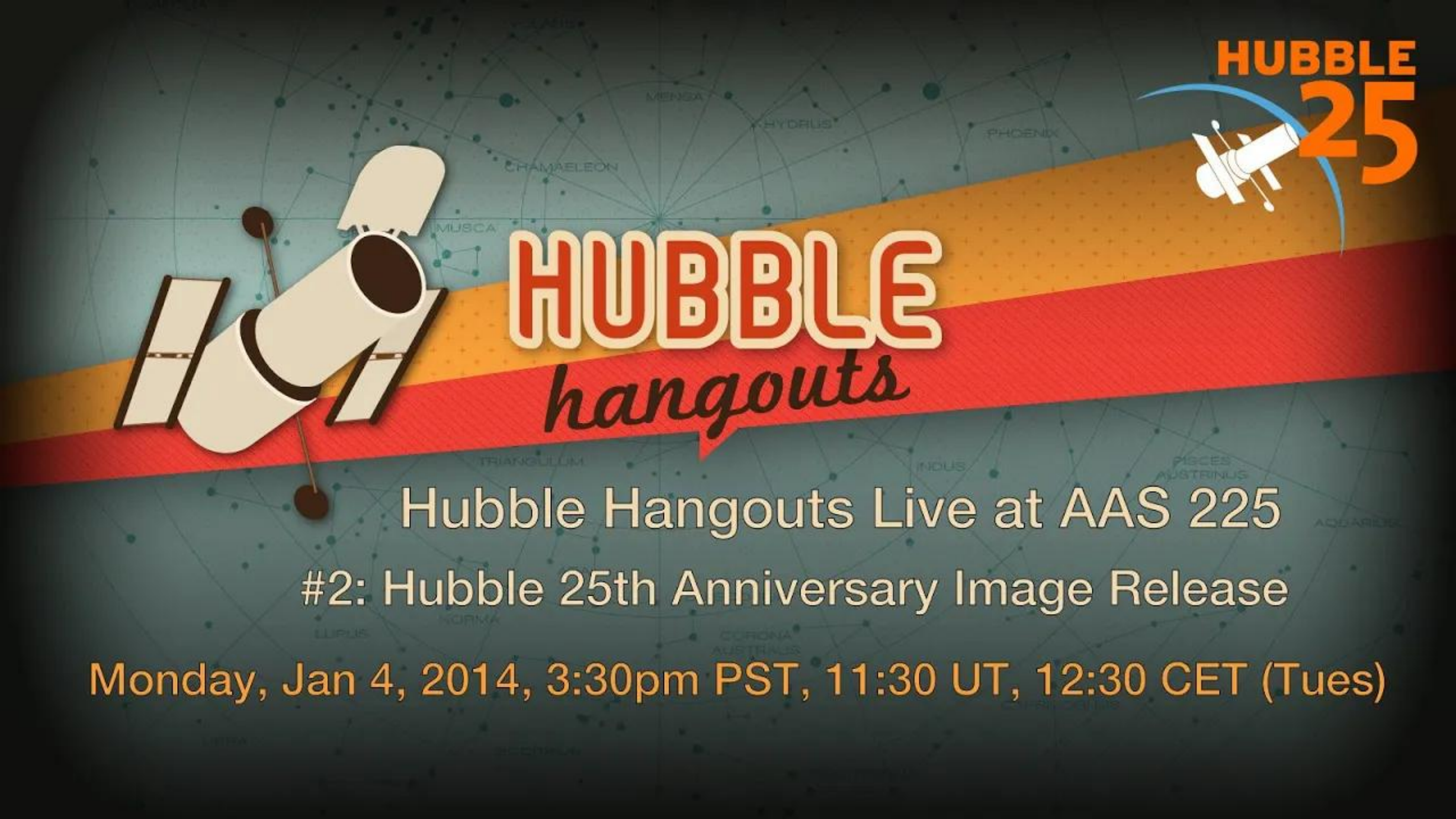
HUBBLE
25
HUBBLE
hangouts
Hubble Hangouts Live at AAS 225
#2: Hubble 25th Anniversary Image Release
Monday, Jan 4, 2014, 3:30pm PST, 11:30 UT, 12:30 CET (Tues)

1
00:00:15,650 --> 00:00:13,549
okay hello everybody and welcome again

2
00:00:18,290 --> 00:00:15,660
to our second I will hang out of the day

3
00:00:19,820 --> 00:00:18,300
at the 225th meeting of the american

4
00:00:22,250 --> 00:00:19,830
astronomical society we're live folks

5
00:00:25,670 --> 00:00:22,260
this is it we are in our exhibit booth

6
00:00:27,920 --> 00:00:25,680
and yeah and carols with me and as well

7
00:00:29,330 --> 00:00:27,930
as Zolt lavey and soon we'll be joined

8
00:00:32,959 --> 00:00:29,340
by this empty chair will be taken up by

9
00:00:34,040 --> 00:00:32,969
Paul is going who actually helped take

10
00:00:36,680 --> 00:00:34,050
the image that we're going to talk about

11
00:00:39,410 --> 00:00:36,690
today because as you may not know and if

12
00:00:41,569 --> 00:00:39,420
you don't know you know now that Hubble

13
00:00:43,490 --> 00:00:41,579

we are celebrating the 25th anniversary

14
00:00:45,590 --> 00:00:43,500
of the Hubble Space Telescope being in

15
00:00:47,779 --> 00:00:45,600
orbit above our heads and that is

16
00:00:49,520 --> 00:00:47,789
remarkable folks no other telescope has

17
00:00:53,540 --> 00:00:49,530
been up there that long i think that's

18
00:00:54,920 --> 00:00:53,550
right right okay so so this is this is

19
00:00:56,779 --> 00:00:54,930
the time we're getting started it'll all

20
00:00:59,900 --> 00:00:56,789
culminate in april on april twentieth

21
00:01:02,689 --> 00:00:59,910
and to celebrate the this auspicious

22
00:01:03,740 --> 00:01:02,699
events this auspicious occasion we have

23
00:01:06,320 --> 00:01:03,750
released the Space Telescope Science

24
00:01:08,990 --> 00:01:06,330
Institute is released a an anniversary

25
00:01:11,179 --> 00:01:09,000
image but it's not d anniversary image

26
00:01:15,260 --> 00:01:11,189
right it's one of the anniversary images

27
00:01:16,999 --> 00:01:15,270
that kickoff kick off of festivities now

28
00:01:20,990 --> 00:01:17,009
we are in a bit of an awkward situation

29
00:01:22,880 --> 00:01:21,000
folks I am doing this live and

30
00:01:24,770 --> 00:01:22,890
ordinarily we have hangouts on air which

31
00:01:26,960 --> 00:01:24,780
give us this ability to share our

32
00:01:28,789 --> 00:01:26,970
screens but because i'm streaming via a

33
00:01:31,640 --> 00:01:28,799
backpack that does not allow me to use

34
00:01:33,609 --> 00:01:31,650
the internet from the convention i'm

35
00:01:36,319 --> 00:01:33,619
kind of limited by what i can do

36
00:01:37,940 --> 00:01:36,329
technologically dreaming camping yeah

37
00:01:39,620 --> 00:01:37,950
we're streaming camping but we have

38
00:01:42,200 --> 00:01:39,630

bandwidth where no one else does so

39
00:01:43,880 --> 00:01:42,210
that's cool too so we are streaming

40
00:01:45,170 --> 00:01:43,890
straight to youtube which means that i

41
00:01:47,719 --> 00:01:45,180
don't have the tools ordinarily

42
00:01:50,090 --> 00:01:47,729
available to me to share my screen and

43
00:01:53,630 --> 00:01:50,100
to show you the image so it's kind of

44
00:01:57,649 --> 00:01:53,640
awkward we also have hecklers all around

45
00:01:58,910 --> 00:01:57,659
us our colleagues that's right so in a

46
00:02:01,789 --> 00:01:58,920
while we're broadcasting people want to

47
00:02:04,190 --> 00:02:01,799
make faces at us so what I've done is

48
00:02:06,469 --> 00:02:04,200
I've taken the 25th an event the image

49
00:02:08,059 --> 00:02:06,479
was just released at two-fifteen pacific

50
00:02:09,859 --> 00:02:08,069
time so it's brand new it's just been

51
00:02:12,170 --> 00:02:09,869
put out I put a link to the press

52
00:02:13,430 --> 00:02:12,180
release on the Google+ event page so you

53
00:02:15,410 --> 00:02:13,440
can go and we'll look at all that

54
00:02:17,360 --> 00:02:15,420
versions of the image there as well as

55
00:02:20,060 --> 00:02:17,370
on the Google+ page our Facebook page

56
00:02:21,710 --> 00:02:20,070
and it's on Twitter and if you need

57
00:02:23,240 --> 00:02:21,720
somewhere else to go see it I would

58
00:02:25,130 --> 00:02:23,250
encourage you to let me know because

59
00:02:29,000 --> 00:02:25,140
I've got a shaun prescott here from nasa

60
00:02:32,780 --> 00:02:29,010
monitoring the youtube oh and we all

61
00:02:37,460 --> 00:02:32,790
would be but don't unveil it yet our

62
00:02:40,490 --> 00:02:37,470
super high-tech super high-tech way of

63
00:02:43,940 --> 00:02:40,500

doing it here so with that I'm gonna I'm

64
00:02:46,790 --> 00:02:43,950
going to hand this over to oh so he's

65
00:02:48,560 --> 00:02:46,800
monitoring in a minute I'm you tell me

66
00:02:50,750 --> 00:02:48,570
how they can interact with us Google+

67
00:02:54,020 --> 00:02:50,760
event page YouTube comments Twitter

68
00:02:55,790 --> 00:02:54,030
Hubble hang out hashtag and Hubble 25

69
00:02:57,080 --> 00:02:55,800
okay we're also looking at that one and

70
00:02:58,820 --> 00:02:57,090
we will get to your comments and

71
00:03:02,360 --> 00:02:58,830
questions we hope you have some okay

72
00:03:06,260 --> 00:03:02,370
Carol go ahead okay so this is the first

73
00:03:09,950 --> 00:03:06,270
part of the m16 image release and it's

74
00:03:11,690 --> 00:03:09,960
the optical part of the image okay now

75
00:03:21,520 --> 00:03:11,700
get ready this is weird this is gonna be

76
00:03:24,080 --> 00:03:21,530
weak reflections and all that's right

77
00:03:26,000 --> 00:03:24,090
okay so what you're looking at is what

78
00:03:27,350 --> 00:03:26,010
are they looking at their soul tell us a

79
00:03:34,010 --> 00:03:27,360
little bit about what we've taken and

80
00:03:36,560 --> 00:03:34,020
why org so what we're looking at is the

81
00:03:40,430 --> 00:03:36,570
famous what's become known as the

82
00:03:43,060 --> 00:03:40,440
pillars of creation m16 the eagle nebula

83
00:03:45,949 --> 00:03:43,070
whatever you want to call it these are

84
00:03:49,479 --> 00:03:45,959
pillars of gas and dust that are being

85
00:03:52,850 --> 00:03:49,489
eroded by stars that are off the picture

86
00:03:54,460 --> 00:03:52,860
so we've taken a new image with all the

87
00:03:57,110 --> 00:03:54,470
space telescope with the current

88
00:04:00,229 --> 00:03:57,120

instrumentation on telescope the wide

89
00:04:03,949 --> 00:04:00,239
field camera 3 with c3 instrument so

90
00:04:06,500 --> 00:04:03,959
this image that you just saw is a

91
00:04:09,770 --> 00:04:06,510
visible light image in the light of

92
00:04:14,030 --> 00:04:09,780
three chemical elements hydrogen oxygen

93
00:04:15,830 --> 00:04:14,040
and sulfur the color colors have been

94
00:04:20,090 --> 00:04:15,840
assigned to the black and white images

95
00:04:21,890 --> 00:04:20,100
of those three images in the sense of

96
00:04:24,590 --> 00:04:21,900
the oxygen is

97
00:04:26,300 --> 00:04:24,600
blue hydrogen is green and the sulfur is

98
00:04:30,950 --> 00:04:26,310
red and when you combine those you get

99
00:04:34,420 --> 00:04:30,960
this nice colourful image we actually

100
00:04:39,110 --> 00:04:34,430
made a second image in infrared light

101
00:04:41,240 --> 00:04:39,120
and I okay it came out ok so the

102
00:04:46,420 --> 00:04:41,250
original image that this kind of

103
00:04:49,790 --> 00:04:46,430
reprises is was made in 1995 with the

104
00:04:54,140 --> 00:04:49,800
with pic to camera on the telescope back

105
00:04:59,469 --> 00:04:54,150
then and became this iconic very popular

106
00:05:03,290 --> 00:04:59,479
image and so we thought we'd see what

107
00:05:06,260 --> 00:05:03,300
the pillars of creation and pillars of

108
00:05:09,409 --> 00:05:06,270
creation because stars are being created

109
00:05:13,550 --> 00:05:09,419
inside these pillars and pillars because

110
00:05:15,320 --> 00:05:13,560
this is relatively dense gas that so

111
00:05:17,659 --> 00:05:15,330
actually there's a dense material at the

112
00:05:21,710 --> 00:05:17,669
top and the less dense materials being

113
00:05:23,779 --> 00:05:21,720

eroded away and being shadowed actually

114
00:05:25,790 --> 00:05:23,789
the pillars are shadowed by this denser

115
00:05:27,920 --> 00:05:25,800
material at the top and so it's creating

116
00:05:30,020 --> 00:05:27,930
these pillars so that's why it's pillars

117
00:05:30,980 --> 00:05:30,030
of creation so this camera the whipping

118
00:05:32,870 --> 00:05:30,990
to you're talking about had lower

119
00:05:36,469 --> 00:05:32,880
resolution and the field of view at the

120
00:05:37,969 --> 00:05:36,479
time was a lot smaller and narrower and

121
00:05:39,920 --> 00:05:37,979
it go anything that Carol said this is

122
00:05:41,899 --> 00:05:39,930
in the optical wavelengths now as you

123
00:05:43,279 --> 00:05:41,909
all know back in 2009 we sent the Space

124
00:05:45,680 --> 00:05:43,289
Shuttle up there and John Grunsfeld gave

125
00:05:48,560 --> 00:05:45,690
us a new Hubble he basically rebuilt the

126
00:05:50,629 --> 00:05:48,570
thing put in new cameras new filters a

127
00:05:52,339 --> 00:05:50,639
new electronics new gyros all kinds of

128
00:05:55,040 --> 00:05:52,349
things so Hubble is now a virtually a

129
00:05:57,110 --> 00:05:55,050
brand new telescope since 2009 and with

130
00:06:00,230 --> 00:05:57,120
with and the main camera being used now

131
00:06:03,200 --> 00:06:00,240
is an infrared camera called white field

132
00:06:09,550 --> 00:06:03,210
camera 3 and so we took the picture

133
00:06:12,350 --> 00:06:09,560
again and this time they saw what we saw

134
00:06:14,570 --> 00:06:12,360
this while still coming up on my screen

135
00:06:18,999 --> 00:06:14,580
we saw

136
00:06:24,189 --> 00:06:19,009
but the infrared version of the image

137
00:06:27,860 --> 00:06:24,199
which is oh there it is finally came up

138
00:06:29,659 --> 00:06:27,870

so the most obvious thing about this

139
00:06:32,510 --> 00:06:29,669
image is that the pillars more or less

140
00:06:35,209 --> 00:06:32,520
disappear and what's happening is that

141
00:06:37,159 --> 00:06:35,219
the infrared light is able to pass

142
00:06:39,350 --> 00:06:37,169
through the material the material hasn't

143
00:06:41,689 --> 00:06:39,360
gone away but the light is able to pass

144
00:06:43,369 --> 00:06:41,699
through more of that material and we're

145
00:06:47,260 --> 00:06:43,379
seeing a lot of the stars that are

146
00:06:49,430 --> 00:06:47,270
embedded in that nebulosity or behind it

147
00:06:51,200 --> 00:06:49,440
which we can't see in the visible light

148
00:06:52,999 --> 00:06:51,210
because that material is absorbing all

149
00:06:56,240 --> 00:06:53,009
that visible light but the infrared

150
00:06:58,309 --> 00:06:56,250
light is getting through so it's really

151
00:07:01,730 --> 00:06:58,319
a very very different picture than what

152
00:07:05,809 --> 00:07:01,740
you see in invisible it was a lot wider

153
00:07:09,860 --> 00:07:05,819
to correct yeah the field of view of

154
00:07:12,379 --> 00:07:09,870
both the visible light camera on whoops

155
00:07:16,850 --> 00:07:12,389
III and the infrared camera on with c3

156
00:07:18,589 --> 00:07:16,860
are wider than the with pic to the field

157
00:07:21,219 --> 00:07:18,599
of view of the which the three visible

158
00:07:25,219 --> 00:07:21,229
light cameras larger than the infrared

159
00:07:27,080 --> 00:07:25,229
and we also made a little mosaic so this

160
00:07:29,209 --> 00:07:27,090
is not just one pointing of the

161
00:07:32,300 --> 00:07:29,219
telescope it's actually four pointings

162
00:07:34,369 --> 00:07:32,310
of the telescope in a two by two grid so

163
00:07:35,809 --> 00:07:34,379

we made a much wider field of view and

164
00:07:38,329 --> 00:07:35,819
we really wanted to see the area around

165
00:07:41,629 --> 00:07:38,339
it one of the most important things to

166
00:07:43,820 --> 00:07:41,639
do was to get the bottom parts of the

167
00:07:45,409 --> 00:07:43,830
pillars and it's interesting and one of

168
00:07:47,659 --> 00:07:45,419
the interesting features about the image

169
00:07:50,029 --> 00:07:47,669
is how the pillars kind of actually

170
00:07:52,309 --> 00:07:50,039
disappear at the bottom and they're kind

171
00:07:54,379 --> 00:07:52,319
of disconnected from the rest of the

172
00:07:56,540 --> 00:07:54,389
nebulosity that there's more of done

173
00:07:57,829 --> 00:07:56,550
underneath i'm hoping i will get our

174
00:07:59,329 --> 00:07:57,839
astronomer here to tell us a little bit

175
00:08:01,339 --> 00:07:59,339
more about the details of what's going

176
00:08:02,390 --> 00:08:01,349
on astronomically and there but carol do

177
00:08:07,100 --> 00:08:02,400
you have any comments what strikes you

178
00:08:09,920 --> 00:08:07,110
about this image well one of one of the

179
00:08:11,779 --> 00:08:09,930
big questions when the first image was

180
00:08:14,360 --> 00:08:11,789
taken besides the fact that it really

181
00:08:17,209 --> 00:08:14,370
demonstrated how powerful Hubble Space

182
00:08:19,939 --> 00:08:17,219
Telescope was at the time and what its

183
00:08:22,249 --> 00:08:19,949
bright future was going to be is what's

184
00:08:25,579 --> 00:08:22,259
inside those pillars and so now that

185
00:08:28,340 --> 00:08:25,589
we've seen the infrared image from

186
00:08:30,950 --> 00:08:28,350
Hubble at a similar resolution

187
00:08:34,820 --> 00:08:30,960
to the optical image we can see that the

188
00:08:37,520 --> 00:08:34,830

the very top and the dense regions there

189
00:08:39,320 --> 00:08:37,530
are indeed it was suspected and a couple

190
00:08:41,510 --> 00:08:39,330
of stars were seen but it was suspected

191
00:08:44,330 --> 00:08:41,520
that there were stars forming in there

192
00:08:46,520 --> 00:08:44,340
now I know at one time there was some

193
00:08:48,890 --> 00:08:46,530
speculation that there were lots of

194
00:08:51,830 --> 00:08:48,900
stars forming in there and i think that

195
00:08:54,500 --> 00:08:51,840
the scientist who originally worked on

196
00:08:56,030 --> 00:08:54,510
the first image have now been looking at

197
00:08:58,610 --> 00:08:56,040
this image and they haven't had it very

198
00:09:00,320 --> 00:08:58,620
long but my understanding is that what

199
00:09:02,810 --> 00:09:00,330
they said there are fewer stars than

200
00:09:06,230 --> 00:09:02,820
what they thought and part of the reason

201
00:09:08,870 --> 00:09:06,240
is that the top of the pillars is so

202
00:09:12,890 --> 00:09:08,880
dense and that's why even in the

203
00:09:16,580 --> 00:09:12,900
infrared you can't see through them so

204
00:09:19,040 --> 00:09:16,590
that it's difficult for many stars to

205
00:09:20,630 --> 00:09:19,050
form in there and also the other

206
00:09:23,150 --> 00:09:20,640
interesting thing is that the brightest

207
00:09:25,280 --> 00:09:23,160
stars are actually ablating and blowing

208
00:09:27,500 --> 00:09:25,290
away some of that gas and dust and what

209
00:09:30,230 --> 00:09:27,510
I found interesting is that from the top

210
00:09:32,420 --> 00:09:30,240
to the bottom of the pillar it takes

211
00:09:35,630 --> 00:09:32,430
five it's five light years so it takes

212
00:09:37,280 --> 00:09:35,640
five years for the light from the top of

213
00:09:40,130 --> 00:09:37,290

the pillar where the really bright stars

214
00:09:44,210 --> 00:09:40,140
are to reach the bottom so that stuff is

215
00:09:45,560 --> 00:09:44,220
sort of dissipating but very slowly so I

216
00:09:47,690 --> 00:09:45,570
have a question for either one of you is

217
00:09:49,490 --> 00:09:47,700
there been anything different about the

218
00:09:51,940 --> 00:09:49,500
nebula ssin since the first one was

219
00:09:53,930 --> 00:09:51,950
taken to get you one comment on that

220
00:09:56,750 --> 00:09:53,940
that's one of the things we wanted to

221
00:09:59,270 --> 00:09:56,760
look at right away with a 20 almost 20

222
00:10:01,610 --> 00:09:59,280
year baseline of time you'd kind of

223
00:10:03,650 --> 00:10:01,620
expect in this very dynamic environment

224
00:10:06,590 --> 00:10:03,660
that you might be able to see some

225
00:10:08,780 --> 00:10:06,600
differences now the opposite side of

226
00:10:11,390 --> 00:10:08,790
that is that it's a very large structure

227
00:10:15,370 --> 00:10:11,400
so you'd have to have things moving

228
00:10:19,070 --> 00:10:15,380
incredibly fast to have them move enough

229
00:10:21,380 --> 00:10:19,080
and it's far away so you'd have to have

230
00:10:23,720 --> 00:10:21,390
it moving very fast to have to be able

231
00:10:25,850 --> 00:10:23,730
to notice even with Hubble's incredible

232
00:10:27,080 --> 00:10:25,860
resolution that's something move and in

233
00:10:29,690 --> 00:10:27,090
fact when we started to look very

234
00:10:31,550 --> 00:10:29,700
closely we did actually see one little

235
00:10:35,450 --> 00:10:31,560
place where we did see a little bit of

236
00:10:37,340 --> 00:10:35,460
change whether that's a motion or just a

237
00:10:39,380 --> 00:10:37,350
change in that structure we're not quite

238
00:10:41,220 --> 00:10:39,390

entirely sure but it looks like what's

239
00:10:44,280 --> 00:10:41,230
happening is there's a jet from

240
00:10:46,830 --> 00:10:44,290
very new star at the near the top of one

241
00:10:49,080 --> 00:10:46,840
of the pillars and we noticed that the

242
00:10:52,800 --> 00:10:49,090
very end of that jet structure is a

243
00:10:55,920 --> 00:10:52,810
little farther away than it was in 1995

244
00:10:58,590 --> 00:10:55,930
so and it looks pretty clear and it

245
00:10:59,880 --> 00:10:58,600
looks convincing so we're kind of pretty

246
00:11:01,680 --> 00:10:59,890
convinced that we're actually seeing

247
00:11:03,840 --> 00:11:01,690
some motion there's some other little

248
00:11:06,510 --> 00:11:03,850
structures around that we see not very

249
00:11:09,080 --> 00:11:06,520
many but some structures around we see

250
00:11:11,730 --> 00:11:09,090
that are different from the 1995 image

251
00:11:14,160 --> 00:11:11,740
what strikes me about astronomy today is

252
00:11:15,750 --> 00:11:14,170
just how much that is possible now there

253
00:11:17,760 --> 00:11:15,760
was a time when the telescopes were so

254
00:11:19,170 --> 00:11:17,770
resolution or and they did the you know

255
00:11:22,260 --> 00:11:19,180
there was just no ability to resolve

256
00:11:23,760 --> 00:11:22,270
much of any detail that we all thought

257
00:11:25,290 --> 00:11:23,770
the universe ever changed you know that

258
00:11:26,820 --> 00:11:25,300
it all stayed the same and now we have

259
00:11:29,490 --> 00:11:26,830
telescopes and detectors that are so

260
00:11:31,290 --> 00:11:29,500
finely tuned and so hot at such a high

261
00:11:33,300 --> 00:11:31,300
resolution that we can actually gain

262
00:11:35,700 --> 00:11:33,310
these insights over 20 20 something

263
00:11:38,370 --> 00:11:35,710

years plus the longevity of the

264
00:11:39,900 --> 00:11:38,380
telescope that's a great thing about how

265
00:11:42,630 --> 00:11:39,910
long it's been able to last and it's

266
00:11:45,210 --> 00:11:42,640
been improved and service so it lasted

267
00:11:48,330 --> 00:11:45,220
it's 25 years and that's a fairly large

268
00:11:50,610 --> 00:11:48,340
baseline maybe not in cosmic terms but

269
00:11:53,460 --> 00:11:50,620
certainly in human terms in astronomical

270
00:11:55,380 --> 00:11:53,470
terms it's a relatively long baseline of

271
00:11:57,720 --> 00:11:55,390
time and you can start to see these

272
00:12:01,740 --> 00:11:57,730
kinds of differences another interesting

273
00:12:06,260 --> 00:12:01,750
thing that was noticed in the very first

274
00:12:08,250 --> 00:12:06,270
image I guess we have a comparison now

275
00:12:10,770 --> 00:12:08,260
yeah we're going to creep up on the

276
00:12:13,260 --> 00:12:10,780
camera so what we noticed in the what

277
00:12:16,200 --> 00:12:13,270
was noticed in the first image the

278
00:12:18,300 --> 00:12:16,210
iconic will pick to image is that the

279
00:12:21,390 --> 00:12:18,310
pillars seem to have very sharp well

280
00:12:25,050 --> 00:12:21,400
defined edges and now that we have twice

281
00:12:28,890 --> 00:12:25,060
the resolution it turns out the pillars

282
00:12:32,130 --> 00:12:28,900
have very well-defined sharp edges so

283
00:12:35,540 --> 00:12:32,140
that impression even sharper and in fact

284
00:12:37,830 --> 00:12:35,550
they're only something like 100

285
00:12:39,630 --> 00:12:37,840
astronomical unit so that's just a

286
00:12:41,940 --> 00:12:39,640
little bit bigger than the size of our

287
00:12:44,670 --> 00:12:41,950
solar system thick so they're not fuzzy

288
00:12:47,160 --> 00:12:44,680

edge they're very very sharp edges which

289
00:12:49,500 --> 00:12:47,170
is really very curious because usually

290
00:12:52,020 --> 00:12:49,510
whenever we look at these star formation

291
00:12:54,090 --> 00:12:52,030
regions we see that things are that the

292
00:12:58,730 --> 00:12:54,100
regions are very diffused

293
00:13:01,319 --> 00:12:58,740
and sort of surreal we see that

294
00:13:03,780 --> 00:13:01,329
surrounding the pillars but the pillars

295
00:13:05,730 --> 00:13:03,790
themselves have very short sharp edges

296
00:13:08,040 --> 00:13:05,740
and so that was in another important

297
00:13:11,400 --> 00:13:08,050
result and looking in both the infrared

298
00:13:14,189 --> 00:13:11,410
and the optical to determine whether our

299
00:13:20,660 --> 00:13:14,199
first impression 25 years ago was really

300
00:13:22,860 --> 00:13:20,670
true so is there any uh are there any

301
00:13:24,439 --> 00:13:22,870
surprises that came out of this things

302
00:13:26,879 --> 00:13:24,449
that we didn't expect to see or was it

303
00:13:28,559 --> 00:13:26,889
pretty much everything except for this

304
00:13:30,780 --> 00:13:28,569
one jet that we saw that was it was an

305
00:13:32,550 --> 00:13:30,790
interesting motion and he was there any

306
00:13:36,120 --> 00:13:32,560
surprises things that jumped out at the

307
00:13:39,509 --> 00:13:36,130
new with a new image I don't think there

308
00:13:42,300 --> 00:13:39,519
was a lot of surprises I think what Paul

309
00:13:45,180 --> 00:13:42,310
Schoen who worked on the original data

310
00:13:47,970 --> 00:13:45,190
did point out these these very sharp

311
00:13:50,340 --> 00:13:47,980
edges of these science Asian regions

312
00:13:52,530 --> 00:13:50,350
that was somewhat surprising that it's

313
00:13:54,509 --> 00:13:52,540

even sharper than they thought from the

314
00:13:57,150 --> 00:13:54,519
original and they were surprised at how

315
00:13:58,470 --> 00:13:57,160
sharp they were in with the two data but

316
00:14:00,179 --> 00:13:58,480
now they're seeing that they're even

317
00:14:02,759 --> 00:14:00,189
sure and that means what that means is

318
00:14:05,309 --> 00:14:02,769
that there's a very small region of

319
00:14:07,379 --> 00:14:05,319
space where this ionization has an

320
00:14:10,740 --> 00:14:07,389
effect where it changes over a

321
00:14:13,530 --> 00:14:10,750
relatively small span of space and that

322
00:14:14,970 --> 00:14:13,540
that space is even smaller than they

323
00:14:17,910 --> 00:14:14,980
originally thought so it's things like

324
00:14:20,569 --> 00:14:17,920
that although you know I mean part of

325
00:14:24,319 --> 00:14:20,579
the reason we did the observation was to

326
00:14:26,819 --> 00:14:24,329
come out to have a picture to look at

327
00:14:29,900 --> 00:14:26,829
and we kind of knew what to expect

328
00:14:33,900 --> 00:14:29,910
because it hasn't changed much since

329
00:14:38,429 --> 00:14:33,910
1995 and the instrumentation while it's

330
00:14:40,319 --> 00:14:38,439
improved in its improved greatly in

331
00:14:42,960 --> 00:14:40,329
resolution and sensitivity and so forth

332
00:14:45,470 --> 00:14:42,970
it's really the same kind of camera and

333
00:14:47,939 --> 00:14:45,480
we use the same filters and

334
00:14:50,939 --> 00:14:47,949
intentionally so that we could compare

335
00:14:55,050 --> 00:14:50,949
kind of apples and apples the image is

336
00:14:56,699 --> 00:14:55,060
the 1985 image to the 2014 image that

337
00:15:01,750 --> 00:14:56,709
was all very

338
00:15:04,660 --> 00:15:01,760

okay Paul's here now so so we have Paul

339
00:15:05,800 --> 00:15:04,670
skallon with us he's the you just got

340
00:15:10,120 --> 00:15:05,810
back from a press release welcome to our

341
00:15:15,790 --> 00:15:10,130
we're on a lot of questions and stuff

342
00:15:17,290 --> 00:15:15,800
that's okay we were talking about the

343
00:15:18,790 --> 00:15:17,300
image itself job was telling us some of

344
00:15:20,230 --> 00:15:18,800
the ways you know some of the

345
00:15:22,269 --> 00:15:20,240
wavelengths and the differences things

346
00:15:25,449 --> 00:15:22,279
that they found that was the varied from

347
00:15:26,650 --> 00:15:25,459
the 1995 image so what about what are

348
00:15:28,259 --> 00:15:26,660
some of the things scientifically that

349
00:15:31,210 --> 00:15:28,269
you found interesting about this image

350
00:15:33,009 --> 00:15:31,220
the neat stuff about these these new

351
00:15:34,389 --> 00:15:33,019
pictures is you've got several things

352
00:15:37,900 --> 00:15:34,399
going for it it's about three things

353
00:15:40,389 --> 00:15:37,910
that really are so much better than the

354
00:15:41,920 --> 00:15:40,399
the data we took remember the first day

355
00:15:44,230 --> 00:15:41,930
we talked was with the first camera

356
00:15:48,550 --> 00:15:44,240
right the first clear the first clear

357
00:15:50,889 --> 00:15:48,560
camera and it provided at that time the

358
00:15:52,420 --> 00:15:50,899
sharpest field of view the shop is view

359
00:15:55,000 --> 00:15:52,430
of what all the structure in the nebula

360
00:15:58,689 --> 00:15:55,010
was like with these data we've got twice

361
00:16:01,030 --> 00:15:58,699
the resolution okay now and that's

362
00:16:02,290 --> 00:16:01,040
spectacular because what a lot of what

363
00:16:05,530 --> 00:16:02,300

we did a lot of the physics that we

364
00:16:08,230 --> 00:16:05,540
learned back then was understanding how

365
00:16:10,000 --> 00:16:08,240
the photons coming from the massive

366
00:16:13,090 --> 00:16:10,010
stars at the center of the cluster were

367
00:16:15,160 --> 00:16:13,100
actually a blazing the walls of the

368
00:16:16,720 --> 00:16:15,170
nebula and eroding it away when you look

369
00:16:19,000 --> 00:16:16,730
at the tops of the pillars you can see

370
00:16:22,300 --> 00:16:19,010
these blue streamers right what you're

371
00:16:28,199 --> 00:16:22,310
looking at there is the ionized gas from

372
00:16:32,139 --> 00:16:28,209
those massive stars being ablated by hi

373
00:16:38,860 --> 00:16:32,149
there we go so little seed oil pants

374
00:16:40,750 --> 00:16:38,870
this isn't it so ok so the stream is at

375
00:16:42,309 --> 00:16:40,760
the top there really show you we already

376
00:16:45,340 --> 00:16:42,319
we already have some suspicions that

377
00:16:47,860 --> 00:16:45,350
this went on in the walls of h2 regions

378
00:16:49,689 --> 00:16:47,870
but this was the first real photographic

379
00:16:52,600 --> 00:16:49,699
evidence of it that you were looking at

380
00:16:56,590 --> 00:16:52,610
gas being eroded away from the walls of

381
00:16:58,660 --> 00:16:56,600
the of the cut of the cavity and that's

382
00:17:00,819 --> 00:16:58,670
great because but you really had to

383
00:17:03,370 --> 00:17:00,829
model it you had to understand how sharp

384
00:17:05,590 --> 00:17:03,380
the edge of those pillars was and so

385
00:17:07,780 --> 00:17:05,600
when you look in the picture that we

386
00:17:09,490 --> 00:17:07,790
took in 95 and you compare it to any

387
00:17:09,850 --> 00:17:09,500
ground-based picture that's been taken

388
00:17:13,179 --> 00:17:09,860

before

389
00:17:14,710 --> 00:17:13,189
all sins for the most part you can tell

390
00:17:17,020 --> 00:17:14,720
it's sharp but you didn't know how sharp

391
00:17:20,169 --> 00:17:17,030
it was so Hubble offered that for the

392
00:17:22,270 --> 00:17:20,179
first time now with these data we look

393
00:17:24,880 --> 00:17:22,280
at and we can see it's even sharper than

394
00:17:26,049 --> 00:17:24,890
we thought something about that what is

395
00:17:27,130 --> 00:17:26,059
what what's the big deal about that

396
00:17:29,470 --> 00:17:27,140
what's the big deal about the sharpness

397
00:17:31,990 --> 00:17:29,480
ok the sharpness is when you're trying

398
00:17:34,240 --> 00:17:32,000
to do the modeling ok you do the

399
00:17:36,220 --> 00:17:34,250
classical numerical modeling of the gas

400
00:17:37,780 --> 00:17:36,230
dynamics of the interface one of the

401
00:17:40,299 --> 00:17:37,790
things you have to build into that is

402
00:17:42,250 --> 00:17:40,309
what kind of density contrast are you

403
00:17:44,470 --> 00:17:42,260
are you running up against when you're

404
00:17:48,039 --> 00:17:44,480
building your model you need to know how

405
00:17:50,500 --> 00:17:48,049
sharp a wall it is a joke yeah so like

406
00:17:53,980 --> 00:17:50,510
so in the center of the of the nebula

407
00:17:55,659 --> 00:17:53,990
it's really tenuous gas ok now what the

408
00:17:59,140 --> 00:17:55,669
reason you see the pillars the way they

409
00:18:02,770 --> 00:17:59,150
are is that it's much denser gas ok it's

410
00:18:06,130 --> 00:18:02,780
like running up against a really sharp

411
00:18:09,430 --> 00:18:06,140
fog bank here on the earth all right but

412
00:18:12,520 --> 00:18:09,440
instead where I'm from in Arizona we

413
00:18:14,590 --> 00:18:12,530

don't have fog banks we have dust storms

414
00:18:16,750 --> 00:18:14,600
and believe me when you run in one of

415
00:18:20,549 --> 00:18:16,760
those you know that's a pretty sharp

416
00:18:22,960 --> 00:18:20,559
contrast that's a sharp edge and

417
00:18:25,570 --> 00:18:22,970
understanding how sharp that edges

418
00:18:28,270 --> 00:18:25,580
affects the way you model how the

419
00:18:30,520 --> 00:18:28,280
photons have a light how the ionizing

420
00:18:33,159 --> 00:18:30,530
radiation from those central stars makes

421
00:18:35,950 --> 00:18:33,169
it through that wall and the reason we

422
00:18:38,020 --> 00:18:35,960
care is why the infrared picture is

423
00:18:40,030 --> 00:18:38,030
important what is the diff when you look

424
00:18:41,650 --> 00:18:40,040
at the two pictures right what's the big

425
00:18:43,360 --> 00:18:41,660
difference they're still pretty it's

426
00:18:46,510 --> 00:18:43,370
still pretty dark it's still pretty dark

427
00:18:48,400 --> 00:18:46,520
but there's so many stars right the

428
00:18:50,919 --> 00:18:48,410
reason you see so many stars is you're

429
00:18:55,750 --> 00:18:50,929
seeing through that interface through

430
00:18:57,640 --> 00:18:55,760
that dust storm edge if you like and the

431
00:18:59,680 --> 00:18:57,650
reason because is because as that

432
00:19:02,590 --> 00:18:59,690
interface gets a bladed away it

433
00:19:04,620 --> 00:19:02,600
compresses the gas behind it that region

434
00:19:07,539 --> 00:19:04,630
is called the photodissociation region

435
00:19:11,500 --> 00:19:07,549
ok yeah wish to most but to most people

436
00:19:13,510 --> 00:19:11,510
like day ok but what the the impact of

437
00:19:15,850 --> 00:19:13,520
that is is the gas gets compressed and

438
00:19:19,240 --> 00:19:15,860

you make a second generation of stars

439
00:19:20,680 --> 00:19:19,250
back there alright and separation as

440
00:19:24,370 --> 00:19:20,690
from the first generation

441
00:19:25,930 --> 00:19:24,380
yes so the fact that you made stars in

442
00:19:27,300 --> 00:19:25,940
one part of the galaxy in that

443
00:19:29,950 --> 00:19:27,310
particular part of the neighborhood

444
00:19:32,770 --> 00:19:29,960
intimately affects how the second

445
00:19:35,050 --> 00:19:32,780
generation of stars around it forms now

446
00:19:37,780 --> 00:19:35,060
the thing that the Eagle Nebula picture

447
00:19:39,460 --> 00:19:37,790
in 1995 represented was that because

448
00:19:42,270 --> 00:19:39,470
when you look at the top of the left

449
00:19:44,440 --> 00:19:42,280
hand pillar you see all these little

450
00:19:48,580 --> 00:19:44,450
dragon heads sticking out of the top

451
00:19:50,910 --> 00:19:48,590
those are proto stellar systems caught

452
00:19:54,280 --> 00:19:50,920
in the act of still collapsing still

453
00:19:57,490 --> 00:19:54,290
accreting gas to get bigger and brighter

454
00:19:59,800 --> 00:19:57,500
and they're being dug up too early right

455
00:20:01,990 --> 00:19:59,810
there being dug up and thrown out into

456
00:20:03,700 --> 00:20:02,000
that stores people by the other stars

457
00:20:07,060 --> 00:20:03,710
being formed and ablating their their

458
00:20:09,400 --> 00:20:07,070
nursery interface or environment and so

459
00:20:12,130 --> 00:20:09,410
that that was the first time we saw

460
00:20:15,510 --> 00:20:12,140
direct evidence that primary star

461
00:20:19,620 --> 00:20:15,520
formation affects how big or how

462
00:20:22,810 --> 00:20:19,630
pervasive or how bright the second step

463
00:20:24,940 --> 00:20:22,820

second generation of stars can be and so

464
00:20:26,950 --> 00:20:24,950
that's a pretty wild place in there then

465
00:20:29,590 --> 00:20:26,960
a lot of stuff's going oh yeah just

466
00:20:33,490 --> 00:20:29,600
about any of these h 2 regions really

467
00:20:36,300 --> 00:20:33,500
are very dynamic environments I have a

468
00:20:38,680 --> 00:20:36,310
question that I wanted to ask you before

469
00:20:41,380 --> 00:20:38,690
and I'm not sure if anybody asked you

470
00:20:43,480 --> 00:20:41,390
but in some of these places you know

471
00:20:45,490 --> 00:20:43,490
were you afte after the original

472
00:20:48,010 --> 00:20:45,500
observation and we did pillars of

473
00:20:49,780 --> 00:20:48,020
creation and star formation we started

474
00:20:52,150 --> 00:20:49,790
looking at Orion and some other places

475
00:20:55,360 --> 00:20:52,160
and we started talking about the

476
00:20:56,890 --> 00:20:55,370
formation of exoplanet systems little

477
00:20:58,450 --> 00:20:56,900
fingers that your dragon heads that

478
00:21:00,910 --> 00:20:58,460
you're talking about are those places

479
00:21:04,750 --> 00:21:00,920
then going to be disrupted and not able

480
00:21:07,090 --> 00:21:04,760
to form exoplanetary systems and maybe

481
00:21:10,540 --> 00:21:07,100
other places in the pillar will or do

482
00:21:13,780 --> 00:21:10,550
you have a feeling for that or great

483
00:21:16,660 --> 00:21:13,790
question because what they note she's a

484
00:21:20,020 --> 00:21:16,670
great straight man because the the whole

485
00:21:23,020 --> 00:21:20,030
point the whole point of the infrared

486
00:21:25,420 --> 00:21:23,030
image is that in places the pillars look

487
00:21:27,250 --> 00:21:25,430
absolutely translucent right but still

488
00:21:29,230 --> 00:21:27,260

in the upper segments of each of those

489
00:21:31,720 --> 00:21:29,240
pillars they're still pretty dark in the

490
00:21:34,190 --> 00:21:31,730
infrared image but what you can see when

491
00:21:37,400 --> 00:21:34,200
you blink the two pictures together

492
00:21:39,920 --> 00:21:37,410
is that there are stellar sources buried

493
00:21:42,350 --> 00:21:39,930
in there and so we can do exactly the

494
00:21:43,520 --> 00:21:42,360
assessment you just describes that get

495
00:21:45,500 --> 00:21:43,530
you know when we originally did the

496
00:21:48,560 --> 00:21:45,510
analysis 20 years ago I think we

497
00:21:52,160 --> 00:21:48,570
identified 60 to 70 possible proto

498
00:21:54,470 --> 00:21:52,170
stellar clumps right but the number of

499
00:21:56,630 --> 00:21:54,480
objects that we had a stellar source in

500
00:21:58,400 --> 00:21:56,640
the heart of we couldn't assess in the

501
00:22:00,740 --> 00:21:58,410
optical because it was completely

502
00:22:03,380 --> 00:22:00,750
shrouded right but now in the infrared

503
00:22:05,930 --> 00:22:03,390
that veil has been lifted and based on

504
00:22:07,970 --> 00:22:05,940
just my first analysis of the data it

505
00:22:14,030 --> 00:22:07,980
looks like ten to fifteen percent of

506
00:22:16,250 --> 00:22:14,040
those clumps do now have or have stellar

507
00:22:20,870 --> 00:22:16,260
sources in the center of them so that

508
00:22:22,610 --> 00:22:20,880
gives you an immediate assessment of how

509
00:22:25,100 --> 00:22:22,620
many of those clumps ultimately will

510
00:22:29,390 --> 00:22:25,110
amount to nothing and how many of those

511
00:22:31,040 --> 00:22:29,400
clumps ultimately will become a star but

512
00:22:33,290 --> 00:22:31,050
probably a lot smaller star than it

513
00:22:36,260 --> 00:22:33,300

would have been because of the process

514
00:22:38,120 --> 00:22:36,270
now your other part of your question is

515
00:22:41,150 --> 00:22:38,130
about the planetary systems around them

516
00:22:42,890 --> 00:22:41,160
right because the question is when you

517
00:22:44,900 --> 00:22:42,900
when you oblate those things when you

518
00:22:47,300 --> 00:22:44,910
start beating them up with these massive

519
00:22:49,490 --> 00:22:47,310
stellar winds are you actually I'm

520
00:22:51,350 --> 00:22:49,500
cutting off the sink of material that

521
00:22:53,330 --> 00:22:51,360
might ultimately end up in a

522
00:22:55,460 --> 00:22:53,340
circumstellar disk and that might

523
00:22:57,410 --> 00:22:55,470
ultimately become that stars version of

524
00:22:58,760 --> 00:22:57,420
a solar system there's been actually a

525
00:23:01,040 --> 00:22:58,770
number of people who have done a lot of

526
00:23:03,830 --> 00:23:01,050
numerical modeling work of this kind in

527
00:23:06,530 --> 00:23:03,840
the intervening 20 years because because

528
00:23:08,090 --> 00:23:06,540
of all the other nebulae right we've

529
00:23:09,740 --> 00:23:08,100
seen this kind of stuff going on in

530
00:23:11,780 --> 00:23:09,750
Orion we've seen it going on in the

531
00:23:14,480 --> 00:23:11,790
trifid we've seen it going a variety of

532
00:23:15,920 --> 00:23:14,490
different places so the question is that

533
00:23:17,630 --> 00:23:15,930
they were trying to answer was if you

534
00:23:20,750 --> 00:23:17,640
have a bunch of protostellar and proto

535
00:23:23,810 --> 00:23:20,760
planetary systems like that in the close

536
00:23:26,750 --> 00:23:23,820
proximity to massive stars what are the

537
00:23:28,790 --> 00:23:26,760
chances how long can it actually stick

538
00:23:31,040 --> 00:23:28,800

around and the remarkable thing is that

539
00:23:34,070 --> 00:23:31,050
by that it depends on where they are in

540
00:23:36,070 --> 00:23:34,080
the phase of aggregating material but a

541
00:23:38,930 --> 00:23:36,080
lot of them actually can survive and

542
00:23:43,120 --> 00:23:38,940
where some of this act became actually

543
00:23:45,520 --> 00:23:43,130
really quite at home and personal was a

544
00:23:47,920 --> 00:23:45,530
my own home department at Arizona State

545
00:23:49,930 --> 00:23:47,930
we have a lot of different folks working

546
00:23:51,940 --> 00:23:49,940
together we've got geologists meteor it

547
00:23:53,440 --> 00:23:51,950
assists planetary scientists all kind of

548
00:23:55,360 --> 00:23:53,450
stuff working together with astronomers

549
00:23:57,610 --> 00:23:55,370
we have one of the best meteorite

550
00:23:58,900 --> 00:23:57,620
collections in the world and we went in

551
00:24:02,920 --> 00:23:58,910
and had a look at some of the meteorite

552
00:24:05,620 --> 00:24:02,930
evidence for abundances of different

553
00:24:07,480 --> 00:24:05,630
kinds of isotopic materials in the

554
00:24:09,220 --> 00:24:07,490
meteorite matrices that we see from

555
00:24:11,580 --> 00:24:09,230
objects that have fallen to earth here

556
00:24:14,110 --> 00:24:11,590
and when you look at the isotopic

557
00:24:16,270 --> 00:24:14,120
abundances of things like iron and

558
00:24:18,790 --> 00:24:16,280
nickel you find that they have been

559
00:24:21,940 --> 00:24:18,800
enhanced in exactly the way you would

560
00:24:25,150 --> 00:24:21,950
expect by a supernova going off really

561
00:24:29,910 --> 00:24:25,160
nearby right when our start when our

562
00:24:34,240 --> 00:24:32,410
right because to test because

563
00:24:36,670 --> 00:24:34,250

statistically that's what it tells you

564
00:24:38,920 --> 00:24:36,680
right for your solar system our solar

565
00:24:42,190 --> 00:24:38,930
system to be caught at that very instant

566
00:24:44,530 --> 00:24:42,200
of forming and a supernova just happens

567
00:24:46,930 --> 00:24:44,540
to be right next door and go boom means

568
00:24:50,230 --> 00:24:46,940
that we formed in a massive sterile

569
00:24:52,630 --> 00:24:50,240
environment just like the Eagle so when

570
00:24:55,750 --> 00:24:52,640
we're looking at the eagle we're looking

571
00:24:59,290 --> 00:24:55,760
at old family photos right that's that's

572
00:25:00,490 --> 00:24:59,300
really well exactly exactly so the super

573
00:25:02,320 --> 00:25:00,500
the supernova you're talking about

574
00:25:03,760 --> 00:25:02,330
though that isn't necessarily in the

575
00:25:06,120 --> 00:25:03,770
eagle nebula itself is just somewhere in

576
00:25:08,200 --> 00:25:06,130
the vicinity right no the the very

577
00:25:10,240 --> 00:25:08,210
massive stars at the center of the

578
00:25:12,670 --> 00:25:10,250
nebula right the ones that are lighting

579
00:25:14,050 --> 00:25:12,680
up the whole neighborhood's the only

580
00:25:16,150 --> 00:25:14,060
stars that can kick out that much

581
00:25:18,970 --> 00:25:16,160
ultraviolet radiation are the most

582
00:25:22,030 --> 00:25:18,980
massive stars are the OB stars that we

583
00:25:25,720 --> 00:25:22,040
see that are tens 20s of solar masses in

584
00:25:27,790 --> 00:25:25,730
mass and those stars are the college

585
00:25:30,220 --> 00:25:27,800
frat brothers of stars in that they live

586
00:25:32,050 --> 00:25:30,230
fast and die young and they don't last

587
00:25:35,530 --> 00:25:32,060
very long they only last a few million

588
00:25:36,970 --> 00:25:35,540

years and then they go Foom and that and

589
00:25:41,290 --> 00:25:36,980
so it becomes a statistical argument

590
00:25:43,600 --> 00:25:41,300
right so the first generation of stars

591
00:25:47,350 --> 00:25:43,610
do you have a sense how many of those

592
00:25:49,870 --> 00:25:47,360
that are in the in the region that when

593
00:25:53,380 --> 00:25:49,880
you look at any given region of star

594
00:25:55,810 --> 00:25:53,390
formation there is this Universal

595
00:25:56,950 --> 00:25:55,820
quality control curve which we call the

596
00:25:59,590 --> 00:25:56,960
initial mass function

597
00:26:01,659 --> 00:25:59,600
alright so when you make a certain

598
00:26:07,210 --> 00:26:01,669
number of massive stars you make a

599
00:26:09,580 --> 00:26:07,220
truckload of solar mass yes right there

600
00:26:12,850 --> 00:26:09,590
you make an awful lot of low-mass stars

601
00:26:15,460 --> 00:26:12,860
for very few massive ones right and and

602
00:26:18,490 --> 00:26:15,470
it's just a sliding vertical scale so

603
00:26:21,130 --> 00:26:18,500
for you to have any massive stars at all

604
00:26:25,000 --> 00:26:21,140
in this neighborhood you have to have

605
00:26:27,750 --> 00:26:25,010
made a bunch of low-mass ones and one of

606
00:26:29,409 --> 00:26:27,760
the one of the guys in the press press

607
00:26:32,230 --> 00:26:29,419
conference asked me that question

608
00:26:34,299 --> 00:26:32,240
because we can now see through the back

609
00:26:38,169 --> 00:26:34,309
wall of the cavity and we can see so

610
00:26:41,500 --> 00:26:38,179
many stars in this picture is it

611
00:26:43,570 --> 00:26:41,510
commensurate is it in fact does it make

612
00:26:45,370 --> 00:26:43,580
sense concerning how big we think the

613
00:26:46,990 --> 00:26:45,380

cluster is and the short answer I've got

614
00:26:48,220 --> 00:26:47,000
right now is I don't know because I

615
00:26:50,519 --> 00:26:48,230
haven't had a chance to count them all

616
00:26:52,570 --> 00:26:50,529
all right but because of the colors

617
00:26:54,940 --> 00:26:52,580
because the infrared picture was taken

618
00:26:58,510 --> 00:26:54,950
into bands you can figure out how

619
00:26:59,620 --> 00:26:58,520
massive each of those stars is so so I

620
00:27:01,360 --> 00:26:59,630
want to get back to the point we were

621
00:27:03,610 --> 00:27:01,370
making about week we were born in the

622
00:27:05,560 --> 00:27:03,620
same kind of neighborhood as the one

623
00:27:08,019 --> 00:27:05,570
you're talking about now what other

624
00:27:09,970 --> 00:27:08,029
stars that are around us would have been

625
00:27:11,560 --> 00:27:09,980
a part of that do you think well the

626
00:27:14,289 --> 00:27:11,570
problem when you make a cluster of stars

627
00:27:17,350 --> 00:27:14,299
is they all form in the same place and

628
00:27:18,669 --> 00:27:17,360
they fall in the same cavity and when

629
00:27:21,279 --> 00:27:18,679
you look at the eagle you're looking at

630
00:27:23,289 --> 00:27:21,289
them just bust it out right there

631
00:27:24,700 --> 00:27:23,299
they're all teenagers going out for

632
00:27:27,880 --> 00:27:24,710
their first party and stuff right

633
00:27:31,000 --> 00:27:27,890
they're all coming out of their nursery

634
00:27:33,310 --> 00:27:31,010
and being exposed to the interstellar

635
00:27:34,720 --> 00:27:33,320
environment the problem is dynamically

636
00:27:36,100 --> 00:27:34,730
they're not just sitting there they're

637
00:27:39,760 --> 00:27:36,110
moving they have their own proper

638
00:27:42,250 --> 00:27:39,770

motions and the cluster over time starts

639
00:27:43,779 --> 00:27:42,260
to dissipate it enlarges stars go in

640
00:27:47,169 --> 00:27:43,789
different directions some have more have

641
00:27:48,760 --> 00:27:47,179
higher velocities than others and the

642
00:27:51,370 --> 00:27:48,770
other problem is they have a finite

643
00:27:53,620 --> 00:27:51,380
width and within a spiral galaxy you

644
00:27:56,760 --> 00:27:53,630
have a gradient in rotational velocity

645
00:27:59,289 --> 00:27:56,770
that causes sheer at any given radius

646
00:28:02,260 --> 00:27:59,299
what the the end oh we're going our

647
00:28:04,990 --> 00:28:02,270
galaxy any spiral galaxy the the part of

648
00:28:06,820 --> 00:28:05,000
of the the neighborhood there that is

649
00:28:08,500 --> 00:28:06,830
closer to the center of the galaxy is

650
00:28:09,070 --> 00:28:08,510
going to rotate around the center of the

651
00:28:11,230 --> 00:28:09,080
galaxy

652
00:28:16,600 --> 00:28:11,240
wika then the stuff does maybe a little

653
00:28:18,610 --> 00:28:16,610
bit further away our intro astronomy if

654
00:28:21,010 --> 00:28:18,620
we were the cluster and the galactic

655
00:28:23,200 --> 00:28:21,020
center he was over there zouk would be

656
00:28:25,180 --> 00:28:23,210
moving the fastest and then mean

657
00:28:29,320 --> 00:28:25,190
accident and then you guys would just

658
00:28:31,720 --> 00:28:29,330
drift away but what that means is the

659
00:28:34,300 --> 00:28:31,730
cluster as we understand it has been

660
00:28:37,960 --> 00:28:34,310
this beautiful round cluster of stars

661
00:28:41,320 --> 00:28:37,970
get stretched out and smeared and so

662
00:28:44,380 --> 00:28:41,330
stars that form together end up all over

663
00:28:47,080 --> 00:28:44,390

the place Lee streamed out along that

664
00:28:48,550 --> 00:28:47,090
radial but you said also they weed to

665
00:28:50,800 --> 00:28:48,560
have their own proper motions to what

666
00:28:52,360 --> 00:28:50,810
causes that because getting bumped

667
00:28:55,870 --> 00:28:52,370
around by other forces and have nebula

668
00:28:58,840 --> 00:28:55,880
just randomness in the way the collapse

669
00:29:00,850 --> 00:28:58,850
happens when you take the the cold dark

670
00:29:04,570 --> 00:29:00,860
material in a molecular cloud and you

671
00:29:07,090 --> 00:29:04,580
collapse it there's always some rotation

672
00:29:09,160 --> 00:29:07,100
built into it and so there's always an

673
00:29:11,350 --> 00:29:09,170
angular momentum vector or a preferred

674
00:29:13,120 --> 00:29:11,360
axis around which it spins and they're

675
00:29:15,940 --> 00:29:13,130
all different all the stars have

676
00:29:18,160 --> 00:29:15,950
different rotation vectors and as they

677
00:29:20,080 --> 00:29:18,170
collapse the mechanism by which that

678
00:29:23,230 --> 00:29:20,090
material makes it onto the surface

679
00:29:25,060 --> 00:29:23,240
requires material to be ejected along

680
00:29:27,400 --> 00:29:25,070
the rotation axis that's why when you

681
00:29:28,900 --> 00:29:27,410
see new stellar systems like this they

682
00:29:31,540 --> 00:29:28,910
always have this characteristic jet

683
00:29:33,010 --> 00:29:31,550
sticking out of them and in fact in the

684
00:29:35,320 --> 00:29:33,020
data in one of the pictures we've got

685
00:29:38,470 --> 00:29:35,330
there over that 20-year life span we can

686
00:29:41,020 --> 00:29:38,480
see one of the Jets moving right right

687
00:29:43,570 --> 00:29:41,030
and so that's telling you that that's an

688
00:29:45,700 --> 00:29:43,580

immediate sign poster says look we just

689
00:29:48,010 --> 00:29:45,710
made a style right here because you can

690
00:29:50,170 --> 00:29:48,020
see the jetta material being spat out of

691
00:29:52,420 --> 00:29:50,180
it as it tries to aggregate material

692
00:29:54,580 --> 00:29:52,430
down into the star and into the

693
00:29:57,280 --> 00:29:54,590
protoplanetary disk that ultimately

694
00:30:00,040 --> 00:29:57,290
becomes the solar system as you can see

695
00:30:02,290 --> 00:30:00,050
in front of the camera right now Thank

696
00:30:05,980 --> 00:30:02,300
You salt but our high-tech high-tech

697
00:30:07,390 --> 00:30:05,990
wizardry here so said something about

698
00:30:08,500 --> 00:30:07,400
the pillar or knows carol they said

699
00:30:11,920 --> 00:30:08,510
something about the pillars being five

700
00:30:13,780 --> 00:30:11,930
light years or so the line is long yeah

701
00:30:18,310 --> 00:30:13,790
what how big would you say the whole

702
00:30:19,480 --> 00:30:18,320
reason in teh area um the the cluster

703
00:30:21,430 --> 00:30:19,490
itself if you look at a typical

704
00:30:22,690 --> 00:30:21,440
ground-based picture the pillars

705
00:30:24,370 --> 00:30:22,700
themselves are

706
00:30:26,980 --> 00:30:24,380
really quite small compared to the rest

707
00:30:29,260 --> 00:30:26,990
of the cavity so if that's you know if

708
00:30:31,150 --> 00:30:29,270
the fit if the pillow length is 5 I

709
00:30:35,470 --> 00:30:31,160
would say the club the cluster has to be

710
00:30:36,940 --> 00:30:35,480
a good 40 or 50 light years across and I

711
00:30:38,650 --> 00:30:36,950
predict a lot of planets coming out of

712
00:30:39,970 --> 00:30:38,660
this one too I don't know seems to me

713
00:30:41,770 --> 00:30:39,980

like there'll be a lot of them coming

714
00:30:44,800 --> 00:30:41,780
out of there so let's get back to the

715
00:30:47,380 --> 00:30:44,810
image itself you can you give us some

716
00:30:49,180 --> 00:30:47,390
idea of how many uh orbits things like

717
00:30:50,650 --> 00:30:49,190
that maybe went into it some some some

718
00:30:52,210 --> 00:30:50,660
images like that you have any rough ID

719
00:30:53,170 --> 00:30:52,220
dogged if you don't know it off the top

720
00:30:55,000 --> 00:30:53,180
of your head I just like to give people

721
00:30:59,350 --> 00:30:55,010
sense of how long it took to put

722
00:31:03,130 --> 00:30:59,360
together age 20 isn't it let's see for

723
00:31:06,370 --> 00:31:03,140
pointings three filters for pointing and

724
00:31:08,230 --> 00:31:06,380
you've is two filters / pointing and

725
00:31:11,410 --> 00:31:08,240
infrared and I believe we were able to

726
00:31:18,010 --> 00:31:11,420
fit both infrared pointing filters in

727
00:31:20,970 --> 00:31:18,020
one orbit so that was like four bits for

728
00:31:23,800 --> 00:31:20,980
the or less for the infrared and

729
00:31:26,740 --> 00:31:23,810
pretense for was 12 orbits for the you

730
00:31:30,580 --> 00:31:26,750
biz so you know 15 orbits or so I

731
00:31:32,980 --> 00:31:30,590
believe we had 15 orbits for it is an

732
00:31:34,960 --> 00:31:32,990
out is an hour and a half right fully an

733
00:31:37,750 --> 00:31:34,970
hour and a half but you only have 40 to

734
00:31:40,210 --> 00:31:37,760
50 minutes within the orbit to actually

735
00:31:42,130 --> 00:31:40,220
no unfortunately none the continuous

736
00:31:44,140 --> 00:31:42,140
being zone so there's all kinds of

737
00:31:47,290 --> 00:31:44,150
overheads with switching filters and

738
00:31:48,850 --> 00:31:47,300

switching pointing so you but it worked

739
00:31:53,590 --> 00:31:48,860
out okay I mean we had enough time to

740
00:31:55,180 --> 00:31:53,600
get a decent decent images a point that

741
00:31:58,480 --> 00:31:55,190
needs to be made concerning the original

742
00:32:00,340 --> 00:31:58,490
data is that in that set those are very

743
00:32:03,490 --> 00:32:00,350
comparable exposure times to what we did

744
00:32:07,090 --> 00:32:03,500
20 years ago but we get 10 times deeper

745
00:32:08,860 --> 00:32:07,100
right which is very cool and what and

746
00:32:10,930 --> 00:32:08,870
what that illustre you know you've got

747
00:32:13,120 --> 00:32:10,940
the infrared channel you've got twice

748
00:32:15,040 --> 00:32:13,130
the resolution and you're going deeper

749
00:32:17,560 --> 00:32:15,050
in the same exposure time what that

750
00:32:20,740 --> 00:32:17,570
illustrates is how much better hubble

751
00:32:22,570 --> 00:32:20,750
became as a facility in the 25 years we

752
00:32:24,550 --> 00:32:22,580
touch on that at the beginning yeah it's

753
00:32:27,220 --> 00:32:24,560
like the advantage we have of Hubble

754
00:32:29,050 --> 00:32:27,230
beings not only a closer North orbit

755
00:32:30,130 --> 00:32:29,060
Earth orbit but also the about the fact

756
00:32:32,259 --> 00:32:30,140
that it was designed with the Space

757
00:32:34,389 --> 00:32:32,269
Shuttle in mind to repair it has

758
00:32:36,310 --> 00:32:34,399
we made Hubble one of the most amazing

759
00:32:38,889 --> 00:32:36,320
long longest-lived instruments we've

760
00:32:40,810 --> 00:32:38,899
ever had so let me turn to Ishaan CP

761
00:32:43,239 --> 00:32:40,820
sound anything nothing on the social

762
00:32:44,979 --> 00:32:43,249
media things okay all right well you

763
00:32:46,029 --> 00:32:44,989

guys have any final comments on anything

764
00:32:49,449 --> 00:32:46,039
you want to mention that we haven't

765
00:32:51,099 --> 00:32:49,459
covered here I I think there's still an

766
00:32:53,409 --> 00:32:51,109
awful lot of science to pull out of that

767
00:32:55,839 --> 00:32:53,419
those data and I've already told Saul I

768
00:32:58,119 --> 00:32:55,849
want to write a paper on this because we

769
00:33:00,129 --> 00:32:58,129
have the ability to go in there look at

770
00:33:01,959 --> 00:33:00,139
those stellar populations look at how

771
00:33:04,299 --> 00:33:01,969
much sharper that interface is redo the

772
00:33:06,310 --> 00:33:04,309
calculations about the gas dynamics in

773
00:33:08,109 --> 00:33:06,320
the nebula and really understand what

774
00:33:10,449 --> 00:33:08,119
the stellar environment stellar

775
00:33:12,009 --> 00:33:10,459
formation environment in in this nebula

776
00:33:14,349 --> 00:33:12,019
looks like and these new data really

777
00:33:15,879 --> 00:33:14,359
gives us gives us that chance sounds

778
00:33:18,069 --> 00:33:15,889
exciting thank you Paul I appreciate

779
00:33:21,009 --> 00:33:18,079
your time for coming by congratulations

780
00:33:23,499 --> 00:33:21,019
on a great release this was awesome oh I

781
00:33:26,979 --> 00:33:23,509
just wanted I'm trying to load the image

782
00:33:31,239 --> 00:33:26,989
of the entire region and so if you look

783
00:33:34,449 --> 00:33:31,249
up m16 astronomy if you look up m16

784
00:33:39,729 --> 00:33:34,459
you'll get the m16 rifle but if you want

785
00:33:42,099 --> 00:33:39,739
to know about m16 astronomy our nebula

786
00:33:44,979 --> 00:33:42,109
I'm 16 nebi oh look up there are some

787
00:33:47,079 --> 00:33:44,989
images of the entire region which I'm

788
00:33:51,449 --> 00:33:47,089

going I actually got the image to loads

789
00:33:56,879 --> 00:33:51,459
all I'll show you it right now okay so

790
00:34:03,149 --> 00:33:56,889
okay so yeah we're looking at the wider

791
00:34:07,449 --> 00:34:05,649
so you can see that the pillar we're

792
00:34:10,240 --> 00:34:07,459
looking pillars were looking at a really

793
00:34:12,609 --> 00:34:10,250
very small part of that entire complex

794
00:34:14,559 --> 00:34:12,619
region and there's other pillars in

795
00:34:16,839 --> 00:34:14,569
there there's another pillar that that

796
00:34:19,649 --> 00:34:16,849
we took Hubble images of a number of

797
00:34:21,789 --> 00:34:19,659
years ago with the ACS camera and

798
00:34:23,589 --> 00:34:21,799
comparable you know comparable

799
00:34:27,579 --> 00:34:23,599
structures very interesting structures

800
00:34:29,409 --> 00:34:27,589
and I just wanted to kind of say that

801
00:34:31,720 --> 00:34:29,419
one of the reasons we took this image

802
00:34:34,450 --> 00:34:31,730
was too kind of book in the project to

803
00:34:36,309 --> 00:34:34,460
the Hubble mission so it's almost 25

804
00:34:38,379 --> 00:34:36,319
years it's been an operation that says

805
00:34:40,850 --> 00:34:38,389
Paul said I think that that's an

806
00:34:43,370 --> 00:34:40,860
eternity for a space mission really

807
00:34:46,280 --> 00:34:43,380
many space missions only last months two

808
00:34:48,640 --> 00:34:46,290
years and Hubble's been because of the

809
00:34:50,870 --> 00:34:48,650
ability to service it it's been not only

810
00:34:53,180 --> 00:34:50,880
operating for this amount of time but

811
00:34:56,570 --> 00:34:53,190
has been improved it's much better than

812
00:34:58,250 --> 00:34:56,580
it was when it first started and it's

813
00:35:00,140 --> 00:34:58,260

stayed competitive with the rest of

814
00:35:02,690 --> 00:35:00,150
astronomy it's been still in the

815
00:35:05,060 --> 00:35:02,700
forefront of astronomy even though it's

816
00:35:08,390 --> 00:35:05,070
25 years old which is no old even for a

817
00:35:10,250 --> 00:35:08,400
ground-based telescope really so that's

818
00:35:12,020 --> 00:35:10,260
the one of the primary reasons we did

819
00:35:14,030 --> 00:35:12,030
this image and we want to highlight the

820
00:35:17,000 --> 00:35:14,040
history the mission and we thought it'd

821
00:35:18,200 --> 00:35:17,010
be a good way to do that so I want to

822
00:35:19,370 --> 00:35:18,210
thank all you guys for joining us has

823
00:35:21,290 --> 00:35:19,380
been a lot of fun thanks for joining us

824
00:35:26,900 --> 00:35:21,300
Paul oh this is really great yeah this

825
00:35:31,010 --> 00:35:26,910
is unfun yeah congratulations yes I got

826
00:35:32,240 --> 00:35:31,020
there I've got the link on we got a lot

827
00:35:35,180 --> 00:35:32,250
of stuff for you to download so we hope

828
00:35:36,560 --> 00:35:35,190
you'll do that and we care hope you'll

829
00:35:38,150 --> 00:35:36,570
join us our next hangout will be at

830
00:35:40,400 --> 00:35:38,160
four-thirty pacific time where Carol and

831
00:35:41,690 --> 00:35:40,410
I will do a recap of the double AAS

832
00:35:44,030 --> 00:35:41,700
meeting today some of the things that we

833
00:35:45,170 --> 00:35:44,040
found interesting for about 15 or 20

834
00:35:47,300 --> 00:35:45,180
minutes we'll sit and chat about the end

835
00:35:48,770 --> 00:35:47,310
of the day and so we hope you'll join