
HUBBLE
25
HUBBLE
hangouts
News from Hubble and Across the Universe
with Dr. Frank Summers
Wednesday, January 28 2015 3pm EST 8pm UT, 9pm CET

1
00:00:08,210 --> 00:00:05,380
hello everybody so I have to push them

2
00:00:10,790 --> 00:00:08,220
hello everybody and welcome to this

3
00:00:14,330 --> 00:00:10,800
week's hang out this is it is time for

4
00:00:16,580 --> 00:00:14,340
our our news from Hubble and across the

5
00:00:19,700 --> 00:00:16,590
universe with doctor Frank summers

6
00:00:21,519 --> 00:00:19,710
hangout we do this every month generally

7
00:00:25,340 --> 00:00:21,529
we tried to anyway and it's usually

8
00:00:27,230 --> 00:00:25,350
coincides with our Hubble public lecture

9
00:00:30,140 --> 00:00:27,240
series which is generally held on the

10
00:00:31,609 --> 00:00:30,150
first Tuesday of every month we got it

11
00:00:32,930 --> 00:00:31,619
because of some scheduling issues we're

12
00:00:34,700 --> 00:00:32,940
having a little bit later in january

13
00:00:37,459 --> 00:00:34,710

plus we had the double a surly ER this

14
00:00:39,139 --> 00:00:37,469
month so we are having it in the last

15
00:00:41,139 --> 00:00:39,149
week of january but that gives us a good

16
00:00:43,790 --> 00:00:41,149
opportunity to talk about next week's

17
00:00:46,190 --> 00:00:43,800
Hubble public lecture which we will be

18
00:00:48,440 --> 00:00:46,200
on Tuesday it's generally our cars

19
00:00:50,420 --> 00:00:48,450
generally rebroadcast on youtube so up

20
00:00:52,639 --> 00:00:50,430
and I'm usually on hand to respond to

21
00:00:54,920 --> 00:00:52,649
questions and comments while the lecture

22
00:00:57,350 --> 00:00:54,930
is going on but we invite you to watch

23
00:00:59,060 --> 00:00:57,360
it after the fact as well so let me just

24
00:01:02,540 --> 00:00:59,070
give the plug promo for that that okay

25
00:01:04,460 --> 00:01:02,550
go ahead dr. Jason Tomlinson of the

26
00:01:06,440 --> 00:01:04,470
Space Telescope Science Institute you

27
00:01:08,690 --> 00:01:06,450
will be speaking on one of the longest

28
00:01:12,710 --> 00:01:08,700
titles I've been ever beginning from

29
00:01:17,749 --> 00:01:12,720
cosmic birth to living earth the next

30
00:01:19,490 --> 00:01:17,759
great space telescope beyond jador st so

31
00:01:20,749 --> 00:01:19,500
I mean we're already looking forward to

32
00:01:24,020 --> 00:01:20,759
the James Webb Space Telescope which

33
00:01:25,340 --> 00:01:24,030
doesn't launch until 2018 but Jason's

34
00:01:29,149 --> 00:01:25,350
going to come and talk to us what

35
00:01:30,830 --> 00:01:29,159
happens after that right and we've also

36
00:01:33,289 --> 00:01:30,840
had a couple of hangouts on that as well

37
00:01:36,050 --> 00:01:33,299
so yeah so you're right we are actually

38
00:01:38,240 --> 00:01:36,060

starting to look look beyond the webb

39
00:01:40,190 --> 00:01:38,250
space telescope so i definitely check

40
00:01:44,480 --> 00:01:40,200
that out i will have it on it's at eight

41
00:01:46,130 --> 00:01:44,490
pm eastern standard time and that's when

42
00:01:48,350 --> 00:01:46,140
it'll be broadcast on youtube and so

43
00:01:49,670 --> 00:01:48,360
will look to see you there before we get

44
00:01:51,350 --> 00:01:49,680
started with Frank today though let me

45
00:01:52,670 --> 00:01:51,360
just tell you where we hope you'll bring

46
00:01:55,940 --> 00:01:52,680
us some questions and comments for

47
00:01:57,709 --> 00:01:55,950
today's for today's hangout we have I'm

48
00:01:59,929 --> 00:01:57,719
looking at the Q&A app that's the best

49
00:02:02,149 --> 00:01:59,939
way to interact with us but I'm also

50
00:02:05,209 --> 00:02:02,159
looking at hubbell hang out hashtag as

51
00:02:07,999 --> 00:02:05,219
well as the event page on Google+ and

52
00:02:10,100 --> 00:02:08,009
the YouTube pages is being broadcast on

53
00:02:11,420 --> 00:02:10,110
so please bring us your questions and

54
00:02:14,120 --> 00:02:11,430
comments and we'll try to read them out

55
00:02:16,580 --> 00:02:14,130
while we're on the air hiya Frank

56
00:02:18,650 --> 00:02:16,590
welcome back I yet Tony how you doing

57
00:02:21,200 --> 00:02:18,660
it's been a spent a long time since we

58
00:02:23,660 --> 00:02:21,210
chat because we had ee s this month was

59
00:02:25,850 --> 00:02:23,670
postponed this month but also last month

60
00:02:28,520 --> 00:02:25,860
we I was at the american geophysical

61
00:02:30,200 --> 00:02:28,530
union conference and you had a vacation

62
00:02:32,720 --> 00:02:30,210
so i don't think we did in december hang

63
00:02:35,030 --> 00:02:32,730

no we didn't do any time is always been

64
00:02:36,950 --> 00:02:35,040
since november so welcome to all our

65
00:02:39,020 --> 00:02:36,960
friends who are joining us there's a

66
00:02:40,430 --> 00:02:39,030
whole ton of stuff to catch up on on

67
00:02:42,640 --> 00:02:40,440
we're not going to get through it all

68
00:02:45,350 --> 00:02:42,650
today okay unfortunately because i got

69
00:02:47,750 --> 00:02:45,360
so much cool stuff just from from from

70
00:02:49,370 --> 00:02:47,760
from one image really well 11 press

71
00:02:52,610 --> 00:02:49,380
release it's just really lots of fun

72
00:02:56,690 --> 00:02:52,620
okay so yeah so go ahead what do you got

73
00:02:58,940 --> 00:02:56,700
for us okay so i am going to talk to you

74
00:03:00,560 --> 00:02:58,950
today this is our news from the Hubble

75
00:03:03,830 --> 00:03:00,570
year of hubble hubble and across the

76
00:03:05,630 --> 00:03:03,840
universe and i will be my story for

77
00:03:08,210 --> 00:03:05,640
today and i apologize there isn't more

78
00:03:10,760 --> 00:03:08,220
than one story j but we got lots of cool

79
00:03:13,850 --> 00:03:10,770
stuff here about this great revisiting a

80
00:03:16,580 --> 00:03:13,860
legend ok we have certain legendary

81
00:03:18,860 --> 00:03:16,590
images we think of Hubble there are

82
00:03:21,950 --> 00:03:18,870
certain images that you say wow that's

83
00:03:24,260 --> 00:03:21,960
something that just is so cool that will

84
00:03:26,810 --> 00:03:24,270
live forever in your memory of Hubble I

85
00:03:29,470 --> 00:03:26,820
think perhaps the most famous image

86
00:03:31,900 --> 00:03:29,480
shuttle has ever released is this one

87
00:03:34,160 --> 00:03:31,910
the pillars in the Eagle Nebula

88
00:03:38,270 --> 00:03:34,170

poetically named the pillars of creation

89
00:03:41,990 --> 00:03:38,280
and the first come out this one was

90
00:03:44,000 --> 00:03:42,000
first released in November 1995 okay

91
00:03:46,790 --> 00:03:44,010
that is I fact definitely an iconic

92
00:03:50,030 --> 00:03:46,800
picture yeah and matter of fact you know

93
00:03:52,100 --> 00:03:50,040
November 1995 was an amazing month for

94
00:03:54,050 --> 00:03:52,110
us because not only did we release this

95
00:03:56,210 --> 00:03:54,060
image but we also released that

96
00:03:59,449 --> 00:03:56,220
beautiful image of the trapezium cluster

97
00:04:02,120 --> 00:03:59,459
in the Orion Nebula that first of Bob

98
00:04:03,770 --> 00:04:02,130
odell image of the Orion Nebula getting

99
00:04:05,660 --> 00:04:03,780
into the trapezium it was like five

100
00:04:08,600 --> 00:04:05,670
thousand pixels across up by five

101
00:04:10,130 --> 00:04:08,610
dollars because amazing so that all came

102
00:04:13,970 --> 00:04:10,140
out within one month so that was a good

103
00:04:16,880 --> 00:04:13,980
month for us but this one this one is

104
00:04:19,580 --> 00:04:16,890
one that people always remember and it's

105
00:04:22,340 --> 00:04:19,590
nicknamed the pillars of creation simply

106
00:04:25,550 --> 00:04:22,350
because these are places where stars are

107
00:04:27,650 --> 00:04:25,560
forming all right so you have the these

108
00:04:29,960 --> 00:04:27,660
long tall pillars

109
00:04:31,880 --> 00:04:29,970
they're being blown back by gas from hot

110
00:04:34,940 --> 00:04:31,890
stars they're forming in this cluster

111
00:04:36,110 --> 00:04:34,950
and in the very tops of these pillars

112
00:04:38,360 --> 00:04:36,120
and I'll show you some of the details

113
00:04:40,430 --> 00:04:38,370

admit our places where stars are

114
00:04:42,230 --> 00:04:40,440
actually forming and so hence that's

115
00:04:44,930 --> 00:04:42,240
where the nickname colors of creation

116
00:04:46,880 --> 00:04:44,940
comes from but let's give you a let's

117
00:04:48,410 --> 00:04:46,890
back up a little bit let's actually give

118
00:04:49,880 --> 00:04:48,420
you a little more context for this

119
00:04:54,230 --> 00:04:49,890
little green explore this in great

120
00:04:56,920 --> 00:04:54,240
detail well this is an image of the

121
00:05:01,280 --> 00:04:56,930
Milky Way center of the Milky Way galaxy

122
00:05:03,170 --> 00:05:01,290
from a cure for GE here is wonderful and

123
00:05:07,460 --> 00:05:03,180
lets us use a lot of his images here at

124
00:05:09,490 --> 00:05:07,470
hubbell and what has been drawn out here

125
00:05:12,610 --> 00:05:09,500
is the locations a lot of different

126
00:05:18,110 --> 00:05:12,620
messy objects near the galactic center

127
00:05:20,960 --> 00:05:18,120
you can see em 16 m 18 and 25 and 23 and

128
00:05:23,390 --> 00:05:20,970
28 cetera but the one that's been boxed

129
00:05:26,780 --> 00:05:23,400
in there is m16 and that is the Eagle

130
00:05:28,070 --> 00:05:26,790
Nebula now some of you may not know when

131
00:05:29,600 --> 00:05:28,080
you're looking towards the galactic

132
00:05:33,230 --> 00:05:29,610
center you're not going to have this

133
00:05:35,090 --> 00:05:33,240
good seeing just to show some of you the

134
00:05:37,340 --> 00:05:35,100
constellation Sagittarius is drawn in

135
00:05:40,190 --> 00:05:37,350
the lower right and I'm going to put in

136
00:05:42,560 --> 00:05:40,200
the constellation lines for for you the

137
00:05:44,780 --> 00:05:42,570
constellation alarms yes that teapot

138
00:05:47,510 --> 00:05:44,790

this isn't the entire constellation

139
00:05:48,890 --> 00:05:47,520
Sagittarius but it's the only part of

140
00:05:52,100 --> 00:05:48,900
the constellation stare said shares that

141
00:05:53,960 --> 00:05:52,110
I know okay that's a point everybody

142
00:05:56,360 --> 00:05:53,970
recognizes that's what I all learned on

143
00:05:58,159 --> 00:05:56,370
as well as how to find a teapot exactly

144
00:06:00,200 --> 00:05:58,169
you gotta find the teapot and then

145
00:06:03,020 --> 00:06:00,210
you're actually looking towards the

146
00:06:05,659 --> 00:06:03,030
center of the Milky Way for those of us

147
00:06:06,860 --> 00:06:05,669
in the northern hemisphere you're only

148
00:06:09,770 --> 00:06:06,870
going to be able to see this in the

149
00:06:12,020 --> 00:06:09,780
summertime July and August and it's

150
00:06:14,659 --> 00:06:12,030
going to be low on the horizon and so

151
00:06:16,820 --> 00:06:14,669
the the center of the galaxy is not

152
00:06:18,380 --> 00:06:16,830
going to be visible in winter it's only

153
00:06:20,630 --> 00:06:18,390
visible in summertime and it only gets

154
00:06:22,730 --> 00:06:20,640
you know tens of trees 30 degrees or so

155
00:06:25,340 --> 00:06:22,740
40 degrees above the above the horizon

156
00:06:29,240 --> 00:06:25,350
and summertime and that's when you can

157
00:06:32,480 --> 00:06:29,250
see the teapot okay and for those of you

158
00:06:34,280 --> 00:06:32,490
who think of astrology and think of that

159
00:06:36,980 --> 00:06:34,290
you are such you're born under the sign

160
00:06:39,650 --> 00:06:36,990
of sagittarius and that you're supposed

161
00:06:41,420 --> 00:06:39,660
to be go hurt her no no remember the

162
00:06:45,620 --> 00:06:41,430
song you were we had

163
00:06:49,550 --> 00:06:45,630

you are a little teapot okay don't sing

164
00:06:52,940 --> 00:06:49,560
it Frank I'll uh uh you didn't like my

165
00:06:56,630 --> 00:06:52,950
singing last oh I'm just like a join in

166
00:07:00,020 --> 00:06:56,640
that's all anyway so there's your teapot

167
00:07:01,670 --> 00:07:00,030
alright so let's zoom into m16 whoops i

168
00:07:06,440 --> 00:07:01,680
hit the wrong button there there's the

169
00:07:09,350 --> 00:07:06,450
button okay so this is a beautiful image

170
00:07:11,810 --> 00:07:09,360
to ground-based image from a website

171
00:07:13,670 --> 00:07:11,820
called clear starry nights calm I

172
00:07:16,910 --> 00:07:13,680
couldn't find the name of the person who

173
00:07:18,980 --> 00:07:16,920
does these images he didn't put a lot of

174
00:07:20,450 --> 00:07:18,990
these which I puts their put their their

175
00:07:23,420 --> 00:07:20,460
names and credits all over the place

176
00:07:25,820 --> 00:07:23,430
with this shows you perhaps why it's

177
00:07:27,830 --> 00:07:25,830
called the Eagle Nebula I wanted a wider

178
00:07:32,240 --> 00:07:27,840
base view so you can see sort of a wing

179
00:07:35,090 --> 00:07:32,250
extending to the lower left and the the

180
00:07:36,980 --> 00:07:35,100
head up at the top of the top left and

181
00:07:38,360 --> 00:07:36,990
the spread of the wings of the evil

182
00:07:39,950 --> 00:07:38,370
sitting in front of you right you can

183
00:07:41,750 --> 00:07:39,960
sort of do you see that Tony yeah yeah

184
00:07:43,220 --> 00:07:41,760
can you do you have the ability to use

185
00:07:45,620 --> 00:07:43,230
your cursor at all to kind of circle

186
00:07:48,350 --> 00:07:45,630
what you're talking about or i do but

187
00:07:50,060 --> 00:07:48,360
it's that this screen is such high

188
00:07:51,680 --> 00:07:50,070

resolution all the ice I don't see it

189
00:07:53,360 --> 00:07:51,690
though go ahead and say ok alright

190
00:07:55,790 --> 00:07:53,370
settlement will you bring come here

191
00:07:58,160 --> 00:07:55,800
there you go ok so that's the head yeah

192
00:08:01,640 --> 00:07:58,170
ok and then if you follow down here you

193
00:08:03,560 --> 00:08:01,650
can see the wing all right ok and then

194
00:08:05,240 --> 00:08:03,570
then back up to the other wing the other

195
00:08:08,000 --> 00:08:05,250
wing is not so sharp maybe he's got the

196
00:08:10,940 --> 00:08:08,010
the other wing folded in right ok so

197
00:08:13,100 --> 00:08:10,950
this is a needle I see the eagle this is

198
00:08:14,930 --> 00:08:13,110
a is it a red wavelengths image do you

199
00:08:18,140 --> 00:08:14,940
know what would fill out this wilderness

200
00:08:20,630 --> 00:08:18,150
well most of the nebula in the universe

201
00:08:23,420 --> 00:08:20,640
glow in the light of hydrogen alpha

202
00:08:26,420 --> 00:08:23,430
right because most of the the gas in the

203
00:08:28,460 --> 00:08:26,430
universe is hydrogen and the excitation

204
00:08:29,780 --> 00:08:28,470
line of hydrogen that gets excited is is

205
00:08:32,330 --> 00:08:29,790
hydrogen alpha which is a red

206
00:08:35,060 --> 00:08:32,340
wavelengths right 65-62 angstroms I

207
00:08:37,850 --> 00:08:35,070
believe there you go so the point is is

208
00:08:39,260 --> 00:08:37,860
that most nebula appear red which is one

209
00:08:41,300 --> 00:08:39,270
of reasons why I went out to search for

210
00:08:42,830 --> 00:08:41,310
this image want to show you the eagle

211
00:08:45,080 --> 00:08:42,840
but to to show you what it really looks

212
00:08:47,300 --> 00:08:45,090
like it isn't the green of the Hubble

213
00:08:49,420 --> 00:08:47,310

image right the Greeners the Hubble

214
00:08:54,170 --> 00:08:49,430
image is actually the oxygen line

215
00:08:55,100 --> 00:08:54,180
colored green uh with in so that it's

216
00:08:57,019 --> 00:08:55,110
not

217
00:08:58,490 --> 00:08:57,029
hubble images use very specific filters

218
00:09:00,560 --> 00:08:58,500
and doesn't show you what the human eye

219
00:09:02,500 --> 00:09:00,570
would see this is a closer approximation

220
00:09:05,630 --> 00:09:02,510
to what the human eye might see okay

221
00:09:07,250 --> 00:09:05,640
okay so where are those Hubble images

222
00:09:10,400 --> 00:09:07,260
well you look in the center of at the

223
00:09:11,990 --> 00:09:10,410
heart of the eagle and you can see these

224
00:09:14,870 --> 00:09:12,000
the pillars and they're kind of fuzzy

225
00:09:16,910 --> 00:09:14,880
here I'm going to switch to oops where

226
00:09:19,579 --> 00:09:16,920
am I I'm hitting the wrong I got two

227
00:09:21,380 --> 00:09:19,589
three laptops laptop and a desktop in

228
00:09:25,550 --> 00:09:21,390
front of me I keep hitting the wrong

229
00:09:28,009 --> 00:09:25,560
keyboard so here this is a zoomed in

230
00:09:30,829 --> 00:09:28,019
toward the center and you can see

231
00:09:34,519 --> 00:09:30,839
outlined in yellow the three pillars

232
00:09:37,519 --> 00:09:34,529
from the 1995 Hubble image taken with

233
00:09:40,220 --> 00:09:37,529
with pick two so it has that interesting

234
00:09:42,920 --> 00:09:40,230
Chevron shape to it yeah wide field

235
00:09:47,569 --> 00:09:42,930
planetary camera 2 there you go with

236
00:09:50,000 --> 00:09:47,579
thick too near well in 2005 we had a new

237
00:09:53,480 --> 00:09:50,010
camera on Hubble the advanced camera for

238
00:09:56,480 --> 00:09:53,490

surveys and we took a two pointing image

239
00:09:58,460 --> 00:09:56,490
of another pillar what we call the spire

240
00:10:01,610 --> 00:09:58,470
in the eagle nebula you can see that

241
00:10:05,780 --> 00:10:01,620
also outlined here so for Hubble's 15th

242
00:10:09,079 --> 00:10:05,790
anniversary we did this image of the

243
00:10:12,889 --> 00:10:09,089
spire in the eagle nebula and you can

244
00:10:14,780 --> 00:10:12,899
see actually is very inspiring it's nice

245
00:10:16,250 --> 00:10:14,790
here but to give it more resolution on

246
00:10:18,980 --> 00:10:16,260
the small screen I'm going to turn it

247
00:10:20,540 --> 00:10:18,990
sideways so you can actually see some a

248
00:10:22,370 --> 00:10:20,550
little bit more our viewers can see a

249
00:10:25,550 --> 00:10:22,380
little bit more of the detail okay ah

250
00:10:28,699 --> 00:10:25,560
and what I like about this is that you

251
00:10:30,290 --> 00:10:28,709
see all of us stuff all of the material

252
00:10:33,259 --> 00:10:30,300
up here that's flowing off of the pillar

253
00:10:36,769 --> 00:10:33,269
you've got the bright head to the pillar

254
00:10:38,960 --> 00:10:36,779
okay where the ionizing radiation is

255
00:10:40,850 --> 00:10:38,970
smashing into this dark gasp the

256
00:10:43,939 --> 00:10:40,860
high-energy radiation is taking that

257
00:10:45,980 --> 00:10:43,949
dark molecular gas heating it ionizing

258
00:10:48,110 --> 00:10:45,990
it turning it into ionized gas that's

259
00:10:52,130 --> 00:10:48,120
flowing off the top you've also got this

260
00:10:54,590 --> 00:10:52,140
jet coming up the top here okay which is

261
00:10:58,430 --> 00:10:54,600
probably from actually I don't think

262
00:11:00,680 --> 00:10:58,440
that's a bet that that's the no I think

263
00:11:02,240 --> 00:11:00,690

that back that's not a jet I'm sorry I'm

264
00:11:05,449 --> 00:11:02,250
used to seeing jet jets it's a little

265
00:11:06,680 --> 00:11:05,459
small smaller I want to go to the right

266
00:11:09,030 --> 00:11:06,690
of the image right now just in case

267
00:11:10,740 --> 00:11:09,040
people on the right of this image so

268
00:11:13,050 --> 00:11:10,750
you've got this really bright region up

269
00:11:16,230 --> 00:11:13,060
here and you've got this really long

270
00:11:18,769 --> 00:11:16,240
tail of material hanging in behind it on

271
00:11:21,420 --> 00:11:18,779
and it's not very beautiful and poetic

272
00:11:28,499 --> 00:11:21,430
image and that's what we released for

273
00:11:31,170 --> 00:11:28,509
our 20 15th anniversary okay so if so if

274
00:11:34,980 --> 00:11:31,180
we go back to our 1995 invention we put

275
00:11:37,699 --> 00:11:34,990
it up here we visited this using our

276
00:11:40,860 --> 00:11:37,709
brand new camera wide field camera 3

277
00:11:42,360 --> 00:11:40,870
right so first first image I showed you

278
00:11:44,430 --> 00:11:42,370
is with pick two with one image i'm

279
00:11:46,139 --> 00:11:44,440
showing you now the second one was a CS

280
00:11:49,230 --> 00:11:46,149
and so we've gone back to the Eagle

281
00:11:52,139 --> 00:11:49,240
Olivia wide field camera 3 and we've

282
00:11:54,569 --> 00:11:52,149
done a mosaic of four pointings across

283
00:12:00,059 --> 00:11:54,579
it and so at the exact same scale as the

284
00:12:01,889 --> 00:12:00,069
1995 image here is our 2015 image of the

285
00:12:03,120 --> 00:12:01,899
e pillars in the Eagle Nebula I never

286
00:12:05,730 --> 00:12:03,130
get tired of seeing that it's really

287
00:12:07,680 --> 00:12:05,740
nice that's amazing you know you but

288
00:12:10,800 --> 00:12:07,690

I've been staring at this all month oh I

289
00:12:14,490 --> 00:12:10,810
know yeah and it still doesn't lose its

290
00:12:16,559 --> 00:12:14,500
beauty to it it's just amazing just how

291
00:12:18,449 --> 00:12:16,569
much there is here so go back to the

292
00:12:20,309 --> 00:12:18,459
2005 and then just kind of go back are

293
00:12:22,379 --> 00:12:20,319
you are you gonna actually how about if

294
00:12:25,110 --> 00:12:22,389
I go to the next day there you go that's

295
00:12:27,150 --> 00:12:25,120
where I do an overland okay I should

296
00:12:29,250 --> 00:12:27,160
have done had it so to prep for this

297
00:12:30,689 --> 00:12:29,260
this presentation I actually went

298
00:12:33,569 --> 00:12:30,699
through and got the highest resolution

299
00:12:34,980 --> 00:12:33,579
images and i overlaid them and and work

300
00:12:38,490 --> 00:12:34,990
them because i'm going to show you all

301
00:12:40,230 --> 00:12:38,500
sorts of details about this and show

302
00:12:42,660 --> 00:12:40,240
them how they look in one image and how

303
00:12:44,100 --> 00:12:42,670
they look in the other image so you're

304
00:12:47,670 --> 00:12:44,110
the green in the width pick two of gaga

305
00:12:50,129 --> 00:12:47,680
image you said was due to oxygen right

306
00:12:53,280 --> 00:12:50,139
okay so the reason why these aren't red

307
00:12:59,890 --> 00:12:53,290
is they aren't red green blue filters

308
00:13:06,340 --> 00:13:03,580
hello line okay so that there are three

309
00:13:09,490 --> 00:13:06,350
specific filters designed to get the

310
00:13:12,970 --> 00:13:09,500
emission from three specific elements

311
00:13:15,190 --> 00:13:12,980
and different elements will be excited

312
00:13:17,620 --> 00:13:15,200
at different temperatures so in a way

313
00:13:19,870 --> 00:13:17,630

you're here each of the the filters

314
00:13:24,430 --> 00:13:19,880
probes a different temperature structure

315
00:13:28,630 --> 00:13:24,440
within the nebula and so the color is

316
00:13:32,530 --> 00:13:28,640
chosen in 1995 put the oxygen in green

317
00:13:35,830 --> 00:13:32,540
the colors chosen in 2015 put the oxygen

318
00:13:37,660 --> 00:13:35,840
in blue so that's why the colors the

319
00:13:41,640 --> 00:13:37,670
color palette chosen here was different

320
00:13:44,200 --> 00:13:41,650
okay just to keep things clear huh

321
00:13:46,900 --> 00:13:44,210
good-o artistic I mean we were very

322
00:13:49,660 --> 00:13:46,910
inexperienced at creating these gorgeous

323
00:13:52,210 --> 00:13:49,670
Hubble images back in 1995 we've got

324
00:13:55,090 --> 00:13:52,220
another what is it another 20 years of

325
00:13:57,970 --> 00:13:55,100
experience in doing this and the

326
00:14:01,450 --> 00:13:57,980
artistic choice of the colors this time

327
00:14:03,120 --> 00:14:01,460
came out like this very quiet so let's

328
00:14:09,280 --> 00:14:03,130
compare a first thing what you see is

329
00:14:11,920 --> 00:14:09,290
that the the with pick to the whiskey 3

330
00:14:14,860 --> 00:14:11,930
image the new 2015 image covers a lot

331
00:14:16,900 --> 00:14:14,870
more area shows you a lot larger field

332
00:14:20,350 --> 00:14:16,910
of view more pixels whereas the original

333
00:14:24,010 --> 00:14:20,360
image was 2.6 million pixels our new

334
00:14:27,610 --> 00:14:24,020
image is 60 million pixels so we've got

335
00:14:30,040 --> 00:14:27,620
30 times the number of pixels to look at

336
00:14:32,680 --> 00:14:30,050
the resolution is actually about a

337
00:14:34,540 --> 00:14:32,690
factor of 2 better across the entire

338
00:14:36,190 --> 00:14:34,550

image but there's so much more in the

339
00:14:40,360 --> 00:14:36,200
image and let's explore a little bit of

340
00:14:43,690 --> 00:14:40,370
that ok ok so if we zoom in to the

341
00:14:48,160 --> 00:14:43,700
center of the leftmost pillar on the

342
00:14:51,850 --> 00:14:48,170
left you see the with picked the 1995

343
00:14:55,440 --> 00:14:51,860
image and on the right you see the 2015

344
00:14:57,520 --> 00:14:55,450
image and there are twice as the

345
00:15:00,430 --> 00:14:57,530
resolution is a factor of two in each

346
00:15:03,490 --> 00:15:00,440
direction so correspondingly there is a

347
00:15:06,850 --> 00:15:03,500
factor of four times more pixels per

348
00:15:10,780 --> 00:15:06,860
unit area in what you're seeing so you

349
00:15:13,810 --> 00:15:10,790
can see that the for example if you take

350
00:15:16,360 --> 00:15:13,820
a look at the ridge along he

351
00:15:19,090 --> 00:15:16,370
okay see that Ridge along here this this

352
00:15:20,710 --> 00:15:19,100
ionization argue on the right image or

353
00:15:22,810 --> 00:15:20,720
pointer yes I'm pointing on the writing

354
00:15:25,930 --> 00:15:22,820
yeah if you look at that's this the same

355
00:15:29,020 --> 00:15:25,940
Ridge on the left image you can see how

356
00:15:31,270 --> 00:15:29,030
it's just fuzzed-out yeah right you see

357
00:15:35,170 --> 00:15:31,280
a lot more structure if you look at this

358
00:15:38,230 --> 00:15:35,180
I don't know smoke stack this very long

359
00:15:40,390 --> 00:15:38,240
dark black a black tube and at the top

360
00:15:42,670 --> 00:15:40,400
of that in the detail that you can see

361
00:15:46,360 --> 00:15:42,680
there you can see just a bit more detail

362
00:15:48,880 --> 00:15:46,370
in the 2015 image and then at the very

363
00:15:51,310 --> 00:15:48,890

highest peak that point that tiny little

364
00:15:53,620 --> 00:15:51,320
nib on there you can start to see the

365
00:15:55,930 --> 00:15:53,630
structure is that as a sign to them

366
00:15:57,970 --> 00:15:55,940
scientific term yes these are technical

367
00:16:01,210 --> 00:15:57,980
terms the other prizes supplement that's

368
00:16:02,740 --> 00:16:01,220
what the nib you can start to see that

369
00:16:04,360 --> 00:16:02,750
structure and so this is to show you

370
00:16:07,420 --> 00:16:04,370
that you know we aren't getting ten

371
00:16:10,000 --> 00:16:07,430
times at a resolution but we are getting

372
00:16:12,220 --> 00:16:10,010
a factor of two resolution and one of

373
00:16:15,670 --> 00:16:12,230
the science results that they came up

374
00:16:17,980 --> 00:16:15,680
with was that you know in 1995 they

375
00:16:20,610 --> 00:16:17,990
tried to measure the thickness of these

376
00:16:23,260 --> 00:16:20,620
yellow that yellow edge to the dark ass

377
00:16:24,730 --> 00:16:23,270
it's called the ionization front the

378
00:16:27,450 --> 00:16:24,740
thickness to the ionization front they

379
00:16:30,610 --> 00:16:27,460
determined was below Hubble's resolution

380
00:16:32,440 --> 00:16:30,620
well they did it again in 2015 and you

381
00:16:36,840 --> 00:16:32,450
look at that and you know what it's

382
00:16:40,780 --> 00:16:36,850
still below Hubble's resolution Wow the

383
00:16:43,900 --> 00:16:40,790
crossover from this hot ionized gas to

384
00:16:47,680 --> 00:16:43,910
this thick dense molecular gas is really

385
00:16:49,960 --> 00:16:47,690
really thin it's it's you know hundreds

386
00:16:52,090 --> 00:16:49,970
of parsecs it's less than hundreds of

387
00:16:54,490 --> 00:16:52,100
parsecs at the distance of Eagle Nebula

388
00:16:57,300 --> 00:16:54,500

showing you that you know that the

389
00:17:00,610 --> 00:16:57,310
transition region is really really sharp

390
00:17:02,980 --> 00:17:00,620
something that we had I guess you sort

391
00:17:04,780 --> 00:17:02,990
of learn that in graduate school that is

392
00:17:07,179 --> 00:17:04,790
supposed to be a very thick very very

393
00:17:09,510 --> 00:17:07,189
sharp transition but to see it in this

394
00:17:12,670 --> 00:17:09,520
amazing detail it's really kind of cool

395
00:17:14,560 --> 00:17:12,680
so while you're on this topic let me get

396
00:17:17,170 --> 00:17:14,570
Nicholas's question in here Nicholas

397
00:17:20,770 --> 00:17:17,180
greater from the Q&A app the red line on

398
00:17:23,470 --> 00:17:20,780
the end the old image yes cosmic ray

399
00:17:27,730 --> 00:17:23,480
hitting the red line on the old image is

400
00:17:30,160 --> 00:17:27,740
actually a diffraction spike from a star

401
00:17:32,320 --> 00:17:30,170
our that's off-screen above if you look

402
00:17:34,810 --> 00:17:32,330
in the the new image you can see a

403
00:17:36,880 --> 00:17:34,820
diagonal line in the upper left off yep

404
00:17:40,600 --> 00:17:36,890
yeah that's the diffraction fight bike

405
00:17:43,030 --> 00:17:40,610
from the same bright star yeah so I look

406
00:17:45,340 --> 00:17:43,040
so it looks so regular though in the the

407
00:17:47,919 --> 00:17:45,350
older image it's like it's just like a

408
00:17:49,210 --> 00:17:47,929
straight line that's weird yeah okay

409
00:17:51,460 --> 00:17:49,220
yeah so that's what that is Nicholas

410
00:17:54,490 --> 00:17:51,470
okay go ahead so now we're going to move

411
00:17:59,110 --> 00:17:54,500
to the top of a set of the middle pillar

412
00:18:01,870 --> 00:17:59,120
okay and this is where the in the white

413
00:18:04,870 --> 00:18:01,880

coat planetary camera 2 we had the pc

414
00:18:06,790 --> 00:18:04,880
chip the planetary camera chip the

415
00:18:08,919 --> 00:18:06,800
reason with pic to have that you know

416
00:18:12,220 --> 00:18:08,929
chevron shape is you've got three chips

417
00:18:14,410 --> 00:18:12,230
that are the same and then you've got

418
00:18:17,230 --> 00:18:14,420
one ship that's twice the resolution so

419
00:18:19,030 --> 00:18:17,240
this would be the chip this will be the

420
00:18:21,610 --> 00:18:19,040
spot in the Eagle Nebula where you'd

421
00:18:23,530 --> 00:18:21,620
have higher resolution in the nineteen

422
00:18:25,900 --> 00:18:23,540
ninety-five image just this one small

423
00:18:27,580 --> 00:18:25,910
region in the nineteen ninety five min

424
00:18:28,960 --> 00:18:27,590
which has high resolution and so I

425
00:18:31,450 --> 00:18:28,970
wanted to show you this to show you that

426
00:18:34,360 --> 00:18:31,460
the resolution from the 1995 image is

427
00:18:37,960 --> 00:18:34,370
roughly comparable to the resolution in

428
00:18:40,450 --> 00:18:37,970
the 2015 image in this one region now

429
00:18:42,820 --> 00:18:40,460
it's still not as good it's here in the

430
00:18:46,299 --> 00:18:42,830
older camera it looks more anyway it's

431
00:18:50,530 --> 00:18:46,309
definitely noisier the improvement in

432
00:18:52,210 --> 00:18:50,540
the in the detectors it is apparent but

433
00:18:54,880 --> 00:18:52,220
the improvement in resolution is not

434
00:18:58,870 --> 00:18:54,890
quite as a parrot in this region as it

435
00:19:01,480 --> 00:18:58,880
was in the other regions just a one

436
00:19:03,310 --> 00:19:01,490
little thing that I like to I like to

437
00:19:05,830 --> 00:19:03,320
point out is d I'm looking at the right

438
00:19:09,299 --> 00:19:05,840

hand image ya see that little thing

439
00:19:13,450 --> 00:19:09,309
their looks like a jellyfish a jellyfish

440
00:19:16,090 --> 00:19:13,460
I think all these small little details

441
00:19:18,430 --> 00:19:16,100
start to pop out when you look at that

442
00:19:20,919 --> 00:19:18,440
this new image of just all these small

443
00:19:22,780 --> 00:19:20,929
was more than that to you could see all

444
00:19:24,640 --> 00:19:22,790
the structure and the clouds to I mean

445
00:19:26,560 --> 00:19:24,650
like there's that that big central

446
00:19:29,500 --> 00:19:26,570
feature there is just all of it looks so

447
00:19:31,870 --> 00:19:29,510
much more defined in the newer image

448
00:19:34,480 --> 00:19:31,880
right so let's go to their really the

449
00:19:37,060 --> 00:19:34,490
real highlight proportion of them the

450
00:19:40,120 --> 00:19:37,070
top of the leftmost pillar okay yeah

451
00:19:41,539 --> 00:19:40,130
this is where you can see the 1995 image

452
00:19:43,729 --> 00:19:41,549
to the 2050

453
00:19:46,609 --> 00:19:43,739
which we get a significant resolution

454
00:19:50,149 --> 00:19:46,619
all sorts of cool things going on in

455
00:19:52,729 --> 00:19:50,159
here the structure in detail and as you

456
00:19:56,779 --> 00:19:52,739
said the structure of the gas is really

457
00:20:00,109 --> 00:19:56,789
apparent here just the when the ionizing

458
00:20:02,930 --> 00:20:00,119
radiation hits this cold dense gas that

459
00:20:04,970 --> 00:20:02,940
gas ionizes and then sort of evaporates

460
00:20:08,359 --> 00:20:04,980
up you should talk about what ionizing

461
00:20:10,279 --> 00:20:08,369
is they don't think ok yeah ok yeah I

462
00:20:14,599 --> 00:20:10,289
would you tend to try that around with

463
00:20:18,889 --> 00:20:14,609

abandon so ionization is when an high

464
00:20:21,619 --> 00:20:18,899
energy photon hits a atom and liberate

465
00:20:23,960 --> 00:20:21,629
some electron ok it puts energy into the

466
00:20:28,489 --> 00:20:23,970
atom and the electron goes free from the

467
00:20:32,930 --> 00:20:28,499
nucleus and so one or more electrons can

468
00:20:35,479 --> 00:20:32,940
be can be liberated and then your

469
00:20:39,950 --> 00:20:35,489
molecules or your atoms become ionized

470
00:20:41,269 --> 00:20:39,960
gas ok and you when you think of it we

471
00:20:43,519 --> 00:20:41,279
can sort of think of the ionized gas

472
00:20:46,099 --> 00:20:43,529
being set free from this dense molecular

473
00:20:48,109 --> 00:20:46,109
State a little bit like it's a little

474
00:20:51,859 --> 00:20:48,119
bit like the steam you see coming off

475
00:20:55,039 --> 00:20:51,869
water all right going from you know this

476
00:20:57,169 --> 00:20:55,049
dense state to this gaseous state and

477
00:20:59,479 --> 00:20:57,179
you you think of it as flows and you

478
00:21:02,930 --> 00:20:59,489
really can see you can feel the flows of

479
00:21:07,099 --> 00:21:02,940
that material the ionized gas coming off

480
00:21:12,799 --> 00:21:07,109
of this dead stuff now if you look down

481
00:21:15,590 --> 00:21:12,809
in the bottom ok you can see this jet

482
00:21:18,080 --> 00:21:15,600
down here alright I'm going to zoom in

483
00:21:22,039 --> 00:21:18,090
on the jet at the bottom and show it to

484
00:21:24,499 --> 00:21:22,049
you 1995 on the left again 2051 right

485
00:21:26,289 --> 00:21:24,509
and here's where you can truly see the

486
00:21:30,889 --> 00:21:26,299
resolution difference right and right

487
00:21:35,779 --> 00:21:30,899
now this is this one is a jet so this is

488
00:21:40,430 --> 00:21:35,789

a jet from a newborn star inside this

489
00:21:43,849 --> 00:21:40,440
nodule here just above center a new star

490
00:21:46,190 --> 00:21:43,859
has formed all right and so a brand new

491
00:21:48,109 --> 00:21:46,200
star is formed and when stars formed

492
00:21:50,090 --> 00:21:48,119
you've got all this material swirling

493
00:21:52,190 --> 00:21:50,100
around and crashing on to this new

494
00:21:54,440 --> 00:21:52,200
forming star some of the material

495
00:21:55,460 --> 00:21:54,450
actually gets thrown off into these

496
00:21:58,279 --> 00:21:55,470
bipolar

497
00:22:00,770 --> 00:21:58,289
it's material streaming off in opposite

498
00:22:03,890 --> 00:22:00,780
directions and so you can see the jet

499
00:22:07,120 --> 00:22:03,900
extending up and the jet is standing

500
00:22:09,649 --> 00:22:07,130
down spewing away from this newborn star

501
00:22:11,810 --> 00:22:09,659
so there's a star hidden in there and in

502
00:22:13,370 --> 00:22:11,820
fact there's their star birth going on

503
00:22:16,250 --> 00:22:13,380
throughout this whole region as you've

504
00:22:18,980 --> 00:22:16,260
already pointed out but are there any

505
00:22:20,360 --> 00:22:18,990
the if you look at this more diffuse

506
00:22:21,919 --> 00:22:20,370
clouds in there I don't know if you want

507
00:22:23,690 --> 00:22:21,929
to go back to that one right before that

508
00:22:26,630 --> 00:22:23,700
you were just showing but there's lots

509
00:22:28,669 --> 00:22:26,640
of structure in the wispy area of the

510
00:22:29,930 --> 00:22:28,679
clouds yeah this one so on the right on

511
00:22:32,899 --> 00:22:29,940
the right here you can see all these

512
00:22:35,600 --> 00:22:32,909
sort of wispy clouds structures that

513
00:22:38,080 --> 00:22:35,610

look like almost like a magnetic field

514
00:22:41,659 --> 00:22:38,090
and the corona or something of the Sun

515
00:22:43,279 --> 00:22:41,669
is that structure being are there any

516
00:22:46,549 --> 00:22:43,289
magnetic fields in there or is it all

517
00:22:49,970 --> 00:22:46,559
just being sculpted by stars being born

518
00:22:53,230 --> 00:22:49,980
and and the winds from all these the

519
00:22:55,779 --> 00:22:53,240
star creation well i would say that

520
00:22:58,549 --> 00:22:55,789
there are magnetic fields first of all

521
00:23:00,169 --> 00:22:58,559
they're magnetic fields are very but the

522
00:23:03,409 --> 00:23:00,179
magnetic fields are very small and very

523
00:23:06,830 --> 00:23:03,419
dense so when you collapse material down

524
00:23:08,299 --> 00:23:06,840
to create a star generally you're going

525
00:23:09,440 --> 00:23:08,309
to bring the magnetic fields along with

526
00:23:11,779 --> 00:23:09,450
it you're going to concentrate the

527
00:23:13,789 --> 00:23:11,789
magnetic field around the formation of

528
00:23:15,710 --> 00:23:13,799
the star a matter of fact one of the

529
00:23:19,399 --> 00:23:15,720
things we believe that creates these

530
00:23:22,310 --> 00:23:19,409
Jets is the magnetic field fleeing

531
00:23:24,289 --> 00:23:22,320
material off in these opposite bipolar

532
00:23:26,060 --> 00:23:24,299
magnetic field of that particular star

533
00:23:29,419 --> 00:23:26,070
though of that particular collapsed are

534
00:23:31,279 --> 00:23:29,429
okay on the sonic is there a nebula wide

535
00:23:33,289 --> 00:23:31,289
magnetic field or is it just the sum of

536
00:23:35,419 --> 00:23:33,299
all the interview nebula wide magnetic

537
00:23:38,570 --> 00:23:35,429
field would generally be very low okay

538
00:23:41,720 --> 00:23:38,580

okay so i would i'm not an expert in

539
00:23:45,049 --> 00:23:41,730
nebula but it would be my opinion that

540
00:23:47,000 --> 00:23:45,059
the magnetic field would not be strong

541
00:23:49,630 --> 00:23:47,010
enough to create the structure that you

542
00:23:52,130 --> 00:23:49,640
see in this gas here okay all right okay

543
00:23:55,669 --> 00:23:52,140
thanks all right no good question

544
00:23:57,140 --> 00:23:55,679
because i actually have have another

545
00:23:58,760 --> 00:23:57,150
point about magnetic fields in just a

546
00:24:01,899 --> 00:23:58,770
minute that's great all right play off

547
00:24:04,370 --> 00:24:01,909
of that okay so you can see the

548
00:24:07,639 --> 00:24:04,380
resolution difference here and you can

549
00:24:09,049 --> 00:24:07,649
see this jet but this jet is moving

550
00:24:12,350 --> 00:24:09,059
right this star

551
00:24:14,629 --> 00:24:12,360
is emitting this debt constantly and if

552
00:24:17,480 --> 00:24:14,639
you go back to look at it you can

553
00:24:20,899 --> 00:24:17,490
actually see the end of the jet moving

554
00:24:22,940 --> 00:24:20,909
between the 1995 image and the two

555
00:24:28,070 --> 00:24:22,950
thousand while I was taken in 2014

556
00:24:30,230 --> 00:24:28,080
released in 2015 so on the left is the

557
00:24:33,759 --> 00:24:30,240
2014 images showing you the region that

558
00:24:37,730 --> 00:24:33,769
were looking at and in the center is the

559
00:24:40,070 --> 00:24:37,740
1995 image with the arrows and then on

560
00:24:41,720 --> 00:24:40,080
the right is the 2014 image with the

561
00:24:43,669 --> 00:24:41,730
same arrows in the exact same place in

562
00:24:45,560 --> 00:24:43,679
the image so over 20 years it's moved a

563
00:24:47,749 --> 00:24:45,570

few pixels how do you have a idea what

564
00:24:50,119 --> 00:24:47,759
the distances on that are you gonna tell

565
00:24:52,100 --> 00:24:50,129
that later I don't remember I should

566
00:24:55,669 --> 00:24:52,110
have that I've ever met I when we were

567
00:24:59,299 --> 00:24:55,679
Double A s I knew that here we are two

568
00:25:00,739 --> 00:24:59,309
or three weeks out that okay yeah but

569
00:25:02,210 --> 00:25:00,749
but it can be figured out one of the

570
00:25:03,590 --> 00:25:02,220
ways you can figure it out is we know

571
00:25:05,359 --> 00:25:03,600
the what's something called the pixel

572
00:25:07,460 --> 00:25:05,369
scale of the camera in other words how

573
00:25:09,169 --> 00:25:07,470
much area each pixel on the camera

574
00:25:10,549 --> 00:25:09,179
covers and you just count the number of

575
00:25:12,379 --> 00:25:10,559
pixels and that'll tell you number of

576
00:25:14,060 --> 00:25:12,389
pixels and you need to know the distance

577
00:25:18,950 --> 00:25:14,070
to the eagle nebula which is something

578
00:25:24,919 --> 00:25:18,960
like 70 7,500 light-years by remember it

579
00:25:28,009 --> 00:25:24,929
can't be a very long the entire a pillar

580
00:25:30,440 --> 00:25:28,019
of the long pillar from the old image is

581
00:25:35,539 --> 00:25:30,450
about three light years in length so

582
00:25:38,060 --> 00:25:35,549
this is this is you know sub very very

583
00:25:41,060 --> 00:25:38,070
very small fraction of a Lightyear on

584
00:25:43,609 --> 00:25:41,070
this right so this is you know not this

585
00:25:45,499 --> 00:25:43,619
solar system scale stuff okay probably

586
00:25:48,139 --> 00:25:45,509
hundreds of a use it of astronomical

587
00:25:49,340 --> 00:25:48,149
units at best okay okay all right it's

588
00:25:50,930 --> 00:25:49,350

good we guys want to give people a sense

589
00:25:52,759 --> 00:25:50,940
of that you know how far this is moving

590
00:25:55,879 --> 00:25:52,769
and when you know how far and you have

591
00:25:58,369 --> 00:25:55,889
the time period you can get the speed

592
00:26:00,549 --> 00:25:58,379
that it's going to exactly okay so

593
00:26:04,249 --> 00:26:00,559
that's the kind of cool stuff that the

594
00:26:06,289 --> 00:26:04,259
changes from the 1995 to the 2014 or

595
00:26:08,330 --> 00:26:06,299
2015 however you want to call it an

596
00:26:11,090 --> 00:26:08,340
image but there are a lot of cool things

597
00:26:14,570 --> 00:26:11,100
that are new right so let's go back to

598
00:26:16,580 --> 00:26:14,580
this whole overview image of m6 of the

599
00:26:18,289 --> 00:26:16,590
new image and one of the things that you

600
00:26:21,470 --> 00:26:18,299
see of course that you couldn't see

601
00:26:22,640 --> 00:26:21,480
before is all this material down bottom

602
00:26:24,650 --> 00:26:22,650
right

603
00:26:27,590 --> 00:26:24,660
and what I really like about it is that

604
00:26:30,350 --> 00:26:27,600
you see the material streaming off of it

605
00:26:33,230 --> 00:26:30,360
when we looked at the old image right

606
00:26:35,390 --> 00:26:33,240
you it sort of had a sharp bottom to it

607
00:26:37,520 --> 00:26:35,400
right and you ridin really and we talked

608
00:26:40,520 --> 00:26:37,530
about the ionizing radiation the wind's

609
00:26:42,620 --> 00:26:40,530
coming down past these these pillars and

610
00:26:44,960 --> 00:26:42,630
strew pulling the material back and

611
00:26:47,030 --> 00:26:44,970
streaming material back now you get to

612
00:26:49,340 --> 00:26:47,040
see that material streaming down off of

613
00:26:52,490 --> 00:26:49,350

it and you can really tell that it is

614
00:26:54,440 --> 00:26:52,500
being pulled away by these wins and wins

615
00:26:56,420 --> 00:26:54,450
and radiation and of course you have

616
00:26:59,240 --> 00:26:56,430
this other structure down below which

617
00:27:02,930 --> 00:26:59,250
iron sort of looks like a stump to me so

618
00:27:06,350 --> 00:27:02,940
I refer to that as stub but General

619
00:27:09,890 --> 00:27:06,360
Robert hurt at JPL I don't personally

620
00:27:11,420 --> 00:27:09,900
know okay uh he looked at this image and

621
00:27:14,720 --> 00:27:11,430
he said well hey you know what let's

622
00:27:17,330 --> 00:27:14,730
single out just the center pillar right

623
00:27:19,640 --> 00:27:17,340
and you can see the pillar coming down

624
00:27:21,950 --> 00:27:19,650
and you can see the material streaming

625
00:27:23,750 --> 00:27:21,960
off of it and you already said all right

626
00:27:27,410 --> 00:27:23,760
that's a de mentor from the Harry Potter

627
00:27:30,440 --> 00:27:27,420
movies I guess oh yeah I guess it does

628
00:27:32,330 --> 00:27:30,450
not gonna look like that ever since he

629
00:27:36,110 --> 00:27:32,340
and I checked about this is like okay

630
00:27:37,850 --> 00:27:36,120
right no that's all I can see ya he's

631
00:27:40,190 --> 00:27:37,860
isolated like this and you see the

632
00:27:42,830 --> 00:27:40,200
material that's that's the visual effect

633
00:27:44,720 --> 00:27:42,840
that they did for the Harry Potter

634
00:27:47,990 --> 00:27:44,730
movies of the Dementors flying across

635
00:27:51,290 --> 00:27:48,000
the sky so we would like to call this

636
00:27:53,510 --> 00:27:51,300
the the Dementor pillar um you can admit

637
00:27:55,460 --> 00:27:53,520
but let's take a look at some of the

638
00:27:56,990 --> 00:27:55,470

other things okay so oops actually I

639
00:28:00,200 --> 00:27:57,000
didn't mean to go that quickly let me go

640
00:28:02,180 --> 00:28:00,210
back to that image right at the bottom

641
00:28:06,470 --> 00:28:02,190
of the of this pillar you can see this

642
00:28:09,020 --> 00:28:06,480
bright yellow region here right down

643
00:28:12,290 --> 00:28:09,030
here I'm going to zoom into that on my

644
00:28:16,130 --> 00:28:12,300
next slide okay so generally the bright

645
00:28:18,680 --> 00:28:16,140
yellow has been these ionization edges

646
00:28:20,840 --> 00:28:18,690
edges of dark clouds that are lit up

647
00:28:22,220 --> 00:28:20,850
yellow you can see on the left-hand side

648
00:28:26,030 --> 00:28:22,230
and Simmons you can see an ionization

649
00:28:29,540 --> 00:28:26,040
front on here right so it's dark ass on

650
00:28:33,320 --> 00:28:29,550
one side and ionized gas on yet this one

651
00:28:36,290 --> 00:28:33,330
here this big yellow spray in the center

652
00:28:38,870 --> 00:28:36,300
of this image I'm not sure what this

653
00:28:43,190 --> 00:28:38,880
and I didn't get a chance to ask the p.i

654
00:28:44,990 --> 00:28:43,200
about this this is a bright yellow what

655
00:28:49,670 --> 00:28:45,000
looks like an ionization front but it's

656
00:28:52,040 --> 00:28:49,680
not on the edge of a dark cloud this is

657
00:28:54,380 --> 00:28:52,050
what looks like you know to my untrained

658
00:28:56,930 --> 00:28:54,390
eye when I first look at it go that's a

659
00:28:59,890 --> 00:28:56,940
jet no no it's not a jet it does doesn't

660
00:29:03,230 --> 00:28:59,900
really have a star form a star

661
00:29:05,450 --> 00:29:03,240
associated with it and then you look at

662
00:29:08,060 --> 00:29:05,460
you saying well that could be ionization

663
00:29:10,430 --> 00:29:08,070

along the magnetic field we see this a

664
00:29:13,070 --> 00:29:10,440
lot in the galactic center Oh bright

665
00:29:16,370 --> 00:29:13,080
lines of strong magnetic lines going

666
00:29:18,890 --> 00:29:16,380
across there so I am not afraid to admit

667
00:29:22,990 --> 00:29:18,900
my ignorance about this it's a really

668
00:29:26,950 --> 00:29:23,000
cool feature about this image that

669
00:29:30,380 --> 00:29:26,960
smacks of you know almost either

670
00:29:31,490 --> 00:29:30,390
magnetic fields or you know it looks a

671
00:29:34,460 --> 00:29:31,500
little bit like the tendrils that we

672
00:29:37,370 --> 00:29:34,470
sometimes see in supernova remnants

673
00:29:39,620 --> 00:29:37,380
right hmm and I don't know did you ever

674
00:29:40,850 --> 00:29:39,630
get a discussion of anybody that they

675
00:29:42,650 --> 00:29:40,860
told you what this is don't know I

676
00:29:44,300 --> 00:29:42,660
haven't I haven't I haven't heard

677
00:29:47,330 --> 00:29:44,310
anybody be able to tell us what that is

678
00:29:50,450 --> 00:29:47,340
yet yeah so I mean this is a really cool

679
00:29:52,250 --> 00:29:50,460
thing and you know I like to say that

680
00:29:54,140 --> 00:29:52,260
you know some of the best days for an

681
00:29:55,420 --> 00:29:54,150
astronomer or when they realize they

682
00:29:57,980 --> 00:29:55,430
don't know what they're talking about

683
00:30:00,200 --> 00:29:57,990
when you recognize your ignorance then

684
00:30:01,460 --> 00:30:00,210
there's something new to discover and

685
00:30:04,160 --> 00:30:01,470
this would be something new for me to

686
00:30:06,230 --> 00:30:04,170
discover in terms of this cool stuff

687
00:30:07,580 --> 00:30:06,240
here and this is a big this is something

688
00:30:09,320 --> 00:30:07,590

we would not have gotten with the older

689
00:30:12,710 --> 00:30:09,330
camera anyway so the new what the new

690
00:30:13,820 --> 00:30:12,720
field of view was something made putted

691
00:30:16,070 --> 00:30:13,830
you know seeing this was made possible

692
00:30:17,240 --> 00:30:16,080
what a new field of you exactly this is

693
00:30:19,520 --> 00:30:17,250
outside the field of view of the old

694
00:30:21,530 --> 00:30:19,530
camera right also outside the field of

695
00:30:25,840 --> 00:30:21,540
view of the old camera is this

696
00:30:33,190 --> 00:30:31,280
these are smaller versions of the

697
00:30:35,170 --> 00:30:33,200
pillars writ large in the big image

698
00:30:38,210 --> 00:30:35,180
matter of fact the one on the right

699
00:30:41,720 --> 00:30:38,220
Zoltan Levay the image processor refers

700
00:30:46,670 --> 00:30:41,730
to that as mini me you know reference to

701
00:30:48,560 --> 00:30:46,680
what were those movies like my herb like

702
00:30:49,850 --> 00:30:48,570
Austin Powers Austin Powers yes the

703
00:30:52,700 --> 00:30:49,860
Austin Powers movies k

704
00:30:55,610 --> 00:30:52,710
so that many me and that uh well here we

705
00:30:58,100 --> 00:30:55,620
have a Hubble mini me in the Eagle

706
00:31:00,620 --> 00:30:58,110
Nebula these pillars and really when you

707
00:31:04,310 --> 00:31:00,630
look around the the nebula you see a

708
00:31:07,190 --> 00:31:04,320
bunch of these small agglomerations of

709
00:31:09,650 --> 00:31:07,200
dense gas that are being eaten away now

710
00:31:12,260 --> 00:31:09,660
these i would expect are going to be

711
00:31:14,060 --> 00:31:12,270
eaten away before they would have any

712
00:31:16,310 --> 00:31:14,070
chance to form stars you might look at

713
00:31:19,310 --> 00:31:16,320

them and say okay there's a dense not of

714
00:31:21,680 --> 00:31:19,320
gas here maybe perhaps at Michaelmas

715
00:31:25,700 --> 00:31:21,690
star but at this scale it's not enough

716
00:31:28,970 --> 00:31:25,710
probably to resist the the erosion

717
00:31:31,450 --> 00:31:28,980
before it forms a star so one of the

718
00:31:33,770 --> 00:31:31,460
things you can learn about is that the

719
00:31:37,070 --> 00:31:33,780
process of star formation after other

720
00:31:39,440 --> 00:31:37,080
stars have formed and are then create

721
00:31:42,080 --> 00:31:39,450
these winds and ionizing radiation that

722
00:31:46,280 --> 00:31:42,090
eats away the gas it actually will

723
00:31:49,310 --> 00:31:46,290
inhibit other stars from forming next

724
00:31:54,230 --> 00:31:49,320
all right so that's it for the visible

725
00:31:56,919 --> 00:31:54,240
light image but there's more because the

726
00:32:01,640 --> 00:31:56,929
wide field camera 3 doesn't have just

727
00:32:04,240 --> 00:32:01,650
visible light it also can do infrared so

728
00:32:07,360 --> 00:32:04,250
here is the new visible light image and

729
00:32:10,789 --> 00:32:07,370
using the infrared portion of it we got

730
00:32:14,480 --> 00:32:10,799
this image in infrared yeah that's my

731
00:32:16,820 --> 00:32:14,490
favorite part and just to have fun I'm

732
00:32:19,970 --> 00:32:16,830
going to I'm going to blink back go go

733
00:32:22,490 --> 00:32:19,980
back to the visible light image and then

734
00:32:24,020 --> 00:32:22,500
go forward to the infrared right and

735
00:32:26,060 --> 00:32:24,030
first thing that stands out or all the

736
00:32:29,330 --> 00:32:26,070
stars that you can see right amazing

737
00:32:32,690 --> 00:32:29,340
number of stars yes with the infrared

738
00:32:35,630 --> 00:32:32,700

you have longer wavelengths you will see

739
00:32:38,120 --> 00:32:35,640
through some of the gas that you cannot

740
00:32:39,620 --> 00:32:38,130
see through in optical light and so

741
00:32:41,870 --> 00:32:39,630
you'll see through and you see all the

742
00:32:44,000 --> 00:32:41,880
stars in the field so all the dark stuff

743
00:32:46,700 --> 00:32:44,010
that you see now is the stuff that's

744
00:32:49,220 --> 00:32:46,710
even too thick for infrared radiation to

745
00:32:50,930 --> 00:32:49,230
get exactly right right so the longer

746
00:32:53,030 --> 00:32:50,940
wavelengths can pass through low-density

747
00:32:55,159 --> 00:32:53,040
gas can't pass through the really high

748
00:32:58,310 --> 00:32:55,169
density guess so with left is the really

749
00:33:01,370 --> 00:32:58,320
high density gas and also the fact that

750
00:33:03,650 --> 00:33:01,380
stars glow appear different in the

751
00:33:04,910 --> 00:33:03,660
infrared right with the

752
00:33:07,940 --> 00:33:04,920
you're going to pick out the cooler

753
00:33:10,340 --> 00:33:07,950
stars and there are more cool stars in

754
00:33:12,550 --> 00:33:10,350
universe then there are hot stars in the

755
00:33:16,820 --> 00:33:12,560
universe so you're also going to get

756
00:33:18,950 --> 00:33:16,830
extra an extra complement of started

757
00:33:20,780 --> 00:33:18,960
simply because you're bringing up the

758
00:33:24,470 --> 00:33:20,790
cool stars that you otherwise wouldn't

759
00:33:27,770 --> 00:33:24,480
okay yep so let's put the two of them

760
00:33:29,900 --> 00:33:27,780
side-by-side and again we were talking

761
00:33:32,660 --> 00:33:29,910
about the the number of stars that you

762
00:33:35,840 --> 00:33:32,670
can see here and you can get a feeling

763
00:33:37,700 --> 00:33:35,850

that the structure is similar but that

764
00:33:40,190 --> 00:33:37,710
they're slightly different and one of

765
00:33:40,940 --> 00:33:40,200
things i like to think about because you

766
00:33:45,050 --> 00:33:40,950
know we do three-dimensional

767
00:33:46,670 --> 00:33:45,060
visualizations right and so when we're

768
00:33:49,850 --> 00:33:46,680
looking at the visible surface of a

769
00:33:52,220 --> 00:33:49,860
nebula whether it's this nebula or other

770
00:33:54,650 --> 00:33:52,230
nebula oh because the infrared

771
00:33:56,000 --> 00:33:54,660
penetrates deeper you're actually

772
00:33:58,150 --> 00:33:56,010
looking at sort of a three-dimensional

773
00:34:00,920 --> 00:33:58,160
surface underneath the visible surface

774
00:34:03,230 --> 00:34:00,930
so you can think of the infrared of

775
00:34:05,510 --> 00:34:03,240
seeing you know below if if the

776
00:34:07,910 --> 00:34:05,520
invisible light is the skin skin deep

777
00:34:09,380 --> 00:34:07,920
the infrared you know those goes a

778
00:34:11,450 --> 00:34:09,390
little bit deeper and you'll see that

779
00:34:12,950 --> 00:34:11,460
the organs and other things the details

780
00:34:15,590 --> 00:34:12,960
under some of the some of the details

781
00:34:18,169 --> 00:34:15,600
underneath the skin of the nebula and

782
00:34:20,270 --> 00:34:18,179
you can see a lot of structure so let's

783
00:34:22,490 --> 00:34:20,280
go and let's do the same thing we did

784
00:34:25,100 --> 00:34:22,500
with the visible light image during 1995

785
00:34:28,120 --> 00:34:25,110
2015 but now we're going to do both of

786
00:34:32,419 --> 00:34:28,130
the 2015 images visible versus infrared

787
00:34:34,460 --> 00:34:32,429
so we start with that pillar that the

788
00:34:37,490 --> 00:34:34,470

central central region where we had that

789
00:34:39,260 --> 00:34:37,500
smokestack you can see here on the left

790
00:34:43,010 --> 00:34:39,270
hand side there is the smoke stack it

791
00:34:45,409 --> 00:34:43,020
with visible light and then over on the

792
00:34:47,900 --> 00:34:45,419
right hand side you can see the infrared

793
00:34:50,000 --> 00:34:47,910
version of it and you can see an

794
00:34:53,390 --> 00:34:50,010
amazingly bright star are at the top

795
00:34:55,640 --> 00:34:53,400
there right I'm not sure that that's the

796
00:34:58,670 --> 00:34:55,650
star that is for our that formed at the

797
00:35:00,500 --> 00:34:58,680
top there okay I tried looking at it in

798
00:35:02,390 --> 00:35:00,510
great detail and I couldn't convince

799
00:35:04,250 --> 00:35:02,400
myself that it absolutely had to be that

800
00:35:06,260 --> 00:35:04,260
a star that reformed you to top the

801
00:35:07,340 --> 00:35:06,270
smokestack but it's certain sir it looks

802
00:35:08,630 --> 00:35:07,350
like it doesn't it yeah and if you look

803
00:35:11,480 --> 00:35:08,640
at the top of the other one you can see

804
00:35:13,460 --> 00:35:11,490
a star there as well then there's like

805
00:35:14,990 --> 00:35:13,470
on the right on the left image it looks

806
00:35:17,550 --> 00:35:15,000
like there's something right behind that

807
00:35:18,960 --> 00:35:17,560
gas cloud that is

808
00:35:20,670 --> 00:35:18,970
raining pretty brightly and it looks

809
00:35:22,590 --> 00:35:20,680
like it's coming through in the infrared

810
00:35:26,640 --> 00:35:22,600
image but maybe you're right maybe it's

811
00:35:29,280 --> 00:35:26,650
just a it could just get a coincidental

812
00:35:31,590 --> 00:35:29,290
placement and so I wouldn't want to tell

813
00:35:34,950 --> 00:35:31,600

our viewers that it absolutely is unless

814
00:35:36,420 --> 00:35:34,960
I knew I knew for sure but it you can

815
00:35:38,490 --> 00:35:36,430
you can see but the other thing that you

816
00:35:40,710 --> 00:35:38,500
can see is that if you look in the left

817
00:35:43,620 --> 00:35:40,720
hand image you can see these two stars

818
00:35:44,820 --> 00:35:43,630
in the lower right okay yeah those stars

819
00:35:46,890 --> 00:35:44,830
and lower right you find the

820
00:35:50,310 --> 00:35:46,900
corresponding stars in the right hand

821
00:35:53,310 --> 00:35:50,320
image and they're honking bright yeah

822
00:35:56,430 --> 00:35:53,320
now so a faint star in the visible light

823
00:36:00,030 --> 00:35:56,440
image might become a very bright star in

824
00:36:02,150 --> 00:36:00,040
the infrared age okay let's go to the

825
00:36:05,010 --> 00:36:02,160
top of the center pit central pillar

826
00:36:08,370 --> 00:36:05,020
again visible light on the left infrared

827
00:36:10,020 --> 00:36:08,380
on the right this is one of the times it

828
00:36:12,570 --> 00:36:10,030
you know remember the Horsehead Nebula

829
00:36:14,370 --> 00:36:12,580
Tony mm-hmm oh yeah when we went from

830
00:36:16,890 --> 00:36:14,380
the visible light image you saw almost

831
00:36:19,170 --> 00:36:16,900
nothing visible like the horse head and

832
00:36:21,570 --> 00:36:19,180
then went into the infrared you saw an

833
00:36:24,510 --> 00:36:21,580
amount of landscape that sort of

834
00:36:26,550 --> 00:36:24,520
appeared by looking at it this is sort

835
00:36:28,920 --> 00:36:26,560
of the opposite I actually feel like we

836
00:36:32,900 --> 00:36:28,930
lose a little bit of detail in going to

837
00:36:35,790 --> 00:36:32,910
the infrared here we don't get as much

838
00:36:37,950 --> 00:36:35,800

there's a awful lot of dense gas here

839
00:36:39,480 --> 00:36:37,960
right yeah but it seems to me like yes

840
00:36:41,790 --> 00:36:39,490
that's what it tells me is it just how

841
00:36:44,130 --> 00:36:41,800
thick and dense that material is but

842
00:36:47,490 --> 00:36:44,140
also that the stuff the structure that

843
00:36:49,410 --> 00:36:47,500
you see on the left is actually a pretty

844
00:36:51,660 --> 00:36:49,420
superficial it's not and it's not doing

845
00:36:54,030 --> 00:36:51,670
much in the way of infrared emissions at

846
00:36:56,490 --> 00:36:54,040
all because it goes away it's dark in

847
00:36:58,320 --> 00:36:56,500
the infrared so right so I mean this is

848
00:37:01,410 --> 00:36:58,330
it this is a seriously thick mountain

849
00:37:03,780 --> 00:37:01,420
top yeah this is a you know this is a

850
00:37:05,730 --> 00:37:03,790
dense Club of gas that's really there's

851
00:37:08,460 --> 00:37:05,740
a lot of stuff there all right you can

852
00:37:11,310 --> 00:37:08,470
see how that that tiny star and the

853
00:37:14,100 --> 00:37:11,320
lowest in the center down bottom becomes

854
00:37:15,750 --> 00:37:14,110
a nice bright star in the infrared the

855
00:37:18,480 --> 00:37:15,760
other thing that you see is you do see

856
00:37:20,280 --> 00:37:18,490
some star formation I do see some star

857
00:37:23,570 --> 00:37:20,290
formation up here at the top of the

858
00:37:27,150 --> 00:37:23,580
pillar you see these two bright stars

859
00:37:30,570 --> 00:37:27,160
okay these look to me like newborn stars

860
00:37:31,350 --> 00:37:30,580
you can see the red red region on the

861
00:37:33,090 --> 00:37:31,360
left

862
00:37:35,490 --> 00:37:33,100
where you can see one of those stars

863
00:37:38,370 --> 00:37:35,500

look like it is just formed in the top

864
00:37:41,370 --> 00:37:38,380
of the pillar and then you bet you see

865
00:37:45,060 --> 00:37:41,380
through a bit and see another one here

866
00:37:47,850 --> 00:37:45,070
in the infrared so again looking in and

867
00:37:50,430 --> 00:37:47,860
seeing details of the star creation

868
00:37:53,580 --> 00:37:50,440
that's probably going on inside of these

869
00:37:56,370 --> 00:37:53,590
pillars and the jellyfish's is really

870
00:37:59,370 --> 00:37:56,380
faded out mm-hmm you know you could

871
00:38:01,710 --> 00:37:59,380
barely see it now in the infrared that

872
00:38:04,590 --> 00:38:01,720
star formation is shown also in detail

873
00:38:07,410 --> 00:38:04,600
at the top of the tall pillar so if we

874
00:38:08,910 --> 00:38:07,420
go to the top of a left pillar again we

875
00:38:10,590 --> 00:38:08,920
see you can see how all of these tall

876
00:38:15,120 --> 00:38:10,600
little fingers these small little

877
00:38:17,340 --> 00:38:15,130
fingers are actually now in the infrared

878
00:38:22,950 --> 00:38:17,350
aren't quite as detail but they're also

879
00:38:25,680 --> 00:38:22,960
Spade in all of this evaporating gas so

880
00:38:28,230 --> 00:38:25,690
all of this bluish grayish light in the

881
00:38:31,560 --> 00:38:28,240
infrared image is that evaporating gas

882
00:38:34,350 --> 00:38:31,570
that sort of colors that the gift gives

883
00:38:36,150 --> 00:38:34,360
us some color in front of the gas so

884
00:38:38,760 --> 00:38:36,160
sometimes I'm not sure we can see just

885
00:38:41,250 --> 00:38:38,770
how much detail how much a dense gas

886
00:38:45,000 --> 00:38:41,260
there is because there's all of this

887
00:38:47,300 --> 00:38:45,010
evaporating gas on top of it and you can

888
00:38:50,850 --> 00:38:47,310

really see the detail of star formation

889
00:38:53,280 --> 00:38:50,860
if you look in this sent this region

890
00:38:55,560 --> 00:38:53,290
here so i put these arrows at the same

891
00:38:57,330 --> 00:38:55,570
spot in each image and you can see on

892
00:39:00,360 --> 00:38:57,340
the visible light image there's that

893
00:39:01,710 --> 00:39:00,370
little red glow all right look at that

894
00:39:04,410 --> 00:39:01,720
and yeah you can still see it but it's

895
00:39:06,210 --> 00:39:04,420
brighter and the provide yeah and the

896
00:39:08,370 --> 00:39:06,220
infrared you can see that there's star

897
00:39:10,620 --> 00:39:08,380
formation going on in there that little

898
00:39:14,940 --> 00:39:10,630
red glow a place where air star looks

899
00:39:16,770 --> 00:39:14,950
like it's for me has become eaten away

900
00:39:19,230 --> 00:39:16,780
you can start to see the physic and

901
00:39:20,970 --> 00:39:19,240
there's a cavity in there and that's

902
00:39:22,320 --> 00:39:20,980
where the stars won't you this is how

903
00:39:26,040 --> 00:39:22,330
what I mean about you have to look

904
00:39:27,780 --> 00:39:26,050
deeper inside to see what's going on and

905
00:39:30,210 --> 00:39:27,790
when you've got these stars somewhat

906
00:39:32,880 --> 00:39:30,220
near the surface that around them

907
00:39:36,000 --> 00:39:32,890
is forming you can actually infrared see

908
00:39:37,850 --> 00:39:36,010
them on Sienna now this of course is

909
00:39:40,170 --> 00:39:37,860
just what we call the near-infrared

910
00:39:42,090 --> 00:39:40,180
bubble doesn't go very far into the

911
00:39:43,350 --> 00:39:42,100
infrared we need something like Spitzer

912
00:39:45,100 --> 00:39:43,360
or the upcoming james webb space

913
00:39:47,590 --> 00:39:45,110

telescope to see

914
00:39:50,410 --> 00:39:47,600
deeper into this and then you can see

915
00:39:52,450 --> 00:39:50,420
all sorts of interesting and more detail

916
00:39:54,190 --> 00:39:52,460
structures inside matter of fact

917
00:39:57,310 --> 00:39:54,200
sometimes when I'm comparing Hubble and

918
00:40:00,040 --> 00:39:57,320
Spitzer images it's really hard because

919
00:40:01,780 --> 00:40:00,050
you're looking so deep into it that the

920
00:40:05,950 --> 00:40:01,790
structures don't don't really match

921
00:40:09,420 --> 00:40:05,960
sometimes the structures don't match so

922
00:40:11,800 --> 00:40:09,430
oh alright one more thing all right

923
00:40:16,270 --> 00:40:11,810
actually two two more things to more

924
00:40:17,860 --> 00:40:16,280
things of this the real difference when

925
00:40:19,690 --> 00:40:17,870
I look at the visible light versus the

926
00:40:22,090 --> 00:40:19,700
infrared light is actually from a much

927
00:40:24,670 --> 00:40:22,100
larger perspective so here we have that

928
00:40:26,650 --> 00:40:24,680
leftmost pillar on the top and when you

929
00:40:29,680 --> 00:40:26,660
look at the visible light image over

930
00:40:32,800 --> 00:40:29,690
here it feels like it's a solid pillar

931
00:40:35,800 --> 00:40:32,810
up and down right that you know but we

932
00:40:38,470 --> 00:40:35,810
know that it's only required that the

933
00:40:42,280 --> 00:40:38,480
top part be dense and that the part down

934
00:40:45,460 --> 00:40:42,290
here could be in shadow well when you go

935
00:40:48,070 --> 00:40:45,470
to the infrared what do we see well

936
00:40:51,700 --> 00:40:48,080
actually we see a whole lot of emptiness

937
00:40:55,120 --> 00:40:51,710
yeah okay there is a really dense cloud

938
00:40:57,310 --> 00:40:55,130

up at the top but all of them you're

939
00:41:01,480 --> 00:40:57,320
seeing so many stars through here and

940
00:41:04,960 --> 00:41:01,490
not much gas that this is shadow we are

941
00:41:07,150 --> 00:41:04,970
seeing emptiness and the infrared that

942
00:41:09,460 --> 00:41:07,160
we otherwise couldn't see using the

943
00:41:11,350 --> 00:41:09,470
visible light and this is one of the

944
00:41:13,810 --> 00:41:11,360
most important things that infrared

945
00:41:17,050 --> 00:41:13,820
allows us to do in looking through the

946
00:41:19,210 --> 00:41:17,060
low-density gas we get to see her I I

947
00:41:21,850 --> 00:41:19,220
hate to say it's like an x-ray because

948
00:41:26,200 --> 00:41:21,860
that mixes a lot of flight metaphors

949
00:41:28,660 --> 00:41:26,210
yeah yeah but you get to look through

950
00:41:30,760 --> 00:41:28,670
the the visible surface and see what's

951
00:41:34,060 --> 00:41:30,770
truly underneath where it is the real

952
00:41:36,550 --> 00:41:34,070
against gas underneath this and you can

953
00:41:38,950 --> 00:41:36,560
see that that pillar isn't a pillar and

954
00:41:40,480 --> 00:41:38,960
if you study the apes' image you

955
00:41:44,950 --> 00:41:40,490
actually can see that the pillar is

956
00:41:47,710 --> 00:41:44,960
composed of a segment of several clumps

957
00:41:49,150 --> 00:41:47,720
with their shadows behind them to create

958
00:41:54,880 --> 00:41:49,160
that big long through like your own

959
00:41:57,850 --> 00:41:54,890
killer well that's kind of cool and the

960
00:41:58,599 --> 00:41:57,860
other thing is that if you look you will

961
00:42:01,599 --> 00:41:58,609
find some

962
00:42:05,289 --> 00:42:01,609
bright stars and the infrared that do

963
00:42:06,670 --> 00:42:05,299

not show up in the visible so I know

964
00:42:08,950 --> 00:42:06,680
you're looking at this gone well what's

965
00:42:12,759 --> 00:42:08,960
he comparing here okay this is a fact

966
00:42:14,079 --> 00:42:12,769
same region from both images well you'd

967
00:42:16,509 --> 00:42:14,089
never know that that looks like that

968
00:42:18,279 --> 00:42:16,519
it's completely different did you look

969
00:42:20,920 --> 00:42:18,289
at this and go what's he doing okay so

970
00:42:22,690 --> 00:42:20,930
let me guide your eye here okay on the

971
00:42:26,140 --> 00:42:22,700
left-hand image you see these four stars

972
00:42:28,779 --> 00:42:26,150
here bing bang yup lingo and bongo right

973
00:42:32,339 --> 00:42:28,789
come over to the right-hand image and

974
00:42:35,829 --> 00:42:32,349
you see the same four stars bing bang

975
00:42:38,620 --> 00:42:35,839
lingo and bongo those are technical term

976
00:42:44,799 --> 00:42:38,630
you say yeah I years do not try this at

977
00:42:47,380 --> 00:42:44,809
all you has a name that too where did

978
00:42:50,349 --> 00:42:47,390
these four honking big infrared stars

979
00:42:52,329 --> 00:42:50,359
come I know they are really bright yeah

980
00:42:54,190 --> 00:42:52,339
and I remember you and I were at the

981
00:42:56,229 --> 00:42:54,200
double-a s and we were looking at this

982
00:42:58,210 --> 00:42:56,239
on the touchscreen and we said oh those

983
00:43:00,039 --> 00:42:58,220
four stars have to be these four smaller

984
00:43:01,900 --> 00:43:00,049
stars and because we were just sliding

985
00:43:04,509 --> 00:43:01,910
back and forth we weren't able to to

986
00:43:06,759 --> 00:43:04,519
crossfade back and forth and so when I

987
00:43:08,410 --> 00:43:06,769
brought this into the image processing

988
00:43:09,609 --> 00:43:08,420

program and I aligned them and

989
00:43:16,920 --> 00:43:09,619
everything and I went down here is like

990
00:43:22,180 --> 00:43:16,930
oh yeah those aren't oh are you there

991
00:43:24,220 --> 00:43:22,190
must be behind Wow the green gas of a

992
00:43:25,930 --> 00:43:24,230
blue gas the oxygen emitting part of the

993
00:43:28,200 --> 00:43:25,940
nebula and that only with the infrared

994
00:43:31,499 --> 00:43:28,210
do you see through it in order to see

995
00:43:35,799 --> 00:43:31,509
these really really really bright stars

996
00:43:39,609 --> 00:43:35,809
cool all right so that takes us to our

997
00:43:42,339 --> 00:43:39,619
final slide of today's presentation on

998
00:43:45,460 --> 00:43:42,349
the left is the 1995 image the center is

999
00:43:49,210 --> 00:43:45,470
the 2015 visible light and on the right

1000
00:43:52,120 --> 00:43:49,220
is the 2015 infrared we have we visited

1001
00:43:54,690 --> 00:43:52,130
a legend there are so much cool stuff to

1002
00:43:57,640 --> 00:43:54,700
looking here I gotta say that the

1003
00:43:59,920 --> 00:43:57,650
visible light image and all 60 million

1004
00:44:02,620 --> 00:43:59,930
pixel glory is available for everybody

1005
00:44:04,690 --> 00:44:02,630
not just astrophysicist the public can

1006
00:44:07,960 --> 00:44:04,700
download it and look at all these cool

1007
00:44:10,029 --> 00:44:07,970
cool details yourself the infrared image

1008
00:44:12,339 --> 00:44:10,039
is something like what I think that's

1009
00:44:15,910 --> 00:44:12,349
around 16 million pixels

1010
00:44:17,620 --> 00:44:15,920
as well so there's lots of all the data

1011
00:44:20,829 --> 00:44:17,630
one of the best things about Hubble is

1012
00:44:22,900 --> 00:44:20,839
it's not just the astronomers on the

1013
00:44:25,359 --> 00:44:22,910

mountaintops telescope it is the

1014
00:44:27,309 --> 00:44:25,369
people's telescope and all of our data

1015
00:44:29,259 --> 00:44:27,319
all of our work is paid for by the

1016
00:44:31,239 --> 00:44:29,269
public so all of our data is made

1017
00:44:33,219 --> 00:44:31,249
available to the plant so if you've got

1018
00:44:35,620 --> 00:44:33,229
a whole site and you want to study these

1019
00:44:37,719 --> 00:44:35,630
the images and details have at it and

1020
00:44:40,989 --> 00:44:37,729
enjoy nobody knows that better than the

1021
00:44:44,499 --> 00:44:40,999
person who's question I want to get to

1022
00:44:48,009 --> 00:44:44,509
right away Judy Schmidt she is hot hi

1023
00:44:50,229 --> 00:44:48,019
Judy she's always a good person to talk

1024
00:44:52,420 --> 00:44:50,239
to about Hubble images and using the

1025
00:44:55,269 --> 00:44:52,430
data things like that but she's asking a

1026
00:44:57,069 --> 00:44:55,279
question she says I like to call that

1027
00:45:00,489 --> 00:44:57,079
reddish protrusion from the center

1028
00:45:02,680 --> 00:45:00,499
pillar a kabuki mask I wonder I wonder

1029
00:45:04,690 --> 00:45:02,690
though I'm gonna put it up here I wonder

1030
00:45:06,039 --> 00:45:04,700
why its composition is a little

1031
00:45:08,700 --> 00:45:06,049
different from the rest of the pillar

1032
00:45:11,620 --> 00:45:08,710
getting you got any response to that um

1033
00:45:14,440 --> 00:45:11,630
you know she calls it a kabuki mask I

1034
00:45:21,099 --> 00:45:14,450
actually looked at it as an ear for guys

1035
00:45:23,049 --> 00:45:21,109
in a pair the red color there I don't

1036
00:45:27,789 --> 00:45:23,059
have a good guess for it to be honest

1037
00:45:29,650 --> 00:45:27,799
with you I know that I mean the red in

1038
00:45:36,489 --> 00:45:29,660

that image has got to be got to be

1039
00:45:38,109 --> 00:45:36,499
nitrogen and you know let me go back to

1040
00:45:41,049 --> 00:45:38,119
that let me see if I if I and I can

1041
00:45:44,559 --> 00:45:41,059
quickly go back to that image I'm going

1042
00:45:48,279 --> 00:45:44,569
to scan through real quick there we go

1043
00:45:50,709 --> 00:45:48,289
what's right spot okay so on the left

1044
00:45:55,989 --> 00:45:50,719
you know that I believe this is what

1045
00:45:58,509 --> 00:45:55,999
Judy's calling kabuki mask it's not so

1046
00:46:01,779 --> 00:45:58,519
much the red dot on the left hand side

1047
00:46:04,719 --> 00:46:01,789
of it that that seems reasonable it's

1048
00:46:09,549 --> 00:46:04,729
these sort of scallop shapes around it

1049
00:46:12,789 --> 00:46:09,559
that I don't quite I don't know I don't

1050
00:46:13,900 --> 00:46:12,799
quite know how that I sort of look at

1051
00:46:18,219 --> 00:46:13,910
those things and I started think of

1052
00:46:20,349 --> 00:46:18,229
winds its etc from from from newborn

1053
00:46:24,579 --> 00:46:20,359
stars to blow out because this looks

1054
00:46:26,140 --> 00:46:24,589
like billowing out of a wind you know

1055
00:46:28,720 --> 00:46:26,150
you know as you as you blow out

1056
00:46:30,930 --> 00:46:28,730
bubbles and such but that's going to be

1057
00:46:34,299 --> 00:46:30,940
my best idea for something like that

1058
00:46:36,309 --> 00:46:34,309
okay all right well it's yeah it's it's

1059
00:46:37,750 --> 00:46:36,319
uh it's gonna be a while I guess before

1060
00:46:39,220 --> 00:46:37,760
we can find out everything there is to

1061
00:46:41,609 --> 00:46:39,230
know about all these images but that's a

1062
00:46:44,430 --> 00:46:41,619
good question Judy Nikolas has a comment

1063
00:46:47,440 --> 00:46:44,440

or actually his questions are about the

1064
00:46:49,779 --> 00:46:47,450
differences in resolutions he's asking

1065
00:46:51,849 --> 00:46:49,789
is it really only mrs. between the two

1066
00:46:54,849 --> 00:46:51,859
cameras is it really only the better

1067
00:46:58,990 --> 00:46:54,859
resolution on the newer images or also

1068
00:47:00,789 --> 00:46:59,000
some some more 2015 ish image processing

1069
00:47:02,710 --> 00:47:00,799
so to what extent do you think the

1070
00:47:04,210 --> 00:47:02,720
details that we're seeing or do to image

1071
00:47:09,180 --> 00:47:04,220
prop the better image processing

1072
00:47:14,049 --> 00:47:11,470
there's a little bit of that ok so first

1073
00:47:16,510 --> 00:47:14,059
of all there's the cameras with pick two

1074
00:47:20,319 --> 00:47:16,520
is a tenth of an arcsecond per pixel why

1075
00:47:23,500 --> 00:47:20,329
twisted with c3 is a 2020 a second per

1076
00:47:26,740 --> 00:47:23,510
pixel so that's definitely there to the

1077
00:47:28,779 --> 00:47:26,750
detectors are more efficient and well

1078
00:47:32,620 --> 00:47:28,789
they can do this same image in shorter

1079
00:47:34,690 --> 00:47:32,630
time but they are our understanding of

1080
00:47:39,309 --> 00:47:34,700
how to process the data is of course

1081
00:47:41,200 --> 00:47:39,319
better way we've processed in the with

1082
00:47:43,480 --> 00:47:41,210
pic to image you know we had only two

1083
00:47:45,220 --> 00:47:43,490
years of working with with it too we've

1084
00:47:47,049 --> 00:47:45,230
had five years of working with whiskey

1085
00:47:49,930 --> 00:47:47,059
three computers are much much much

1086
00:47:51,519 --> 00:47:49,940
faster we know how to remove errors

1087
00:47:53,470 --> 00:47:51,529
there are some errors by the way that if

1088
00:47:56,859 --> 00:47:53,480

you compare the two you can go oh that's

1089
00:47:59,950 --> 00:47:56,869
not a star that's a that's a glitch from

1090
00:48:01,930 --> 00:47:59,960
the bright star creating a a a peak in

1091
00:48:04,930 --> 00:48:01,940
the CCD so there's some of those small

1092
00:48:07,000 --> 00:48:04,940
things there so it's improvement in

1093
00:48:09,490 --> 00:48:07,010
resolution improvement in the detectors

1094
00:48:12,279 --> 00:48:09,500
and improvement in our processing that

1095
00:48:16,650 --> 00:48:12,289
do that to help all of our gaining much

1096
00:48:18,849 --> 00:48:16,660
more sensory from these images right and

1097
00:48:24,160 --> 00:48:18,859
one point I'd like to make is that you

1098
00:48:26,200 --> 00:48:24,170
can also with the if when we have the

1099
00:48:27,760 --> 00:48:26,210
data from the original camera there's

1100
00:48:29,109 --> 00:48:27,770
nothing to prevent you from reprocessing

1101
00:48:30,609 --> 00:48:29,119
and using new techniques once you

1102
00:48:32,319 --> 00:48:30,619
understand how to better do things don't

1103
00:48:34,150 --> 00:48:32,329
if he can't really do is maybe take

1104
00:48:35,170 --> 00:48:34,160
different calibration images or things

1105
00:48:36,640 --> 00:48:35,180
like that because the camera is no

1106
00:48:37,690 --> 00:48:36,650
longer there but there's nothing to

1107
00:48:39,430 --> 00:48:37,700
prevent you from using the newer

1108
00:48:43,780 --> 00:48:39,440
techniques right

1109
00:48:45,490 --> 00:48:43,790
so okay so I think I will that's I mean

1110
00:48:47,500 --> 00:48:45,500
maybe look to see if there's any any

1111
00:48:51,400 --> 00:48:47,510
more questions around i'm looking at

1112
00:48:54,099 --> 00:48:51,410
hubbell hangouts I don't see that I

1113
00:48:55,630 --> 00:48:54,109

don't see any tweets or anything so the

1114
00:48:58,599 --> 00:48:55,640
only other question is from zigzagging

1115
00:49:02,710 --> 00:48:58,609
I'm not quite sure how to interpret this

1116
00:49:05,470 --> 00:49:02,720
but we have those Weston's of the rate

1117
00:49:11,849 --> 00:49:05,480
of mass expansion oh it just disappeared

1118
00:49:15,370 --> 00:49:11,859
great a the idea of the rate of mass

1119
00:49:16,630 --> 00:49:15,380
expansion in miles per hour we talked

1120
00:49:18,400 --> 00:49:16,640
about that briefly if you're talking

1121
00:49:20,890 --> 00:49:18,410
about the the increase in the rate of

1122
00:49:23,710 --> 00:49:20,900
the or the movement of some of those

1123
00:49:25,240 --> 00:49:23,720
features you can know we didn't know it

1124
00:49:27,339 --> 00:49:25,250
on top of our heads but you can figure

1125
00:49:30,579 --> 00:49:27,349
it out once you wouldn't by knowing for

1126
00:49:34,300 --> 00:49:30,589
pixel scale which is the the area on a

1127
00:49:35,890 --> 00:49:34,310
side of each pixel and then count the

1128
00:49:38,230 --> 00:49:35,900
number of pixels and since we know the

1129
00:49:40,000 --> 00:49:38,240
time there wasn't like you know 20 years

1130
00:49:42,220 --> 00:49:40,010
have gone by we can kind of get a speed

1131
00:49:44,230 --> 00:49:42,230
from that as well so that's that's the

1132
00:49:46,240 --> 00:49:44,240
way in which you would figure it out the

1133
00:49:50,050 --> 00:49:46,250
scale on this is going to be an order of

1134
00:49:52,000 --> 00:49:50,060
a thousand kilometers a second okay the

1135
00:49:54,700 --> 00:49:52,010
solar wind okay the suns and midlands

1136
00:49:57,160 --> 00:49:54,710
star the solar wind from the Sun blows

1137
00:50:00,069 --> 00:49:57,170
out at 400 kilometers a second regularly

1138
00:50:03,069 --> 00:50:00,079

and 800 kilometers second vertically the

1139
00:50:04,630 --> 00:50:03,079
Jets are going to be proud at faster

1140
00:50:07,059 --> 00:50:04,640
speeds than that so there'll be a few

1141
00:50:09,010 --> 00:50:07,069
thousand kilometers per second maybe as

1142
00:50:14,500 --> 00:50:09,020
high as 10 10 or 20,000 kilometers a

1143
00:50:20,319 --> 00:50:14,510
second now the kilometer per second if

1144
00:50:22,510 --> 00:50:20,329
you do the map ends up being what do we

1145
00:50:24,670 --> 00:50:22,520
get 30 kilometers per second is about a

1146
00:50:28,180 --> 00:50:24,680
hundred eight thousand hundred thousand

1147
00:50:31,210 --> 00:50:28,190
kilometers per hour so you're

1148
00:50:34,210 --> 00:50:31,220
multiplying by a buyout by large novella

1149
00:50:37,000 --> 00:50:34,220
by large numbers 3600 in order to get

1150
00:50:38,530 --> 00:50:37,010
these things up to per hour right rare

1151
00:50:40,300 --> 00:50:38,540
very large numbers in terms of per hour

1152
00:50:41,740 --> 00:50:40,310
but a couple thousand kilometers per

1153
00:50:44,859 --> 00:50:41,750
second which is how astronomers think of

1154
00:50:47,440 --> 00:50:44,869
it right okay well thank you Frank this

1155
00:50:49,089 --> 00:50:47,450
has been awesome I will I'm going to

1156
00:50:52,100 --> 00:50:49,099
stop it there but I want to remind

1157
00:50:54,320 --> 00:50:52,110
everybody that we can you

1158
00:50:57,380 --> 00:50:54,330
we have a new Hubble public lecture next

1159
00:50:59,300 --> 00:50:57,390
week and we will be broadcasting it on

1160
00:51:00,560 --> 00:50:59,310
YouTube I also wanted to point out I

1161
00:51:02,660 --> 00:51:00,570
should have done this at the top of the

1162
00:51:06,020 --> 00:51:02,670
Hangout but I didn't do it next on

1163
00:51:09,740 --> 00:51:06,030

Monday the ISA the European Space Agency

1164
00:51:12,620 --> 00:51:09,750
is launching a video contest called ode

1165
00:51:16,280 --> 00:51:12,630
to Hubble for Hubble's 25th and and I'm

1166
00:51:19,730 --> 00:51:16,290
gonna post it right now on the event

1167
00:51:22,580 --> 00:51:19,740
page i just posted it the link to where

1168
00:51:25,790 --> 00:51:22,590
you can learn more about it so if you

1169
00:51:27,320 --> 00:51:25,800
have a and they're taking all video

1170
00:51:29,660 --> 00:51:27,330
submissions i think under three minutes

1171
00:51:32,420 --> 00:51:29,670
so if you have something about Hubble

1172
00:51:34,520 --> 00:51:32,430
you'd like to say or a message you want

1173
00:51:38,180 --> 00:51:34,530
to send Hubble than they will you can

1174
00:51:39,680 --> 00:51:38,190
enter the contest and felt I think

1175
00:51:41,090 --> 00:51:39,690
they're going to they're going to

1176
00:51:42,620 --> 00:51:41,100
discuss what the prices are going to be

1177
00:51:44,930 --> 00:51:42,630
on my question what they are yet but

1178
00:51:46,580 --> 00:51:44,940
keep an eye out on that web page for it

1179
00:51:48,530 --> 00:51:46,590
and make a video make it into three

1180
00:51:50,330 --> 00:51:48,540
minutes and submitted and who knows what

1181
00:51:52,070 --> 00:51:50,340
will happen and and they're taking two

1182
00:51:54,620 --> 00:51:52,080
categories one of them will be for

1183
00:51:56,210 --> 00:51:54,630
people under 25 years old those are the

1184
00:51:57,590 --> 00:51:56,220
people who are calling a hubble

1185
00:51:59,630 --> 00:51:57,600
generation these are the people who

1186
00:52:01,250 --> 00:51:59,640
don't know a world without the Hubble

1187
00:52:04,610 --> 00:52:01,260
Space Telescope and then there's there's

1188
00:52:06,050 --> 00:52:04,620

entries for those over 25 so keep an eye

1189
00:52:08,750 --> 00:52:06,060
out for that on Monday will be tweeting

1190
00:52:10,550 --> 00:52:08,760
about it and pass in sending out more

1191
00:52:13,640 --> 00:52:10,560
information once that launches so

1192
00:52:14,990 --> 00:52:13,650
there's that also tomorrow we have our

1193
00:52:16,130 --> 00:52:15,000
net we have our regularly scheduled

1194
00:52:18,230 --> 00:52:16,140
Hubble to hang out where we're going to

1195
00:52:19,700 --> 00:52:18,240
be talking more on the history of Hubble

1196
00:52:21,860 --> 00:52:19,710
with Carolyn columns Peterson she's an

1197
00:52:24,290 --> 00:52:21,870
author who has written many books on

1198
00:52:27,260 --> 00:52:24,300
Hubble as well as Antonella nota she's

1199
00:52:28,580 --> 00:52:27,270
the ISA program head at the Institute

1200
00:52:29,840 --> 00:52:28,590
she's going to give us some ideas she's

1201
00:52:32,390 --> 00:52:29,850
going to give us a brief overview of

1202
00:52:34,220 --> 00:52:32,400
some of esa's role in the history of the

1203
00:52:36,080 --> 00:52:34,230
Hubble Space Telescope mission so we

1204
00:52:39,470 --> 00:52:36,090
hope you guys will watch that then Frank

1205
00:52:41,840 --> 00:52:39,480
this has been fun thank you again thanks

1206
00:52:43,370 --> 00:52:41,850
Tony I find it surprising we could have

1207
00:52:46,360 --> 00:52:43,380
this much to talk about but one image

1208
00:52:49,040 --> 00:52:46,370
but i will i'm not surprised at all

1209
00:52:50,780 --> 00:52:49,050
returnable stories next month and we'll

1210
00:52:52,730 --> 00:52:50,790
definitely get to Andromeda because that

1211
00:52:54,770 --> 00:52:52,740
was a something I really wanted to fit

1212
00:52:56,090 --> 00:52:54,780
in today as well yes ok good so that I

1213
00:52:59,350 --> 00:52:56,100

wanted to ask you about that so well we

1214
00:53:02,240 --> 00:52:59,360
gonna do a hangout next week also on I

1215
00:53:04,010 --> 00:53:02,250
really two weeks ok in two weeks all

1216
00:53:05,780 --> 00:53:04,020
right so in two weeks look for another

1217
00:53:07,520 --> 00:53:05,790
news from Hubble and across the

1218
00:53:08,720 --> 00:53:07,530
universe with doctor Frank summers and

1219
00:53:10,340 --> 00:53:08,730
we will talk about all kinds of things

1220
00:53:11,980 --> 00:53:10,350
hopefully we'll get to the Andromeda

1221
00:53:15,110 --> 00:53:11,990
image as well like you said which is

1222
00:53:17,600 --> 00:53:15,120
another really incredible people so I

1223
00:53:19,370 --> 00:53:17,610
can't wait to to talk about that with

1224
00:53:21,680 --> 00:53:19,380
you to also Frank all right well that's

1225
00:53:25,130 --> 00:53:21,690
it for this week space fans I do that