

1
00:00:10,789 --> 00:00:15,660
okay hello everybody and welcome again

2
00:00:13,558 --> 00:00:18,299
to our second I will hang out of the day

3
00:00:15,660 --> 00:00:19,829
at the 225th meeting of the american

4
00:00:18,300 --> 00:00:22,260
astronomical society we're live folks

5
00:00:19,829 --> 00:00:25,679
this is it we are in our exhibit booth

6
00:00:22,260 --> 00:00:27,929
and yeah and carols with me and as well

7
00:00:25,679 --> 00:00:29,339
as Zolt lavey and soon we'll be joined

8
00:00:27,929 --> 00:00:32,969
by this empty chair will be taken up by

9
00:00:29,339 --> 00:00:34,049
Paul is going who actually helped take

10
00:00:32,969 --> 00:00:36,689
the image that we're going to talk about

11
00:00:34,049 --> 00:00:39,419
today because as you may not know and if

12
00:00:36,689 --> 00:00:41,579
you don't know you know now that Hubble

13
00:00:39,420 --> 00:00:43,500
we are celebrating the 25th anniversary

14
00:00:41,579 --> 00:00:45,600
of the Hubble Space Telescope being in

15
00:00:43,500 --> 00:00:47,789
orbit above our heads and that is

16
00:00:45,600 --> 00:00:49,530
remarkable folks no other telescope has

17
00:00:47,789 --> 00:00:53,550
been up there that long i think that's

18
00:00:49,530 --> 00:00:54,929
right right okay so so this is this is

19
00:00:53,549 --> 00:00:56,788
the time we're getting started it'll all

20
00:00:54,929 --> 00:00:59,909
culminate in april on april twentieth

21
00:00:56,789 --> 00:01:02,698
and to celebrate the this auspicious

22
00:00:59,909 --> 00:01:03,750
events this auspicious occasion we have

23
00:01:02,698 --> 00:01:06,329
released the Space Telescope Science

24
00:01:03,750 --> 00:01:09,000
Institute is released a an anniversary

25
00:01:06,329 --> 00:01:11,188
image but it's not d anniversary image

26
00:01:09,000 --> 00:01:15,269
right it's one of the anniversary images

27
00:01:11,188 --> 00:01:17,008
that kickoff kick off of festivities now

28
00:01:15,269 --> 00:01:21,000
we are in a bit of an awkward situation

29

00:01:17,009 --> 00:01:22,890
folks I am doing this live and

30
00:01:21,000 --> 00:01:24,780
ordinarily we have hangouts on air which

31
00:01:22,890 --> 00:01:26,969
give us this ability to share our

32
00:01:24,780 --> 00:01:28,799
screens but because i'm streaming via a

33
00:01:26,969 --> 00:01:31,650
backpack that does not allow me to use

34
00:01:28,799 --> 00:01:33,618
the internet from the convention i'm

35
00:01:31,650 --> 00:01:36,329
kind of limited by what i can do

36
00:01:33,618 --> 00:01:37,950
technologically dreaming camping yeah

37
00:01:36,328 --> 00:01:39,629
we're streaming camping but we have

38
00:01:37,950 --> 00:01:42,210
bandwidth where no one else does so

39
00:01:39,629 --> 00:01:43,890
that's cool too so we are streaming

40
00:01:42,209 --> 00:01:45,179
straight to youtube which means that i

41
00:01:43,890 --> 00:01:47,728
don't have the tools ordinarily

42
00:01:45,180 --> 00:01:50,100
available to me to share my screen and

43
00:01:47,728 --> 00:01:53,640

to show you the image so it's kind of

44
00:01:50,099 --> 00:01:57,658
awkward we also have hecklers all around

45
00:01:53,640 --> 00:01:58,920
us our colleagues that's right so in a

46
00:01:57,659 --> 00:02:01,799
while we're broadcasting people want to

47
00:01:58,920 --> 00:02:04,200
make faces at us so what I've done is

48
00:02:01,799 --> 00:02:06,479
I've taken the 25th an event the image

49
00:02:04,200 --> 00:02:08,069
was just released at two-fifteen pacific

50
00:02:06,478 --> 00:02:09,868
time so it's brand new it's just been

51
00:02:08,068 --> 00:02:12,179
put out I put a link to the press

52
00:02:09,868 --> 00:02:13,439
release on the Google+ event page so you

53
00:02:12,180 --> 00:02:15,420
can go and we'll look at all that

54
00:02:13,439 --> 00:02:17,370
versions of the image there as well as

55
00:02:15,419 --> 00:02:20,069
on the Google+ page our Facebook page

56
00:02:17,370 --> 00:02:21,719
and it's on Twitter and if you need

57
00:02:20,069 --> 00:02:23,250
somewhere else to go see it I would

58
00:02:21,719 --> 00:02:25,139
encourage you to let me know because

59
00:02:23,250 --> 00:02:29,009
I've got a shaun prescott here from nasa

60
00:02:25,139 --> 00:02:32,789
monitoring the youtube oh and we all

61
00:02:29,009 --> 00:02:37,469
would be but don't unveil it yet our

62
00:02:32,789 --> 00:02:40,500
super high-tech super high-tech way of

63
00:02:37,469 --> 00:02:43,949
doing it here so with that I'm gonna I'm

64
00:02:40,500 --> 00:02:46,800
going to hand this over to oh so he's

65
00:02:43,949 --> 00:02:48,569
monitoring in a minute I'm you tell me

66
00:02:46,800 --> 00:02:50,760
how they can interact with us Google+

67
00:02:48,569 --> 00:02:54,030
event page YouTube comments Twitter

68
00:02:50,759 --> 00:02:55,799
Hubble hang out hashtag and Hubble 25

69
00:02:54,030 --> 00:02:57,090
okay we're also looking at that one and

70
00:02:55,800 --> 00:02:58,830
we will get to your comments and

71
00:02:57,090 --> 00:03:02,370
questions we hope you have some okay

72
00:02:58,830 --> 00:03:06,270
Carol go ahead okay so this is the first

73
00:03:02,370 --> 00:03:09,960
part of the m16 image release and it's

74
00:03:06,270 --> 00:03:11,700
the optical part of the image okay now

75
00:03:09,960 --> 00:03:21,530
get ready this is weird this is gonna be

76
00:03:11,699 --> 00:03:24,089
weak reflections and all that's right

77
00:03:21,530 --> 00:03:26,009
okay so what you're looking at is what

78
00:03:24,090 --> 00:03:27,360
are they looking at their soul tell us a

79
00:03:26,009 --> 00:03:34,019
little bit about what we've taken and

80
00:03:27,360 --> 00:03:36,570
why org so what we're looking at is the

81
00:03:34,020 --> 00:03:40,439
famous what's become known as the

82
00:03:36,569 --> 00:03:43,069
pillars of creation m16 the eagle nebula

83
00:03:40,439 --> 00:03:45,959
whatever you want to call it these are

84
00:03:43,069 --> 00:03:49,489
pillars of gas and dust that are being

85
00:03:45,959 --> 00:03:52,860
eroded by stars that are off the picture

86

00:03:49,489 --> 00:03:54,469
so we've taken a new image with all the

87
00:03:52,860 --> 00:03:57,120
space telescope with the current

88
00:03:54,469 --> 00:04:00,239
instrumentation on telescope the wide

89
00:03:57,120 --> 00:04:03,959
field camera 3 with c3 instrument so

90
00:04:00,239 --> 00:04:06,509
this image that you just saw is a

91
00:04:03,959 --> 00:04:09,780
visible light image in the light of

92
00:04:06,509 --> 00:04:14,039
three chemical elements hydrogen oxygen

93
00:04:09,780 --> 00:04:15,840
and sulfur the color colors have been

94
00:04:14,039 --> 00:04:20,099
assigned to the black and white images

95
00:04:15,840 --> 00:04:21,899
of those three images in the sense of

96
00:04:20,100 --> 00:04:24,600
the oxygen is

97
00:04:21,899 --> 00:04:26,310
blue hydrogen is green and the sulfur is

98
00:04:24,600 --> 00:04:30,960
red and when you combine those you get

99
00:04:26,310 --> 00:04:34,430
this nice colourful image we actually

100
00:04:30,959 --> 00:04:39,120

made a second image in infrared light

101

00:04:34,430 --> 00:04:41,250
and I okay it came out ok so the

102

00:04:39,120 --> 00:04:46,430
original image that this kind of

103

00:04:41,250 --> 00:04:49,800
reprises is was made in 1995 with the

104

00:04:46,430 --> 00:04:54,150
with pic to camera on the telescope back

105

00:04:49,800 --> 00:04:59,478
then and became this iconic very popular

106

00:04:54,149 --> 00:05:03,299
image and so we thought we'd see what

107

00:04:59,478 --> 00:05:06,269
the pillars of creation and pillars of

108

00:05:03,300 --> 00:05:09,418
creation because stars are being created

109

00:05:06,269 --> 00:05:13,560
inside these pillars and pillars because

110

00:05:09,418 --> 00:05:15,329
this is relatively dense gas that so

111

00:05:13,560 --> 00:05:17,668
actually there's a dense material at the

112

00:05:15,329 --> 00:05:21,719
top and the less dense materials being

113

00:05:17,668 --> 00:05:23,788
eroded away and being shadowed actually

114

00:05:21,720 --> 00:05:25,800
the pillars are shadowed by this denser

115
00:05:23,788 --> 00:05:27,930
material at the top and so it's creating

116
00:05:25,800 --> 00:05:30,030
these pillars so that's why it's pillars

117
00:05:27,930 --> 00:05:30,990
of creation so this camera the whipping

118
00:05:30,029 --> 00:05:32,879
to you're talking about had lower

119
00:05:30,990 --> 00:05:36,478
resolution and the field of view at the

120
00:05:32,879 --> 00:05:37,978
time was a lot smaller and narrower and

121
00:05:36,478 --> 00:05:39,930
it go anything that Carol said this is

122
00:05:37,978 --> 00:05:41,908
in the optical wavelengths now as you

123
00:05:39,930 --> 00:05:43,288
all know back in 2009 we sent the Space

124
00:05:41,908 --> 00:05:45,689
Shuttle up there and John Grunsfeld gave

125
00:05:43,288 --> 00:05:48,569
us a new Hubble he basically rebuilt the

126
00:05:45,689 --> 00:05:50,639
thing put in new cameras new filters a

127
00:05:48,569 --> 00:05:52,348
new electronics new gyros all kinds of

128
00:05:50,639 --> 00:05:55,050
things so Hubble is now a virtually a

129
00:05:52,348 --> 00:05:57,120
brand new telescope since 2009 and with

130
00:05:55,050 --> 00:06:00,240
with and the main camera being used now

131
00:05:57,120 --> 00:06:03,209
is an infrared camera called white field

132
00:06:00,240 --> 00:06:09,560
camera 3 and so we took the picture

133
00:06:03,209 --> 00:06:12,359
again and this time they saw what we saw

134
00:06:09,560 --> 00:06:14,579
this while still coming up on my screen

135
00:06:12,360 --> 00:06:19,009
we saw

136
00:06:14,579 --> 00:06:24,198
but the infrared version of the image

137
00:06:19,009 --> 00:06:27,870
which is oh there it is finally came up

138
00:06:24,199 --> 00:06:29,669
so the most obvious thing about this

139
00:06:27,870 --> 00:06:32,519
image is that the pillars more or less

140
00:06:29,668 --> 00:06:35,218
disappear and what's happening is that

141
00:06:32,519 --> 00:06:37,168
the infrared light is able to pass

142
00:06:35,218 --> 00:06:39,360
through the material the material hasn't

143

00:06:37,168 --> 00:06:41,698
gone away but the light is able to pass

144
00:06:39,360 --> 00:06:43,379
through more of that material and we're

145
00:06:41,699 --> 00:06:47,270
seeing a lot of the stars that are

146
00:06:43,379 --> 00:06:49,439
embedded in that nebulosity or behind it

147
00:06:47,269 --> 00:06:51,209
which we can't see in the visible light

148
00:06:49,439 --> 00:06:53,009
because that material is absorbing all

149
00:06:51,209 --> 00:06:56,250
that visible light but the infrared

150
00:06:53,009 --> 00:06:58,319
light is getting through so it's really

151
00:06:56,250 --> 00:07:01,740
a very very different picture than what

152
00:06:58,319 --> 00:07:05,819
you see in invisible it was a lot wider

153
00:07:01,740 --> 00:07:09,870
to correct yeah the field of view of

154
00:07:05,819 --> 00:07:12,389
both the visible light camera on whoops

155
00:07:09,870 --> 00:07:16,860
III and the infrared camera on with c3

156
00:07:12,389 --> 00:07:18,598
are wider than the with pic to the field

157
00:07:16,860 --> 00:07:21,229

of view of the which the three visible

158

00:07:18,598 --> 00:07:25,228
light cameras larger than the infrared

159

00:07:21,228 --> 00:07:27,089
and we also made a little mosaic so this

160

00:07:25,228 --> 00:07:29,218
is not just one pointing of the

161

00:07:27,089 --> 00:07:32,310
telescope it's actually four pointings

162

00:07:29,218 --> 00:07:34,379
of the telescope in a two by two grid so

163

00:07:32,310 --> 00:07:35,819
we made a much wider field of view and

164

00:07:34,379 --> 00:07:38,338
we really wanted to see the area around

165

00:07:35,819 --> 00:07:41,639
it one of the most important things to

166

00:07:38,338 --> 00:07:43,829
do was to get the bottom parts of the

167

00:07:41,639 --> 00:07:45,418
pillars and it's interesting and one of

168

00:07:43,829 --> 00:07:47,668
the interesting features about the image

169

00:07:45,418 --> 00:07:50,038
is how the pillars kind of actually

170

00:07:47,668 --> 00:07:52,318
disappear at the bottom and they're kind

171

00:07:50,038 --> 00:07:54,389
of disconnected from the rest of the

172
00:07:52,319 --> 00:07:56,550
nebulousity that there's more of done

173
00:07:54,389 --> 00:07:57,838
underneath i'm hoping i will get our

174
00:07:56,550 --> 00:07:59,338
astronomer here to tell us a little bit

175
00:07:57,838 --> 00:08:01,348
more about the details of what's going

176
00:07:59,338 --> 00:08:02,399
on astronomically and there but carol do

177
00:08:01,348 --> 00:08:07,110
you have any comments what strikes you

178
00:08:02,399 --> 00:08:09,929
about this image well one of one of the

179
00:08:07,110 --> 00:08:11,788
big questions when the first image was

180
00:08:09,930 --> 00:08:14,370
taken besides the fact that it really

181
00:08:11,788 --> 00:08:17,218
demonstrated how powerful Hubble Space

182
00:08:14,370 --> 00:08:19,949
Telescope was at the time and what its

183
00:08:17,218 --> 00:08:22,259
bright future was going to be is what's

184
00:08:19,949 --> 00:08:25,588
inside those pillars and so now that

185
00:08:22,259 --> 00:08:28,350
we've seen the infrared image from

186
00:08:25,588 --> 00:08:30,959
Hubble at a similar resolution

187
00:08:28,350 --> 00:08:34,830
to the optical image we can see that the

188
00:08:30,959 --> 00:08:37,529
the very top and the dense regions there

189
00:08:34,830 --> 00:08:39,330
are indeed it was suspected and a couple

190
00:08:37,529 --> 00:08:41,519
of stars were seen but it was suspected

191
00:08:39,330 --> 00:08:44,340
that there were stars forming in there

192
00:08:41,519 --> 00:08:46,529
now I know at one time there was some

193
00:08:44,340 --> 00:08:48,899
speculation that there were lots of

194
00:08:46,529 --> 00:08:51,839
stars forming in there and i think that

195
00:08:48,899 --> 00:08:54,509
the scientist who originally worked on

196
00:08:51,840 --> 00:08:56,040
the first image have now been looking at

197
00:08:54,509 --> 00:08:58,620
this image and they haven't had it very

198
00:08:56,039 --> 00:09:00,329
long but my understanding is that what

199
00:08:58,620 --> 00:09:02,820
they said there are fewer stars than

200

00:09:00,330 --> 00:09:06,240
what they thought and part of the reason

201
00:09:02,820 --> 00:09:08,879
is that the top of the pillars is so

202
00:09:06,240 --> 00:09:12,899
dense and that's why even in the

203
00:09:08,879 --> 00:09:16,590
infrared you can't see through them so

204
00:09:12,899 --> 00:09:19,049
that it's difficult for many stars to

205
00:09:16,590 --> 00:09:20,639
form in there and also the other

206
00:09:19,049 --> 00:09:23,159
interesting thing is that the brightest

207
00:09:20,639 --> 00:09:25,289
stars are actually ablating and blowing

208
00:09:23,159 --> 00:09:27,509
away some of that gas and dust and what

209
00:09:25,289 --> 00:09:30,240
I found interesting is that from the top

210
00:09:27,509 --> 00:09:32,429
to the bottom of the pillar it takes

211
00:09:30,240 --> 00:09:35,639
five it's five light years so it takes

212
00:09:32,429 --> 00:09:37,289
five years for the light from the top of

213
00:09:35,639 --> 00:09:40,139
the pillar where the really bright stars

214
00:09:37,289 --> 00:09:44,219

are to reach the bottom so that stuff is

215

00:09:40,139 --> 00:09:45,569

sort of dissipating but very slowly so I

216

00:09:44,220 --> 00:09:47,700

have a question for either one of you is

217

00:09:45,570 --> 00:09:49,500

there been anything different about the

218

00:09:47,700 --> 00:09:51,950

nebula ssin since the first one was

219

00:09:49,500 --> 00:09:53,940

taken to get you one comment on that

220

00:09:51,950 --> 00:09:56,759

that's one of the things we wanted to

221

00:09:53,940 --> 00:09:59,280

look at right away with a 20 almost 20

222

00:09:56,759 --> 00:10:01,620

year baseline of time you'd kind of

223

00:09:59,279 --> 00:10:03,659

expect in this very dynamic environment

224

00:10:01,620 --> 00:10:06,600

that you might be able to see some

225

00:10:03,659 --> 00:10:08,789

differences now the opposite side of

226

00:10:06,600 --> 00:10:11,399

that is that it's a very large structure

227

00:10:08,789 --> 00:10:15,379

so you'd have to have things moving

228

00:10:11,399 --> 00:10:19,079

incredibly fast to have them move enough

229
00:10:15,379 --> 00:10:21,389
and it's far away so you'd have to have

230
00:10:19,080 --> 00:10:23,730
it moving very fast to have to be able

231
00:10:21,389 --> 00:10:25,860
to notice even with Hubble's incredible

232
00:10:23,730 --> 00:10:27,090
resolution that's something move and in

233
00:10:25,860 --> 00:10:29,700
fact when we started to look very

234
00:10:27,090 --> 00:10:31,560
closely we did actually see one little

235
00:10:29,700 --> 00:10:35,460
place where we did see a little bit of

236
00:10:31,559 --> 00:10:37,349
change whether that's a motion or just a

237
00:10:35,460 --> 00:10:39,389
change in that structure we're not quite

238
00:10:37,350 --> 00:10:41,230
entirely sure but it looks like what's

239
00:10:39,389 --> 00:10:44,289
happening is there's a jet from

240
00:10:41,230 --> 00:10:46,840
very new star at the near the top of one

241
00:10:44,289 --> 00:10:49,089
of the pillars and we noticed that the

242
00:10:46,840 --> 00:10:52,810
very end of that jet structure is a

243
00:10:49,090 --> 00:10:55,930
little farther away than it was in 1995

244
00:10:52,809 --> 00:10:58,599
so and it looks pretty clear and it

245
00:10:55,929 --> 00:10:59,889
looks convincing so we're kind of pretty

246
00:10:58,600 --> 00:11:01,690
convinced that we're actually seeing

247
00:10:59,889 --> 00:11:03,850
some motion there's some other little

248
00:11:01,690 --> 00:11:06,520
structures around that we see not very

249
00:11:03,850 --> 00:11:09,090
many but some structures around we see

250
00:11:06,519 --> 00:11:11,740
that are different from the 1995 image

251
00:11:09,090 --> 00:11:14,170
what strikes me about astronomy today is

252
00:11:11,740 --> 00:11:15,759
just how much that is possible now there

253
00:11:14,169 --> 00:11:17,769
was a time when the telescopes were so

254
00:11:15,759 --> 00:11:19,179
resolution or and they did the you know

255
00:11:17,769 --> 00:11:22,269
there was just no ability to resolve

256
00:11:19,179 --> 00:11:23,769
much of any detail that we all thought

257

00:11:22,269 --> 00:11:25,299
the universe ever changed you know that

258
00:11:23,769 --> 00:11:26,829
it all stayed the same and now we have

259
00:11:25,299 --> 00:11:29,500
telescopes and detectors that are so

260
00:11:26,830 --> 00:11:31,300
finely tuned and so hot at such a high

261
00:11:29,500 --> 00:11:33,309
resolution that we can actually gain

262
00:11:31,299 --> 00:11:35,709
these insights over 20 20 something

263
00:11:33,309 --> 00:11:38,379
years plus the longevity of the

264
00:11:35,710 --> 00:11:39,910
telescope that's a great thing about how

265
00:11:38,379 --> 00:11:42,639
long it's been able to last and it's

266
00:11:39,909 --> 00:11:45,219
been improved and service so it lasted

267
00:11:42,639 --> 00:11:48,340
it's 25 years and that's a fairly large

268
00:11:45,220 --> 00:11:50,620
baseline maybe not in cosmic terms but

269
00:11:48,340 --> 00:11:53,470
certainly in human terms in astronomical

270
00:11:50,620 --> 00:11:55,389
terms it's a relatively long baseline of

271
00:11:53,470 --> 00:11:57,730

time and you can start to see these

272

00:11:55,389 --> 00:12:01,750

kinds of differences another interesting

273

00:11:57,730 --> 00:12:06,269

thing that was noticed in the very first

274

00:12:01,750 --> 00:12:08,259

image I guess we have a comparison now

275

00:12:06,269 --> 00:12:10,779

yeah we're going to creep up on the

276

00:12:08,259 --> 00:12:13,269

camera so what we noticed in the what

277

00:12:10,779 --> 00:12:16,209

was noticed in the first image the

278

00:12:13,269 --> 00:12:18,309

iconic will pick to image is that the

279

00:12:16,210 --> 00:12:21,400

pillars seem to have very sharp well

280

00:12:18,309 --> 00:12:25,059

defined edges and now that we have twice

281

00:12:21,399 --> 00:12:28,899

the resolution it turns out the pillars

282

00:12:25,059 --> 00:12:32,139

have very well-defined sharp edges so

283

00:12:28,899 --> 00:12:35,549

that impression even sharper and in fact

284

00:12:32,139 --> 00:12:37,840

they're only something like 100

285

00:12:35,549 --> 00:12:39,639

astronomical unit so that's just a

286
00:12:37,840 --> 00:12:41,950
little bit bigger than the size of our

287
00:12:39,639 --> 00:12:44,679
solar system thick so they're not fuzzy

288
00:12:41,950 --> 00:12:47,170
edge they're very very sharp edges which

289
00:12:44,679 --> 00:12:49,509
is really very curious because usually

290
00:12:47,169 --> 00:12:52,029
whenever we look at these star formation

291
00:12:49,509 --> 00:12:54,100
regions we see that things are that the

292
00:12:52,029 --> 00:12:58,740
regions are very diffused

293
00:12:54,100 --> 00:13:01,329
and sort of surreal we see that

294
00:12:58,740 --> 00:13:03,789
surrounding the pillars but the pillars

295
00:13:01,328 --> 00:13:05,739
themselves have very short sharp edges

296
00:13:03,789 --> 00:13:08,049
and so that was in another important

297
00:13:05,740 --> 00:13:11,409
result and looking in both the infrared

298
00:13:08,049 --> 00:13:14,198
and the optical to determine whether our

299
00:13:11,409 --> 00:13:20,669
first impression 25 years ago was really

300
00:13:14,198 --> 00:13:22,870
true so is there any uh are there any

301
00:13:20,669 --> 00:13:24,448
surprises that came out of this things

302
00:13:22,870 --> 00:13:26,889
that we didn't expect to see or was it

303
00:13:24,448 --> 00:13:28,568
pretty much everything except for this

304
00:13:26,889 --> 00:13:30,789
one jet that we saw that was it was an

305
00:13:28,568 --> 00:13:32,559
interesting motion and he was there any

306
00:13:30,789 --> 00:13:36,129
surprises things that jumped out at the

307
00:13:32,559 --> 00:13:39,518
new with a new image I don't think there

308
00:13:36,129 --> 00:13:42,309
was a lot of surprises I think what Paul

309
00:13:39,519 --> 00:13:45,190
Schoen who worked on the original data

310
00:13:42,309 --> 00:13:47,979
did point out these these very sharp

311
00:13:45,190 --> 00:13:50,350
edges of these science Asian regions

312
00:13:47,980 --> 00:13:52,539
that was somewhat surprising that it's

313
00:13:50,350 --> 00:13:54,519
even sharper than they thought from the

314

00:13:52,539 --> 00:13:57,159
original and they were surprised at how

315
00:13:54,519 --> 00:13:58,480
sharp they were in with the two data but

316
00:13:57,159 --> 00:14:00,188
now they're seeing that they're even

317
00:13:58,480 --> 00:14:02,769
sure and that means what that means is

318
00:14:00,188 --> 00:14:05,318
that there's a very small region of

319
00:14:02,769 --> 00:14:07,389
space where this ionization has an

320
00:14:05,318 --> 00:14:10,750
effect where it changes over a

321
00:14:07,389 --> 00:14:13,539
relatively small span of space and that

322
00:14:10,750 --> 00:14:14,980
that space is even smaller than they

323
00:14:13,539 --> 00:14:17,919
originally thought so it's things like

324
00:14:14,980 --> 00:14:20,579
that although you know I mean part of

325
00:14:17,919 --> 00:14:24,328
the reason we did the observation was to

326
00:14:20,578 --> 00:14:26,828
come out to have a picture to look at

327
00:14:24,328 --> 00:14:29,909
and we kind of knew what to expect

328
00:14:26,828 --> 00:14:33,909

because it hasn't changed much since

329

00:14:29,909 --> 00:14:38,438

1995 and the instrumentation while it's

330

00:14:33,909 --> 00:14:40,328

improved in its improved greatly in

331

00:14:38,438 --> 00:14:42,969

resolution and sensitivity and so forth

332

00:14:40,328 --> 00:14:45,479

it's really the same kind of camera and

333

00:14:42,970 --> 00:14:47,949

we use the same filters and

334

00:14:45,480 --> 00:14:50,949

intentionally so that we could compare

335

00:14:47,948 --> 00:14:55,059

kind of apples and apples the image is

336

00:14:50,948 --> 00:14:56,708

the 1985 image to the 2014 image that

337

00:14:55,059 --> 00:15:01,759

was all very

338

00:14:56,708 --> 00:15:04,669

okay Paul's here now so so we have Paul

339

00:15:01,759 --> 00:15:05,809

skallon with us he's the you just got

340

00:15:04,669 --> 00:15:10,129

back from a press release welcome to our

341

00:15:05,809 --> 00:15:15,799

we're on a lot of questions and stuff

342

00:15:10,129 --> 00:15:17,299

that's okay we were talking about the

343
00:15:15,799 --> 00:15:18,799
image itself job was telling us some of

344
00:15:17,299 --> 00:15:20,240
the ways you know some of the

345
00:15:18,799 --> 00:15:22,278
wavelengths and the differences things

346
00:15:20,240 --> 00:15:25,459
that they found that was the varied from

347
00:15:22,278 --> 00:15:26,659
the 1995 image so what about what are

348
00:15:25,458 --> 00:15:28,268
some of the things scientifically that

349
00:15:26,659 --> 00:15:31,219
you found interesting about this image

350
00:15:28,269 --> 00:15:33,019
the neat stuff about these these new

351
00:15:31,220 --> 00:15:34,399
pictures is you've got several things

352
00:15:33,019 --> 00:15:37,909
going for it it's about three things

353
00:15:34,399 --> 00:15:40,399
that really are so much better than the

354
00:15:37,909 --> 00:15:41,929
the data we took remember the first day

355
00:15:40,399 --> 00:15:44,240
we talked was with the first camera

356
00:15:41,929 --> 00:15:48,559
right the first clear the first clear

357
00:15:44,240 --> 00:15:50,899
camera and it provided at that time the

358
00:15:48,559 --> 00:15:52,429
sharpest field of view the shop is view

359
00:15:50,899 --> 00:15:55,009
of what all the structure in the nebula

360
00:15:52,429 --> 00:15:58,698
was like with these data we've got twice

361
00:15:55,009 --> 00:16:01,039
the resolution okay now and that's

362
00:15:58,698 --> 00:16:02,299
spectacular because what a lot of what

363
00:16:01,039 --> 00:16:05,539
we did a lot of the physics that we

364
00:16:02,299 --> 00:16:08,240
learned back then was understanding how

365
00:16:05,539 --> 00:16:10,009
the photons coming from the massive

366
00:16:08,240 --> 00:16:13,100
stars at the center of the cluster were

367
00:16:10,009 --> 00:16:15,169
actually a blazing the walls of the

368
00:16:13,100 --> 00:16:16,730
nebula and eroding it away when you look

369
00:16:15,169 --> 00:16:19,009
at the tops of the pillars you can see

370
00:16:16,730 --> 00:16:22,310
these blue streamers right what you're

371

00:16:19,009 --> 00:16:28,208
looking at there is the ionized gas from

372
00:16:22,309 --> 00:16:32,149
those massive stars being ablated by hi

373
00:16:28,208 --> 00:16:38,869
there we go so little seed oil pants

374
00:16:32,149 --> 00:16:40,759
this isn't it so ok so the stream is at

375
00:16:38,870 --> 00:16:42,318
the top there really show you we already

376
00:16:40,759 --> 00:16:45,350
we already have some suspicions that

377
00:16:42,318 --> 00:16:47,870
this went on in the walls of h2 regions

378
00:16:45,350 --> 00:16:49,699
but this was the first real photographic

379
00:16:47,870 --> 00:16:52,610
evidence of it that you were looking at

380
00:16:49,698 --> 00:16:56,599
gas being eroded away from the walls of

381
00:16:52,610 --> 00:16:58,669
the of the cut of the cavity and that's

382
00:16:56,600 --> 00:17:00,829
great because but you really had to

383
00:16:58,669 --> 00:17:03,379
model it you had to understand how sharp

384
00:17:00,828 --> 00:17:05,599
the edge of those pillars was and so

385
00:17:03,379 --> 00:17:07,789

when you look in the picture that we

386

00:17:05,599 --> 00:17:09,500

took in 95 and you compare it to any

387

00:17:07,789 --> 00:17:09,859

ground-based picture that's been taken

388

00:17:09,500 --> 00:17:13,189

before

389

00:17:09,859 --> 00:17:14,719

all sins for the most part you can tell

390

00:17:13,189 --> 00:17:17,029

it's sharp but you didn't know how sharp

391

00:17:14,720 --> 00:17:20,179

it was so Hubble offered that for the

392

00:17:17,029 --> 00:17:22,279

first time now with these data we look

393

00:17:20,179 --> 00:17:24,890

at and we can see it's even sharper than

394

00:17:22,279 --> 00:17:26,058

we thought something about that what is

395

00:17:24,890 --> 00:17:27,140

what what's the big deal about that

396

00:17:26,058 --> 00:17:29,480

what's the big deal about the sharpness

397

00:17:27,140 --> 00:17:32,000

ok the sharpness is when you're trying

398

00:17:29,480 --> 00:17:34,250

to do the modeling ok you do the

399

00:17:32,000 --> 00:17:36,230

classical numerical modeling of the gas

400
00:17:34,250 --> 00:17:37,789
dynamics of the interface one of the

401
00:17:36,230 --> 00:17:40,308
things you have to build into that is

402
00:17:37,789 --> 00:17:42,259
what kind of density contrast are you

403
00:17:40,308 --> 00:17:44,480
are you running up against when you're

404
00:17:42,259 --> 00:17:48,048
building your model you need to know how

405
00:17:44,480 --> 00:17:50,509
sharp a wall it is a joke yeah so like

406
00:17:48,048 --> 00:17:53,990
so in the center of the of the nebula

407
00:17:50,509 --> 00:17:55,669
it's really tenuous gas ok now what the

408
00:17:53,990 --> 00:17:59,150
reason you see the pillars the way they

409
00:17:55,669 --> 00:18:02,780
are is that it's much denser gas ok it's

410
00:17:59,150 --> 00:18:06,140
like running up against a really sharp

411
00:18:02,779 --> 00:18:09,440
fog bank here on the earth all right but

412
00:18:06,140 --> 00:18:12,530
instead where I'm from in Arizona we

413
00:18:09,440 --> 00:18:14,600
don't have fog banks we have dust storms

414
00:18:12,529 --> 00:18:16,759
and believe me when you run in one of

415
00:18:14,599 --> 00:18:20,558
those you know that's a pretty sharp

416
00:18:16,759 --> 00:18:22,970
contrast that's a sharp edge and

417
00:18:20,558 --> 00:18:25,579
understanding how sharp that edges

418
00:18:22,970 --> 00:18:28,279
affects the way you model how the

419
00:18:25,579 --> 00:18:30,529
photons have a light how the ionizing

420
00:18:28,279 --> 00:18:33,168
radiation from those central stars makes

421
00:18:30,529 --> 00:18:35,960
it through that wall and the reason we

422
00:18:33,169 --> 00:18:38,030
care is why the infrared picture is

423
00:18:35,960 --> 00:18:40,039
important what is the diff when you look

424
00:18:38,029 --> 00:18:41,660
at the two pictures right what's the big

425
00:18:40,039 --> 00:18:43,369
difference they're still pretty it's

426
00:18:41,660 --> 00:18:46,519
still pretty dark it's still pretty dark

427
00:18:43,369 --> 00:18:48,409
but there's so many stars right the

428

00:18:46,519 --> 00:18:50,929
reason you see so many stars is you're

429
00:18:48,410 --> 00:18:55,759
seeing through that interface through

430
00:18:50,929 --> 00:18:57,650
that dust storm edge if you like and the

431
00:18:55,759 --> 00:18:59,690
reason because is because as that

432
00:18:57,650 --> 00:19:02,600
interface gets a bladed away it

433
00:18:59,690 --> 00:19:04,630
compresses the gas behind it that region

434
00:19:02,599 --> 00:19:07,548
is called the photodissociation region

435
00:19:04,630 --> 00:19:11,510
ok yeah wish to most but to most people

436
00:19:07,548 --> 00:19:13,519
like day ok but what the the impact of

437
00:19:11,509 --> 00:19:15,859
that is is the gas gets compressed and

438
00:19:13,519 --> 00:19:19,250
you make a second generation of stars

439
00:19:15,859 --> 00:19:20,689
back there alright and separation as

440
00:19:19,250 --> 00:19:24,380
from the first generation

441
00:19:20,690 --> 00:19:25,940
yes so the fact that you made stars in

442
00:19:24,380 --> 00:19:27,310

one part of the galaxy in that

443

00:19:25,940 --> 00:19:29,960

particular part of the neighborhood

444

00:19:27,309 --> 00:19:32,779

intimately affects how the second

445

00:19:29,960 --> 00:19:35,059

generation of stars around it forms now

446

00:19:32,779 --> 00:19:37,789

the thing that the Eagle Nebula picture

447

00:19:35,059 --> 00:19:39,470

in 1995 represented was that because

448

00:19:37,789 --> 00:19:42,279

when you look at the top of the left

449

00:19:39,470 --> 00:19:44,450

hand pillar you see all these little

450

00:19:42,279 --> 00:19:48,589

dragon heads sticking out of the top

451

00:19:44,450 --> 00:19:50,920

those are proto stellar systems caught

452

00:19:48,589 --> 00:19:54,289

in the act of still collapsing still

453

00:19:50,920 --> 00:19:57,500

accreting gas to get bigger and brighter

454

00:19:54,289 --> 00:19:59,809

and they're being dug up too early right

455

00:19:57,500 --> 00:20:02,000

there being dug up and thrown out into

456

00:19:59,809 --> 00:20:03,710

that stores people by the other stars

457
00:20:02,000 --> 00:20:07,069
being formed and ablating their their

458
00:20:03,710 --> 00:20:09,410
nursery interface or environment and so

459
00:20:07,069 --> 00:20:12,139
that that was the first time we saw

460
00:20:09,410 --> 00:20:15,519
direct evidence that primary star

461
00:20:12,140 --> 00:20:19,630
formation affects how big or how

462
00:20:15,519 --> 00:20:22,819
pervasive or how bright the second step

463
00:20:19,630 --> 00:20:24,950
second generation of stars can be and so

464
00:20:22,819 --> 00:20:26,960
that's a pretty wild place in there then

465
00:20:24,950 --> 00:20:29,600
a lot of stuff's going oh yeah just

466
00:20:26,960 --> 00:20:33,500
about any of these h 2 regions really

467
00:20:29,599 --> 00:20:36,309
are very dynamic environments I have a

468
00:20:33,500 --> 00:20:38,690
question that I wanted to ask you before

469
00:20:36,309 --> 00:20:41,389
and I'm not sure if anybody asked you

470
00:20:38,690 --> 00:20:43,490
but in some of these places you know

471
00:20:41,390 --> 00:20:45,500
were you after the original

472
00:20:43,490 --> 00:20:48,019
observation and we did pillars of

473
00:20:45,500 --> 00:20:49,789
creation and star formation we started

474
00:20:48,019 --> 00:20:52,160
looking at Orion and some other places

475
00:20:49,789 --> 00:20:55,369
and we started talking about the

476
00:20:52,160 --> 00:20:56,900
formation of exoplanet systems little

477
00:20:55,369 --> 00:20:58,459
fingers that your dragon heads that

478
00:20:56,900 --> 00:21:00,920
you're talking about are those places

479
00:20:58,460 --> 00:21:04,759
then going to be disrupted and not able

480
00:21:00,920 --> 00:21:07,100
to form exoplanetary systems and maybe

481
00:21:04,759 --> 00:21:10,549
other places in the pillar will or do

482
00:21:07,099 --> 00:21:13,789
you have a feeling for that or great

483
00:21:10,549 --> 00:21:16,669
question because what they note she's a

484
00:21:13,789 --> 00:21:20,029
great straight man because the the whole

485

00:21:16,670 --> 00:21:23,029
point the whole point of the infrared

486
00:21:20,029 --> 00:21:25,430
image is that in places the pillars look

487
00:21:23,029 --> 00:21:27,259
absolutely translucent right but still

488
00:21:25,430 --> 00:21:29,240
in the upper segments of each of those

489
00:21:27,259 --> 00:21:31,730
pillars they're still pretty dark in the

490
00:21:29,240 --> 00:21:34,200
infrared image but what you can see when

491
00:21:31,730 --> 00:21:37,410
you blink the two pictures together

492
00:21:34,200 --> 00:21:39,930
is that there are stellar sources buried

493
00:21:37,410 --> 00:21:42,360
in there and so we can do exactly the

494
00:21:39,930 --> 00:21:43,529
assessment you just describes that get

495
00:21:42,359 --> 00:21:45,509
you know when we originally did the

496
00:21:43,529 --> 00:21:48,569
analysis 20 years ago I think we

497
00:21:45,509 --> 00:21:52,170
identified 60 to 70 possible proto

498
00:21:48,569 --> 00:21:54,480
stellar clumps right but the number of

499
00:21:52,170 --> 00:21:56,640

objects that we had a stellar source in

500

00:21:54,480 --> 00:21:58,410

the heart of we couldn't assess in the

501

00:21:56,640 --> 00:22:00,750

optical because it was completely

502

00:21:58,410 --> 00:22:03,390

shrouded right but now in the infrared

503

00:22:00,750 --> 00:22:05,940

that veil has been lifted and based on

504

00:22:03,390 --> 00:22:07,980

just my first analysis of the data it

505

00:22:05,940 --> 00:22:14,039

looks like ten to fifteen percent of

506

00:22:07,980 --> 00:22:16,259

those clumps do now have or have stellar

507

00:22:14,039 --> 00:22:20,879

sources in the center of them so that

508

00:22:16,259 --> 00:22:22,619

gives you an immediate assessment of how

509

00:22:20,880 --> 00:22:25,110

many of those clumps ultimately will

510

00:22:22,619 --> 00:22:29,399

amount to nothing and how many of those

511

00:22:25,109 --> 00:22:31,049

clumps ultimately will become a star but

512

00:22:29,400 --> 00:22:33,300

probably a lot smaller star than it

513

00:22:31,049 --> 00:22:36,269

would have been because of the process

514
00:22:33,299 --> 00:22:38,129
now your other part of your question is

515
00:22:36,269 --> 00:22:41,160
about the planetary systems around them

516
00:22:38,130 --> 00:22:42,900
right because the question is when you

517
00:22:41,160 --> 00:22:44,910
when you obliterate those things when you

518
00:22:42,900 --> 00:22:47,310
start beating them up with these massive

519
00:22:44,910 --> 00:22:49,500
stellar winds are you actually I'm

520
00:22:47,309 --> 00:22:51,359
cutting off the sink of material that

521
00:22:49,500 --> 00:22:53,339
might ultimately end up in a

522
00:22:51,359 --> 00:22:55,469
circumstellar disk and that might

523
00:22:53,339 --> 00:22:57,419
ultimately become that stars version of

524
00:22:55,470 --> 00:22:58,769
a solar system there's been actually a

525
00:22:57,420 --> 00:23:01,050
number of people who have done a lot of

526
00:22:58,769 --> 00:23:03,839
numerical modeling work of this kind in

527
00:23:01,049 --> 00:23:06,539
the intervening 20 years because because

528
00:23:03,839 --> 00:23:08,099
of all the other nebulae right we've

529
00:23:06,539 --> 00:23:09,750
seen this kind of stuff going on in

530
00:23:08,099 --> 00:23:11,789
Orion we've seen it going on in the

531
00:23:09,750 --> 00:23:14,490
trifid we've seen it going a variety of

532
00:23:11,789 --> 00:23:15,930
different places so the question is that

533
00:23:14,490 --> 00:23:17,640
they were trying to answer was if you

534
00:23:15,930 --> 00:23:20,759
have a bunch of protostellar and proto

535
00:23:17,640 --> 00:23:23,820
planetary systems like that in the close

536
00:23:20,759 --> 00:23:26,759
proximity to massive stars what are the

537
00:23:23,819 --> 00:23:28,799
chances how long can it actually stick

538
00:23:26,759 --> 00:23:31,049
around and the remarkable thing is that

539
00:23:28,799 --> 00:23:34,079
by that it depends on where they are in

540
00:23:31,049 --> 00:23:36,079
the phase of aggregating material but a

541
00:23:34,079 --> 00:23:38,939
lot of them actually can survive and

542

00:23:36,079 --> 00:23:43,129
where some of this act became actually

543
00:23:38,940 --> 00:23:45,529
really quite at home and personal was a

544
00:23:43,130 --> 00:23:47,930
my own home department at Arizona State

545
00:23:45,529 --> 00:23:49,940
we have a lot of different folks working

546
00:23:47,930 --> 00:23:51,950
together we've got geologists meteor it

547
00:23:49,940 --> 00:23:53,450
assists planetary scientists all kind of

548
00:23:51,950 --> 00:23:55,370
stuff working together with astronomers

549
00:23:53,450 --> 00:23:57,620
we have one of the best meteorite

550
00:23:55,369 --> 00:23:58,909
collections in the world and we went in

551
00:23:57,619 --> 00:24:02,929
and had a look at some of the meteorite

552
00:23:58,910 --> 00:24:05,630
evidence for abundances of different

553
00:24:02,930 --> 00:24:07,490
kinds of isotopic materials in the

554
00:24:05,630 --> 00:24:09,230
meteorite matrices that we see from

555
00:24:07,490 --> 00:24:11,589
objects that have fallen to earth here

556
00:24:09,230 --> 00:24:14,120

and when you look at the isotopic

557

00:24:11,589 --> 00:24:16,279
abundances of things like iron and

558

00:24:14,119 --> 00:24:18,799
nickel you find that they have been

559

00:24:16,279 --> 00:24:21,950
enhanced in exactly the way you would

560

00:24:18,799 --> 00:24:25,159
expect by a supernova going off really

561

00:24:21,950 --> 00:24:29,410
nearby right when our start when our

562

00:24:25,160 --> 00:24:29,410
solar system wasn't exactly the phase

563

00:24:29,920 --> 00:24:34,250
right because to test because

564

00:24:32,420 --> 00:24:36,680
statistically that's what it tells you

565

00:24:34,250 --> 00:24:38,930
right for your solar system our solar

566

00:24:36,680 --> 00:24:42,200
system to be caught at that very instant

567

00:24:38,930 --> 00:24:44,539
of forming and a supernova just happens

568

00:24:42,200 --> 00:24:46,940
to be right next door and go boom means

569

00:24:44,539 --> 00:24:50,240
that we formed in a massive sterile

570

00:24:46,940 --> 00:24:52,640
environment just like the Eagle so when

571
00:24:50,240 --> 00:24:55,759
we're looking at the eagle we're looking

572
00:24:52,640 --> 00:24:59,300
at old family photos right that's that's

573
00:24:55,759 --> 00:25:00,500
really well exactly exactly so the super

574
00:24:59,299 --> 00:25:02,329
the supernova you're talking about

575
00:25:00,500 --> 00:25:03,769
though that isn't necessarily in the

576
00:25:02,329 --> 00:25:06,129
eagle nebula itself is just somewhere in

577
00:25:03,769 --> 00:25:08,210
the vicinity right no the the very

578
00:25:06,130 --> 00:25:10,250
massive stars at the center of the

579
00:25:08,210 --> 00:25:12,680
nebula right the ones that are lighting

580
00:25:10,250 --> 00:25:14,059
up the whole neighborhood's the only

581
00:25:12,680 --> 00:25:16,160
stars that can kick out that much

582
00:25:14,059 --> 00:25:18,980
ultraviolet radiation are the most

583
00:25:16,160 --> 00:25:22,040
massive stars are the OB stars that we

584
00:25:18,980 --> 00:25:25,730
see that are tens 20s of solar masses in

585
00:25:22,039 --> 00:25:27,799
mass and those stars are the college

586
00:25:25,730 --> 00:25:30,230
frat brothers of stars in that they live

587
00:25:27,799 --> 00:25:32,059
fast and die young and they don't last

588
00:25:30,230 --> 00:25:35,539
very long they only last a few million

589
00:25:32,059 --> 00:25:36,980
years and then they go Foom and that and

590
00:25:35,539 --> 00:25:41,299
so it becomes a statistical argument

591
00:25:36,980 --> 00:25:43,610
right so the first generation of stars

592
00:25:41,299 --> 00:25:47,359
do you have a sense how many of those

593
00:25:43,609 --> 00:25:49,879
that are in the in the region that when

594
00:25:47,359 --> 00:25:53,389
you look at any given region of star

595
00:25:49,880 --> 00:25:55,820
formation there is this Universal

596
00:25:53,390 --> 00:25:56,960
quality control curve which we call the

597
00:25:55,819 --> 00:25:59,599
initial mass function

598
00:25:56,960 --> 00:26:01,669
alright so when you make a certain

599

00:25:59,599 --> 00:26:07,219
number of massive stars you make a

600
00:26:01,669 --> 00:26:09,590
truckload of solar mass yes right there

601
00:26:07,220 --> 00:26:12,860
you make an awful lot of low-mass stars

602
00:26:09,589 --> 00:26:15,470
for very few massive ones right and and

603
00:26:12,859 --> 00:26:18,500
it's just a sliding vertical scale so

604
00:26:15,470 --> 00:26:21,140
for you to have any massive stars at all

605
00:26:18,500 --> 00:26:25,009
in this neighborhood you have to have

606
00:26:21,140 --> 00:26:27,759
made a bunch of low-mass ones and one of

607
00:26:25,009 --> 00:26:29,419
the one of the guys in the press press

608
00:26:27,759 --> 00:26:32,240
conference asked me that question

609
00:26:29,419 --> 00:26:34,309
because we can now see through the back

610
00:26:32,240 --> 00:26:38,179
wall of the cavity and we can see so

611
00:26:34,308 --> 00:26:41,509
many stars in this picture is it

612
00:26:38,179 --> 00:26:43,580
commensurate is it in fact does it make

613
00:26:41,509 --> 00:26:45,379

sense concerning how big we think the

614

00:26:43,579 --> 00:26:47,000

cluster is and the short answer I've got

615

00:26:45,380 --> 00:26:48,230

right now is I don't know because I

616

00:26:47,000 --> 00:26:50,528

haven't had a chance to count them all

617

00:26:48,230 --> 00:26:52,579

all right but because of the colors

618

00:26:50,528 --> 00:26:54,950

because the infrared picture was taken

619

00:26:52,579 --> 00:26:58,519

into bands you can figure out how

620

00:26:54,950 --> 00:26:59,630

massive each of those stars is so so I

621

00:26:58,519 --> 00:27:01,369

want to get back to the point we were

622

00:26:59,630 --> 00:27:03,620

making about week we were born in the

623

00:27:01,369 --> 00:27:05,569

same kind of neighborhood as the one

624

00:27:03,619 --> 00:27:08,028

you're talking about now what other

625

00:27:05,569 --> 00:27:09,980

stars that are around us would have been

626

00:27:08,028 --> 00:27:11,569

a part of that do you think well the

627

00:27:09,980 --> 00:27:14,298

problem when you make a cluster of stars

628
00:27:11,569 --> 00:27:17,359
is they all form in the same place and

629
00:27:14,298 --> 00:27:18,679
they fall in the same cavity and when

630
00:27:17,359 --> 00:27:21,288
you look at the eagle you're looking at

631
00:27:18,679 --> 00:27:23,298
them just bust it out right there

632
00:27:21,288 --> 00:27:24,710
they're all teenagers going out for

633
00:27:23,298 --> 00:27:27,889
their first party and stuff right

634
00:27:24,710 --> 00:27:31,009
they're all coming out of their nursery

635
00:27:27,890 --> 00:27:33,320
and being exposed to the interstellar

636
00:27:31,009 --> 00:27:34,730
environment the problem is dynamically

637
00:27:33,319 --> 00:27:36,109
they're not just sitting there they're

638
00:27:34,730 --> 00:27:39,769
moving they have their own proper

639
00:27:36,109 --> 00:27:42,259
motions and the cluster over time starts

640
00:27:39,769 --> 00:27:43,788
to dissipate it enlarges stars go in

641
00:27:42,259 --> 00:27:47,179
different directions some have more have

642
00:27:43,788 --> 00:27:48,769
higher velocities than others and the

643
00:27:47,179 --> 00:27:51,380
other problem is they have a finite

644
00:27:48,769 --> 00:27:53,629
width and within a spiral galaxy you

645
00:27:51,380 --> 00:27:56,770
have a gradient in rotational velocity

646
00:27:53,630 --> 00:27:59,299
that causes sheer at any given radius

647
00:27:56,769 --> 00:28:02,269
what the the end oh we're going our

648
00:27:59,298 --> 00:28:05,000
galaxy any spiral galaxy the the part of

649
00:28:02,269 --> 00:28:06,829
of the the neighborhood there that is

650
00:28:05,000 --> 00:28:08,509
closer to the center of the galaxy is

651
00:28:06,829 --> 00:28:09,079
going to rotate around the center of the

652
00:28:08,509 --> 00:28:11,240
galaxy

653
00:28:09,079 --> 00:28:16,609
wika then the stuff does maybe a little

654
00:28:11,240 --> 00:28:18,620
bit further away our intro astronomy if

655
00:28:16,609 --> 00:28:21,019
we were the cluster and the galactic

656

00:28:18,619 --> 00:28:23,209
center he was over there zouk would be

657
00:28:21,019 --> 00:28:25,190
moving the fastest and then mean

658
00:28:23,210 --> 00:28:29,329
accident and then you guys would just

659
00:28:25,190 --> 00:28:31,730
drift away but what that means is the

660
00:28:29,329 --> 00:28:34,309
cluster as we understand it has been

661
00:28:31,730 --> 00:28:37,970
this beautiful round cluster of stars

662
00:28:34,309 --> 00:28:41,329
get stretched out and smeared and so

663
00:28:37,970 --> 00:28:44,390
stars that form together end up all over

664
00:28:41,329 --> 00:28:47,089
the place Lee streamed out along that

665
00:28:44,390 --> 00:28:48,560
radial but you said also they weed to

666
00:28:47,089 --> 00:28:50,809
have their own proper motions to what

667
00:28:48,559 --> 00:28:52,369
causes that because getting bumped

668
00:28:50,809 --> 00:28:55,879
around by other forces and have nebula

669
00:28:52,369 --> 00:28:58,849
just randomness in the way the collapse

670
00:28:55,880 --> 00:29:00,860

happens when you take the the cold dark

671

00:28:58,849 --> 00:29:04,579

material in a molecular cloud and you

672

00:29:00,859 --> 00:29:07,099

collapse it there's always some rotation

673

00:29:04,579 --> 00:29:09,169

built into it and so there's always an

674

00:29:07,099 --> 00:29:11,359

angular momentum vector or a preferred

675

00:29:09,170 --> 00:29:13,130

axis around which it spins and they're

676

00:29:11,359 --> 00:29:15,949

all different all the stars have

677

00:29:13,130 --> 00:29:18,170

different rotation vectors and as they

678

00:29:15,950 --> 00:29:20,090

collapse the mechanism by which that

679

00:29:18,170 --> 00:29:23,240

material makes it onto the surface

680

00:29:20,089 --> 00:29:25,069

requires material to be ejected along

681

00:29:23,240 --> 00:29:27,410

the rotation axis that's why when you

682

00:29:25,069 --> 00:29:28,909

see new stellar systems like this they

683

00:29:27,410 --> 00:29:31,550

always have this characteristic jet

684

00:29:28,910 --> 00:29:33,019

sticking out of them and in fact in the

685
00:29:31,549 --> 00:29:35,329
data in one of the pictures we've got

686
00:29:33,019 --> 00:29:38,480
there over that 20-year life span we can

687
00:29:35,329 --> 00:29:41,029
see one of the Jets moving right right

688
00:29:38,480 --> 00:29:43,579
and so that's telling you that that's an

689
00:29:41,029 --> 00:29:45,710
immediate sign poster says look we just

690
00:29:43,579 --> 00:29:48,019
made a style right here because you can

691
00:29:45,710 --> 00:29:50,180
see the jetta material being spat out of

692
00:29:48,019 --> 00:29:52,430
it as it tries to aggregate material

693
00:29:50,180 --> 00:29:54,590
down into the star and into the

694
00:29:52,430 --> 00:29:57,289
protoplanetary disk that ultimately

695
00:29:54,589 --> 00:30:00,049
becomes the solar system as you can see

696
00:29:57,289 --> 00:30:02,299
in front of the camera right now Thank

697
00:30:00,049 --> 00:30:05,990
You salt but our high-tech high-tech

698
00:30:02,299 --> 00:30:07,399
wizardry here so said something about

699
00:30:05,990 --> 00:30:08,509
the pillar or knows carol they said

700
00:30:07,400 --> 00:30:11,930
something about the pillars being five

701
00:30:08,509 --> 00:30:13,789
light years or so the line is long yeah

702
00:30:11,930 --> 00:30:18,320
what how big would you say the whole

703
00:30:13,789 --> 00:30:19,490
reason in teh area um the the cluster

704
00:30:18,319 --> 00:30:21,439
itself if you look at a typical

705
00:30:19,490 --> 00:30:22,700
ground-based picture the pillars

706
00:30:21,440 --> 00:30:24,380
themselves are

707
00:30:22,700 --> 00:30:26,990
really quite small compared to the rest

708
00:30:24,380 --> 00:30:29,270
of the cavity so if that's you know if

709
00:30:26,990 --> 00:30:31,160
the fit if the pillow length is 5 l

710
00:30:29,269 --> 00:30:35,480
would say the club the cluster has to be

711
00:30:31,160 --> 00:30:36,950
a good 40 or 50 light years across and l

712
00:30:35,480 --> 00:30:38,660
predict a lot of planets coming out of

713

00:30:36,950 --> 00:30:39,980
this one too I don't know seems to me

714
00:30:38,660 --> 00:30:41,779
like there'll be a lot of them coming

715
00:30:39,980 --> 00:30:44,809
out of there so let's get back to the

716
00:30:41,779 --> 00:30:47,389
image itself you can you give us some

717
00:30:44,809 --> 00:30:49,190
idea of how many uh orbits things like

718
00:30:47,390 --> 00:30:50,660
that maybe went into it some some some

719
00:30:49,190 --> 00:30:52,220
images like that you have any rough ID

720
00:30:50,660 --> 00:30:53,180
dogged if you don't know it off the top

721
00:30:52,220 --> 00:30:55,009
of your head I just like to give people

722
00:30:53,180 --> 00:30:59,360
sense of how long it took to put

723
00:30:55,009 --> 00:31:03,140
together age 20 isn't it let's see for

724
00:30:59,359 --> 00:31:06,379
pointings three filters for pointing and

725
00:31:03,140 --> 00:31:08,240
you've is two filters / pointing and

726
00:31:06,380 --> 00:31:11,420
infrared and I believe we were able to

727
00:31:08,240 --> 00:31:18,019

fit both infrared pointing filters in

728

00:31:11,420 --> 00:31:20,980

one orbit so that was like four bits for

729

00:31:18,019 --> 00:31:23,809

the or less for the infrared and

730

00:31:20,980 --> 00:31:26,750

pretense for was 12 orbits for the you

731

00:31:23,809 --> 00:31:30,589

biz so you know 15 orbits or so I

732

00:31:26,750 --> 00:31:32,990

believe we had 15 orbits for it is an

733

00:31:30,589 --> 00:31:34,970

out is an hour and a half right fully an

734

00:31:32,990 --> 00:31:37,759

hour and a half but you only have 40 to

735

00:31:34,970 --> 00:31:40,220

50 minutes within the orbit to actually

736

00:31:37,759 --> 00:31:42,140

no unfortunately none the continuous

737

00:31:40,220 --> 00:31:44,150

being zone so there's all kinds of

738

00:31:42,140 --> 00:31:47,300

overheads with switching filters and

739

00:31:44,150 --> 00:31:48,860

switching pointing so you but it worked

740

00:31:47,299 --> 00:31:53,599

out okay I mean we had enough time to

741

00:31:48,859 --> 00:31:55,189

get a decent decent images a point that

742
00:31:53,599 --> 00:31:58,490
needs to be made concerning the original

743
00:31:55,190 --> 00:32:00,350
data is that in that set those are very

744
00:31:58,490 --> 00:32:03,500
comparable exposure times to what we did

745
00:32:00,349 --> 00:32:07,099
20 years ago but we get 10 times deeper

746
00:32:03,500 --> 00:32:08,869
right which is very cool and what and

747
00:32:07,099 --> 00:32:10,939
what that illustre you know you've got

748
00:32:08,869 --> 00:32:13,129
the infrared channel you've got twice

749
00:32:10,940 --> 00:32:15,049
the resolution and you're going deeper

750
00:32:13,130 --> 00:32:17,570
in the same exposure time what that

751
00:32:15,049 --> 00:32:20,750
illustrates is how much better hubble

752
00:32:17,569 --> 00:32:22,579
became as a facility in the 25 years we

753
00:32:20,750 --> 00:32:24,559
touch on that at the beginning yeah it's

754
00:32:22,579 --> 00:32:27,230
like the advantage we have of Hubble

755
00:32:24,559 --> 00:32:29,059
beings not only a closer North orbit

756
00:32:27,230 --> 00:32:30,140
Earth orbit but also the about the fact

757
00:32:29,059 --> 00:32:32,269
that it was designed with the Space

758
00:32:30,140 --> 00:32:34,399
Shuttle in mind to repair it has

759
00:32:32,269 --> 00:32:36,319
we made Hubble one of the most amazing

760
00:32:34,398 --> 00:32:38,898
long longest-lived instruments we've

761
00:32:36,319 --> 00:32:40,819
ever had so let me turn to Ishaan CP

762
00:32:38,898 --> 00:32:43,248
sound anything nothing on the social

763
00:32:40,819 --> 00:32:44,989
media things okay all right well you

764
00:32:43,249 --> 00:32:46,038
guys have any final comments on anything

765
00:32:44,989 --> 00:32:49,459
you want to mention that we haven't

766
00:32:46,038 --> 00:32:51,108
covered here I I think there's still an

767
00:32:49,459 --> 00:32:53,419
awful lot of science to pull out of that

768
00:32:51,108 --> 00:32:55,848
those data and I've already told Saul I

769
00:32:53,419 --> 00:32:58,129
want to write a paper on this because we

770

00:32:55,848 --> 00:33:00,138
have the ability to go in there look at

771
00:32:58,128 --> 00:33:01,968
those stellar populations look at how

772
00:33:00,138 --> 00:33:04,308
much sharper that interface is redo the

773
00:33:01,969 --> 00:33:06,320
calculations about the gas dynamics in

774
00:33:04,308 --> 00:33:08,118
the nebula and really understand what

775
00:33:06,319 --> 00:33:10,458
the stellar environment stellar

776
00:33:08,118 --> 00:33:12,019
formation environment in in this nebula

777
00:33:10,459 --> 00:33:14,359
looks like and these new data really

778
00:33:12,019 --> 00:33:15,888
gives us gives us that chance sounds

779
00:33:14,358 --> 00:33:18,078
exciting thank you Paul I appreciate

780
00:33:15,888 --> 00:33:21,019
your time for coming by congratulations

781
00:33:18,078 --> 00:33:23,509
on a great release this was awesome oh I

782
00:33:21,019 --> 00:33:26,989
just wanted I'm trying to load the image

783
00:33:23,509 --> 00:33:31,249
of the entire region and so if you look

784
00:33:26,989 --> 00:33:34,459

up m16 astronomy if you look up m16

785

00:33:31,249 --> 00:33:39,739

you'll get the m16 rifle but if you want

786

00:33:34,459 --> 00:33:42,109

to know about m16 astronomy our nebula

787

00:33:39,739 --> 00:33:44,989

I'm 16 nebi oh look up there are some

788

00:33:42,108 --> 00:33:47,088

images of the entire region which I'm

789

00:33:44,989 --> 00:33:51,459

going I actually got the image to loads

790

00:33:47,088 --> 00:33:56,888

all I'll show you it right now okay so

791

00:33:51,459 --> 00:34:02,379

okay so yeah we're looking at the wider

792

00:33:56,888 --> 00:34:02,378

wider view of the whole Eagle Nebula is

793

00:34:03,159 --> 00:34:07,459

so you can see that the pillar we're

794

00:34:05,659 --> 00:34:10,250

looking pillars were looking at a really

795

00:34:07,459 --> 00:34:12,619

very small part of that entire complex

796

00:34:10,250 --> 00:34:14,568

region and there's other pillars in

797

00:34:12,619 --> 00:34:16,849

there there's another pillar that that

798

00:34:14,568 --> 00:34:19,659

we took Hubble images of a number of

799

00:34:16,849 --> 00:34:21,798
years ago with the ACS camera and

800

00:34:19,659 --> 00:34:23,599
comparable you know comparable

801

00:34:21,798 --> 00:34:27,588
structures very interesting structures

802

00:34:23,599 --> 00:34:29,419
and I just wanted to kind of say that

803

00:34:27,588 --> 00:34:31,730
one of the reasons we took this image

804

00:34:29,418 --> 00:34:34,460
was too kind of book in the project to

805

00:34:31,730 --> 00:34:36,318
the Hubble mission so it's almost 25

806

00:34:34,460 --> 00:34:38,389
years it's been an operation that says

807

00:34:36,318 --> 00:34:40,860
Paul said I think that that's an

808

00:34:38,389 --> 00:34:43,380
eternity for a space mission really

809

00:34:40,860 --> 00:34:46,289
many space missions only last months two

810

00:34:43,380 --> 00:34:48,650
years and Hubble's been because of the

811

00:34:46,289 --> 00:34:50,880
ability to service it it's been not only

812

00:34:48,650 --> 00:34:53,190
operating for this amount of time but

813
00:34:50,880 --> 00:34:56,579
has been improved it's much better than

814
00:34:53,190 --> 00:34:58,260
it was when it first started and it's

815
00:34:56,579 --> 00:35:00,150
stayed competitive with the rest of

816
00:34:58,260 --> 00:35:02,700
astronomy it's been still in the

817
00:35:00,150 --> 00:35:05,070
forefront of astronomy even though it's

818
00:35:02,699 --> 00:35:08,399
25 years old which is no old even for a

819
00:35:05,070 --> 00:35:10,260
ground-based telescope really so that's

820
00:35:08,400 --> 00:35:12,030
the one of the primary reasons we did

821
00:35:10,260 --> 00:35:14,040
this image and we want to highlight the

822
00:35:12,030 --> 00:35:17,010
history the mission and we thought it'd

823
00:35:14,039 --> 00:35:18,210
be a good way to do that so I want to

824
00:35:17,010 --> 00:35:19,380
thank all you guys for joining us has

825
00:35:18,210 --> 00:35:21,300
been a lot of fun thanks for joining us

826
00:35:19,380 --> 00:35:26,910
Paul oh this is really great yeah this

827

00:35:21,300 --> 00:35:31,019
is unfun yeah congratulations yes I got

828
00:35:26,909 --> 00:35:32,250
there I've got the link on we got a lot

829
00:35:31,019 --> 00:35:35,190
of stuff for you to download so we hope

830
00:35:32,250 --> 00:35:36,570
you'll do that and we care hope you'll

831
00:35:35,190 --> 00:35:38,159
join us our next hangout will be at

832
00:35:36,570 --> 00:35:40,410
four-thirty pacific time where Carol and

833
00:35:38,159 --> 00:35:41,699
I will do a recap of the double AAS

834
00:35:40,409 --> 00:35:44,039
meeting today some of the things that we

835
00:35:41,699 --> 00:35:45,179
found interesting for about 15 or 20

836
00:35:44,039 --> 00:35:47,309
minutes we'll sit and chat about the end

837
00:35:45,179 --> 00:35:48,779
of the day and so we hope you'll join

838
00:35:47,309 --> 00:35:53,719
that I want to thank you all for

839
00:35:48,780 --> 00:35:53,720
watching and as always keep looking up