
Google+

1
00:00:09,110 --> 00:00:06,789
all right hello everybody the uh

2
00:00:11,030 --> 00:00:09,120
broadcast is said to be live now i hope

3
00:00:13,430 --> 00:00:11,040
it's recording well

4
00:00:16,630 --> 00:00:13,440
uh i am dr frank summers of the space

5
00:00:18,710 --> 00:00:16,640
telescope science institute and it is my

6
00:00:23,109 --> 00:00:18,720
pleasure to welcome you to celebrating

7
00:00:27,670 --> 00:00:23,119
23 years of the hubble space telescope

8
00:00:30,870 --> 00:00:29,509
we have some amazing things and let me

9
00:00:31,669 --> 00:00:30,880
just show you

10
00:00:34,229 --> 00:00:31,679
uh

11
00:00:37,750 --> 00:00:34,239
a couple things um what we're

12
00:00:39,910 --> 00:00:37,760
celebrating is that um 23 years ago this

13
00:00:45,430 --> 00:00:39,920

was the launch of the hubble space

14
00:00:47,590 --> 00:00:45,440
telescope on the shuttle mission sts-31

15
00:00:50,069 --> 00:00:47,600
and you'll notice that not only do we

16
00:00:53,270 --> 00:00:50,079
have uh hubble launching on discovery

17
00:00:54,869 --> 00:00:53,280
here we also had uh just happen to have

18
00:00:57,029 --> 00:00:54,879
um another

19
00:01:01,270 --> 00:00:57,039
uh

20
00:01:03,830 --> 00:01:01,280
doing doing some testing

21
00:01:06,230 --> 00:01:03,840
um and then a day later

22
00:01:07,670 --> 00:01:06,240
uh we had hubble was deployed by the

23
00:01:10,390 --> 00:01:07,680
astronauts of

24
00:01:13,030 --> 00:01:10,400
sts-31

25
00:01:14,950 --> 00:01:13,040
and uh we have 23 years of amazing

26
00:01:17,109 --> 00:01:14,960
history of images

27
00:01:19,910 --> 00:01:17,119
and today we are going to discuss the

28
00:01:22,550 --> 00:01:19,920
image that we released last friday night

29
00:01:26,230 --> 00:01:22,560
last no friday morning sorry um an

30
00:01:28,070 --> 00:01:26,240
infrared view of the horse head nebula

31
00:01:31,830 --> 00:01:28,080
this is the image here

32
00:01:34,710 --> 00:01:31,840
and this is uh the amazing image that

33
00:01:36,710 --> 00:01:34,720
the experts who processed it will tell

34
00:01:38,390 --> 00:01:36,720
you all about it

35
00:01:41,590 --> 00:01:38,400
so let me

36
00:01:43,429 --> 00:01:41,600
stop my screen share there we go

37
00:01:44,789 --> 00:01:43,439
um and introduce the experts who are

38
00:01:47,510 --> 00:01:44,799

going to talk about it

39
00:01:51,109 --> 00:01:47,520
um our first expert here today i'm gonna

40
00:01:53,590 --> 00:01:51,119
introduce is uh mr zolt levay

41
00:01:55,749 --> 00:01:53,600
and zol why don't you tell them a bit

42
00:01:58,550 --> 00:01:55,759
about your history here what you do at

43
00:02:01,190 --> 00:01:58,560
space telescope okay uh thanks frank and

44
00:02:02,950 --> 00:02:01,200
welcome everybody and happy birthday

45
00:02:04,870 --> 00:02:02,960
happy birthday hubble

46
00:02:06,870 --> 00:02:04,880
uh and happy earth day

47
00:02:09,190 --> 00:02:06,880
all those things

48
00:02:10,630 --> 00:02:09,200
so i started here at space telescope

49
00:02:12,309 --> 00:02:10,640
science institute quite a long time ago

50
00:02:15,190 --> 00:02:12,319
about 30 years ago

51
00:02:16,790 --> 00:02:15,200
uh and for the last uh

52
00:02:19,510 --> 00:02:16,800
many years i've been

53
00:02:22,229 --> 00:02:19,520
producing images from hubble data so

54
00:02:24,150 --> 00:02:22,239
that's kind of what we do we

55
00:02:25,350 --> 00:02:24,160
use the same data that the astronomers

56
00:02:27,270 --> 00:02:25,360
use

57
00:02:29,750 --> 00:02:27,280
and produce

58
00:02:32,229 --> 00:02:29,760
have produced quite a number of

59
00:02:34,070 --> 00:02:32,239
nice colorful images

60
00:02:36,710 --> 00:02:34,080
to distribute to the public to

61
00:02:38,630 --> 00:02:36,720
demonstrate how what hubble's doing

62
00:02:41,830 --> 00:02:38,640
to announce the science discoveries from

63
00:02:47,670 --> 00:02:45,110

and i'll turn it over to jennifer mack

64
00:02:50,710 --> 00:02:47,680
hi i'm jennifer and i've been at the

65
00:02:53,830 --> 00:02:50,720
institute here for about 16 years

66
00:02:56,390 --> 00:02:53,840
i am i do both science research and

67
00:02:58,630 --> 00:02:56,400
instrument calibration for the telescope

68
00:03:01,670 --> 00:02:58,640
and i'm a member of the wide field

69
00:03:03,750 --> 00:03:01,680
camera 3 team um that's the camera that

70
00:03:05,589 --> 00:03:03,760
was used to make the observations that

71
00:03:07,670 --> 00:03:05,599
were made today that we're presenting

72
00:03:08,390 --> 00:03:07,680
today and so i'll be giving you a bit of

73
00:03:17,190 --> 00:03:08,400
a

74
00:03:19,509 --> 00:03:17,200
put them in together

75
00:03:20,790 --> 00:03:19,519
to then create this beautiful color

76
00:03:23,509 --> 00:03:20,800
composite

77
00:03:25,350 --> 00:03:23,519
that you see in the news

78
00:03:26,630 --> 00:03:25,360
right so as you can see we're going to

79
00:03:28,149 --> 00:03:26,640
be taking you

80
00:03:29,670 --> 00:03:28,159
not just give you the pretty picture

81
00:03:32,070 --> 00:03:29,680
overview where we're going to give you

82
00:03:34,390 --> 00:03:32,080
the technical behind the scenes of how

83
00:03:36,630 --> 00:03:34,400
these images really are put together

84
00:03:38,789 --> 00:03:36,640
so uh zolt has put together a powerpoint

85
00:03:41,350 --> 00:03:38,799
presentation so if he'll turn on his

86
00:03:43,509 --> 00:03:41,360
screen share we'll uh go back to zoltan

87
00:03:45,030 --> 00:03:43,519
zolt take it away tell tell them all the

88
00:03:47,910 --> 00:03:45,040

cool stuff

89
00:03:50,869 --> 00:03:47,920
okay thanks frank and i'll get my thing

90
00:03:54,949 --> 00:03:50,879
started here i will

91
00:04:00,789 --> 00:03:57,270
so as frank mentioned we're talking

92
00:04:03,670 --> 00:04:00,799
today about this new image from hubble

93
00:04:07,030 --> 00:04:03,680
a horse head of a different color

94
00:04:09,270 --> 00:04:07,040
uh in the uh looking at this iconic

95
00:04:11,190 --> 00:04:09,280
astronomical object in the infrared

96
00:04:13,190 --> 00:04:11,200
instead of the visible light as we

97
00:04:14,390 --> 00:04:13,200
normally see it

98
00:04:16,629 --> 00:04:14,400
so

99
00:04:17,990 --> 00:04:16,639
um

100
00:04:19,830 --> 00:04:18,000
just a little overview of what we're

101
00:04:22,710 --> 00:04:19,840
going to be talking about today as we

102
00:04:24,950 --> 00:04:22,720
said this is uh celebrating hubble's

103
00:04:27,189 --> 00:04:24,960
23rd anniversary

104
00:04:28,790 --> 00:04:27,199
these observations were made by the

105
00:04:30,950 --> 00:04:28,800
hubble heritage

106
00:04:32,070 --> 00:04:30,960
team which is a project here at the

107
00:04:35,510 --> 00:04:32,080
institute

108
00:04:38,070 --> 00:04:35,520
which strives to find and distribute the

109
00:04:39,590 --> 00:04:38,080
aesthetically best images from hubble

110
00:04:42,390 --> 00:04:39,600
not necessarily

111
00:04:43,909 --> 00:04:42,400
for their science content

112
00:04:46,469 --> 00:04:43,919
but for their

113
00:04:48,870 --> 00:04:46,479

sheer beauty quite honestly and so we'll

114
00:04:50,790 --> 00:04:48,880
talk about

115
00:04:53,430 --> 00:04:50,800
how we got the data

116
00:04:55,909 --> 00:04:53,440
what the data were and jennifer's going

117
00:04:57,749 --> 00:04:55,919
to talk about how those data sets were

118
00:05:00,230 --> 00:04:57,759
originally processed

119
00:05:03,270 --> 00:05:00,240
to produce the images that we use then

120
00:05:04,950 --> 00:05:03,280
to to reconstruct the color image

121
00:05:07,270 --> 00:05:04,960
and finally we're going to talk about

122
00:05:12,070 --> 00:05:07,280
another part of this project which was

123
00:05:16,390 --> 00:05:14,710
so let's have a little bit of context

124
00:05:18,629 --> 00:05:16,400
the horsehead nebula sits in the

125
00:05:20,790 --> 00:05:18,639
constellation orion

126
00:05:22,469 --> 00:05:20,800
as we see it in the sky

127
00:05:24,950 --> 00:05:22,479
this is one of the most recognizable

128
00:05:27,029 --> 00:05:24,960
constellations in the sky and it appears

129
00:05:28,790 --> 00:05:27,039
most prominently in the wintertime

130
00:05:30,310 --> 00:05:28,800
uh when coincidentally at least in the

131
00:05:32,870 --> 00:05:30,320
northern hemisphere the skies are nice

132
00:05:35,670 --> 00:05:32,880
and clear and and we can see all the

133
00:05:38,469 --> 00:05:35,680
beautiful stuff that's in the uh orion

134
00:05:40,230 --> 00:05:38,479
constellation as it turns out

135
00:05:42,310 --> 00:05:40,240
there's a huge amount of stuff that's

136
00:05:44,390 --> 00:05:42,320
going on in in as we

137
00:05:46,710 --> 00:05:44,400
look out towards this constellation

138
00:05:48,390 --> 00:05:46,720

there's an entire complex of material

139
00:05:49,990 --> 00:05:48,400
out there the horse said maybe there's

140
00:05:50,830 --> 00:05:50,000
one small part of it this has been

141
00:05:53,909 --> 00:05:50,840
studied

142
00:05:55,270 --> 00:05:53,919
extensively uh includes the

143
00:05:57,990 --> 00:05:55,280
the giant

144
00:06:00,950 --> 00:05:58,000
uh greater nebula and orion also known

145
00:06:02,710 --> 00:06:00,960
as m42 which has a cluster of stars

146
00:06:04,710 --> 00:06:02,720
embedded in it that they're powering

147
00:06:06,710 --> 00:06:04,720
this thing and lots of other things

148
00:06:08,870 --> 00:06:06,720
going on in this well today we're going

149
00:06:10,710 --> 00:06:08,880
to concentrate on the horsehead nebula

150
00:06:12,629 --> 00:06:10,720
which is one portion of this here's a

151
00:06:15,430 --> 00:06:12,639
beautiful image

152
00:06:17,990 --> 00:06:15,440
from david malin who has been making

153
00:06:19,830 --> 00:06:18,000
color pictures astronomical images for

154
00:06:22,870 --> 00:06:19,840
many many decades

155
00:06:25,029 --> 00:06:22,880
really the originator of producing color

156
00:06:27,189 --> 00:06:25,039
pictures from astronomical

157
00:06:29,189 --> 00:06:27,199
scientific astronomical data

158
00:06:30,150 --> 00:06:29,199
going back quite a ways and he produced

159
00:06:32,469 --> 00:06:30,160
this image

160
00:06:34,390 --> 00:06:32,479
some time ago of the

161
00:06:36,070 --> 00:06:34,400
course of nebular region

162
00:06:38,070 --> 00:06:36,080
and as you can see there's a lot of

163
00:06:41,590 --> 00:06:38,080

other stuff going on so this pinkish

164
00:06:43,430 --> 00:06:41,600
area is emission from hydrogen gas

165
00:06:46,870 --> 00:06:43,440
uh there's a brighter area there's a

166
00:06:49,110 --> 00:06:46,880
there's some very bright stars nearby

167
00:06:50,790 --> 00:06:49,120
uh there's a brighter area just above

168
00:06:53,110 --> 00:06:50,800
where the horsehead is

169
00:06:55,029 --> 00:06:53,120
and that's a region of active

170
00:06:57,430 --> 00:06:55,039
star formation there are new stars being

171
00:07:00,150 --> 00:06:57,440
formed there

172
00:07:02,070 --> 00:07:00,160
but again we'll we'll zoom farther in

173
00:07:03,189 --> 00:07:02,080
to the to the horse head itself and

174
00:07:05,909 --> 00:07:03,199
here's another

175
00:07:07,909 --> 00:07:05,919
nice uh image uh from

176
00:07:10,469 --> 00:07:07,919
an uh uh an accomplished

177
00:07:13,189 --> 00:07:10,479
astrophotographer named adam block

178
00:07:14,150 --> 00:07:13,199
who works out in arizona

179
00:07:15,589 --> 00:07:14,160
that's all

180
00:07:17,350 --> 00:07:15,599
yes

181
00:07:19,510 --> 00:07:17,360
you just almost called him an amateur

182
00:07:20,950 --> 00:07:19,520
right but you corrected yourself because

183
00:07:23,189 --> 00:07:20,960
that's the traditional name for him

184
00:07:25,510 --> 00:07:23,199
there's amateur astronomers but these

185
00:07:27,830 --> 00:07:25,520
guys are so professional at what they do

186
00:07:30,550 --> 00:07:27,840
well also adam has a concerted outreach

187
00:07:31,909 --> 00:07:30,560
effort and he collaborates with uh kitt

188
00:07:33,990 --> 00:07:31,919

peak national observatory and other

189
00:07:36,790 --> 00:07:34,000
observatories and he does a lot of

190
00:07:39,189 --> 00:07:36,800
really high-end uh uh

191
00:07:40,790 --> 00:07:39,199
uh astronomical imaging so yeah i'm

192
00:07:41,990 --> 00:07:40,800
hard-pressed to call people like that

193
00:07:44,469 --> 00:07:42,000
amateurs

194
00:07:46,309 --> 00:07:44,479
they may not be doing uh

195
00:07:49,350 --> 00:07:46,319
you know real

196
00:07:51,189 --> 00:07:49,360
research scientific research or writing

197
00:07:52,629 --> 00:07:51,199
scientific papers but they're doing very

198
00:07:53,909 --> 00:07:52,639
very high-end

199
00:07:55,670 --> 00:07:53,919
imaging work and there's a number of

200
00:07:59,029 --> 00:07:55,680
people like that

201
00:08:00,710 --> 00:07:59,039
so i just have to agree because

202
00:08:02,710 --> 00:08:00,720
i just i i have to agree because it sort

203
00:08:05,270 --> 00:08:02,720
of sticks in my craw every time i call i

204
00:08:08,070 --> 00:08:05,280
say amateur astrophotographer these guys

205
00:08:08,869 --> 00:08:08,080
are just so professional what they do

206
00:08:10,150 --> 00:08:08,879
um

207
00:08:12,629 --> 00:08:10,160
so so

208
00:08:13,430 --> 00:08:12,639
on the other side of the frame here we

209
00:08:16,629 --> 00:08:13,440
see

210
00:08:18,150 --> 00:08:16,639
what's labeled hst with pick 2 image so

211
00:08:21,510 --> 00:08:18,160
a number of years ago

212
00:08:24,869 --> 00:08:21,520
the hubble heritage project

213
00:08:26,629 --> 00:08:24,879

actually had a had a public poll and we

214
00:08:27,749 --> 00:08:26,639
asked the public

215
00:08:32,870 --> 00:08:27,759
which

216
00:08:35,430 --> 00:08:32,880
would they like hubble to look at and by

217
00:08:37,750 --> 00:08:35,440
about by pretty wide margin

218
00:08:39,589 --> 00:08:37,760
uh the poll returned that people would

219
00:08:41,589 --> 00:08:39,599
like to look at the horsehead nebula

220
00:08:43,829 --> 00:08:41,599
which a lot of people know about it's a

221
00:08:45,750 --> 00:08:43,839
very famous object in astronomy you know

222
00:08:47,269 --> 00:08:45,760
everybody looks at it

223
00:08:48,870 --> 00:08:47,279
and so we

224
00:08:51,509 --> 00:08:48,880
actually took those observations as it

225
00:08:53,110 --> 00:08:51,519
turns out hubble uh

226
00:08:56,790 --> 00:08:53,120
with that camera

227
00:08:58,550 --> 00:08:56,800
at the time this was in 2001

228
00:09:00,470 --> 00:08:58,560
got a pretty nice image although it's

229
00:09:01,910 --> 00:09:00,480
not the best image we've done as it

230
00:09:03,670 --> 00:09:01,920
turns out although

231
00:09:06,870 --> 00:09:03,680
if you compare these two images you can

232
00:09:09,269 --> 00:09:06,880
see that the hubble image we see a fair

233
00:09:11,990 --> 00:09:09,279
amount more detail

234
00:09:14,550 --> 00:09:12,000
the structures that we see are more uh

235
00:09:16,150 --> 00:09:14,560
they're finer structures so this this is

236
00:09:17,910 --> 00:09:16,160
evidence of the

237
00:09:19,190 --> 00:09:17,920
the better resolution that hubble has

238
00:09:20,630 --> 00:09:19,200

primarily because it's above the

239
00:09:22,630 --> 00:09:20,640
atmosphere

240
00:09:25,030 --> 00:09:22,640
than ground-based even the best

241
00:09:26,470 --> 00:09:25,040
ground-based telescopes can see

242
00:09:29,910 --> 00:09:26,480
so the other thing about this image is

243
00:09:32,310 --> 00:09:29,920
that it's it's in one it's in one filter

244
00:09:34,389 --> 00:09:32,320
it's in the light of uh

245
00:09:35,750 --> 00:09:34,399
of light of hydrogen so hydrogen atoms

246
00:09:37,670 --> 00:09:35,760
are emitting light

247
00:09:38,630 --> 00:09:37,680
and this filter in the camera is tuned

248
00:09:42,230 --> 00:09:38,640
to the

249
00:09:44,949 --> 00:09:42,240
that's what we're looking at here

250
00:09:48,470 --> 00:09:44,959
uh so we see a dark object against a

251
00:09:49,350 --> 00:09:48,480
fairly bright field surrounding it

252
00:09:51,430 --> 00:09:49,360
um

253
00:09:54,310 --> 00:09:51,440
now this now we actually did take images

254
00:09:57,030 --> 00:09:54,320
and other filters some broadband filters

255
00:09:58,389 --> 00:09:57,040
uh to get a color image we produced this

256
00:09:59,269 --> 00:09:58,399
color image

257
00:10:00,870 --> 00:09:59,279
uh

258
00:10:02,630 --> 00:10:00,880
with with pic2

259
00:10:05,990 --> 00:10:02,640
back in 2001 this was the hubble

260
00:10:07,509 --> 00:10:06,000
heritage image of the horse head

261
00:10:09,430 --> 00:10:07,519
and again you can see there's there's a

262
00:10:12,470 --> 00:10:09,440
fair amount of detail there

263
00:10:15,190 --> 00:10:12,480

we see a bright object at the top sort

264
00:10:18,310 --> 00:10:15,200
of at the forehead of the horse

265
00:10:20,870 --> 00:10:18,320
uh and this is a star that's em embedded

266
00:10:22,870 --> 00:10:20,880
in the in the nebula

267
00:10:24,310 --> 00:10:22,880
so this this was essentially the best

268
00:10:25,670 --> 00:10:24,320
image we could get of the horse head at

269
00:10:28,230 --> 00:10:25,680
the time now you notice the colors are a

270
00:10:30,150 --> 00:10:28,240
little bit different we chose to assign

271
00:10:31,990 --> 00:10:30,160
colors in a way it was a little bit

272
00:10:33,829 --> 00:10:32,000
different because the selection of

273
00:10:35,990 --> 00:10:33,839
filters that we had is a little bit

274
00:10:37,269 --> 00:10:36,000
different from the the normal view of

275
00:10:40,470 --> 00:10:37,279
the horsehead that you normally get

276
00:10:42,470 --> 00:10:40,480
which is mostly red because it's mostly

277
00:10:45,110 --> 00:10:42,480
hydrogen light emission which is

278
00:10:47,509 --> 00:10:45,120
primarily in red

279
00:10:50,630 --> 00:10:47,519
so just uh so going on

280
00:10:51,829 --> 00:10:50,640
now uh in 2013

281
00:10:54,069 --> 00:10:51,839
we uh

282
00:10:56,870 --> 00:10:54,079
actually in 2009 a new camera was

283
00:10:58,310 --> 00:10:56,880
installed on hubble called whitefield

284
00:11:00,389 --> 00:10:58,320
camera three

285
00:11:02,949 --> 00:11:00,399
and this actually incorporates two

286
00:11:05,990 --> 00:11:02,959
separate cameras one is the is a visible

287
00:11:07,430 --> 00:11:06,000
light the camera it also uh is sensitive

288
00:11:09,190 --> 00:11:07,440

a little bit into the infrared and a

289
00:11:11,430 --> 00:11:09,200
little bit into the ultraviolet so the

290
00:11:13,110 --> 00:11:11,440
infrared is light that's redder than the

291
00:11:15,670 --> 00:11:13,120
light reddest light that human humans

292
00:11:18,710 --> 00:11:15,680
can see and ultraviolet is

293
00:11:20,630 --> 00:11:18,720
a light that's bluer or higher frequency

294
00:11:22,870 --> 00:11:20,640
higher energy if you will

295
00:11:25,030 --> 00:11:22,880
light than than the human eye than the

296
00:11:27,269 --> 00:11:25,040
bluest light the human eye can see

297
00:11:29,750 --> 00:11:27,279
but in addition there's a infrared light

298
00:11:32,150 --> 00:11:29,760
camera that's dead that's only sensitive

299
00:11:34,870 --> 00:11:32,160
to infrared light and this is beyond the

300
00:11:36,069 --> 00:11:34,880
sensitivity in the infrared into the

301
00:11:37,670 --> 00:11:36,079
that the

302
00:11:38,790 --> 00:11:37,680
visible light camera

303
00:11:40,710 --> 00:11:38,800
can see

304
00:11:41,750 --> 00:11:40,720
so we decided to redo

305
00:11:44,630 --> 00:11:41,760
the

306
00:11:45,509 --> 00:11:44,640
corset image in infrared light and in

307
00:11:48,230 --> 00:11:45,519
fact

308
00:11:50,790 --> 00:11:48,240
we were somewhat prompted in this and

309
00:11:53,750 --> 00:11:50,800
encouraged in this by seeing

310
00:11:56,389 --> 00:11:53,760
this image which is a ground-based image

311
00:11:58,949 --> 00:11:56,399
taken in infrared light by

312
00:12:01,430 --> 00:11:58,959
a telescope of the european southern

313
00:12:02,790 --> 00:12:01,440

observatory this telescope is called

314
00:12:04,949 --> 00:12:02,800
vista

315
00:12:06,870 --> 00:12:04,959
and that acronym is currently escaping

316
00:12:09,269 --> 00:12:06,880
me but it's

317
00:12:11,910 --> 00:12:09,279
it's an infrared camera

318
00:12:13,829 --> 00:12:11,920
on a large crown based telescope

319
00:12:14,790 --> 00:12:13,839
the interesting thing about this is that

320
00:12:16,949 --> 00:12:14,800
we can

321
00:12:18,870 --> 00:12:16,959
start to see how different this area

322
00:12:21,590 --> 00:12:18,880
looks in the infrared as opposed to

323
00:12:24,389 --> 00:12:21,600
visible light we see this very bright

324
00:12:26,310 --> 00:12:24,399
nebulosity in the center left of the

325
00:12:28,870 --> 00:12:26,320
image which we'd seen in that david

326
00:12:30,870 --> 00:12:28,880
malin image as a as again a very bright

327
00:12:33,670 --> 00:12:30,880
patch very active

328
00:12:35,910 --> 00:12:33,680
region of very active star formation and

329
00:12:39,750 --> 00:12:35,920
toward the upper right we can see

330
00:12:44,710 --> 00:12:39,760
a sort of ghostly head sticking out and

331
00:12:49,990 --> 00:12:47,190
all right so zolt the uh acronym is

332
00:12:52,870 --> 00:12:50,000
visible an infrared survey telescope for

333
00:12:53,990 --> 00:12:52,880
astronomy there you go that's what vista

334
00:12:54,790 --> 00:12:54,000
stands for

335
00:12:56,150 --> 00:12:54,800
yeah

336
00:12:59,110 --> 00:12:56,160
on to the next one

337
00:13:02,230 --> 00:12:59,120
okay so actually i'm gonna uh actually

338
00:13:03,590 --> 00:13:02,240

hand it over now to jennifer uh and and

339
00:13:05,590 --> 00:13:03,600
i'll just say that

340
00:13:09,590 --> 00:13:05,600
so uh

341
00:13:12,870 --> 00:13:09,600
hubble heritage uh is a program again to

342
00:13:15,430 --> 00:13:12,880
to locate and distribute the

343
00:13:16,790 --> 00:13:15,440
visually best images from hubble now in

344
00:13:18,470 --> 00:13:16,800
the process of this we've been very

345
00:13:20,629 --> 00:13:18,480
fortunate to actually have a little bit

346
00:13:22,069 --> 00:13:20,639
of time on the telescope

347
00:13:24,470 --> 00:13:22,079
that

348
00:13:27,030 --> 00:13:24,480
directors of the this institute have

349
00:13:29,110 --> 00:13:27,040
agreed to award a little bit of time to

350
00:13:30,470 --> 00:13:29,120
heritage to be able to make our own

351
00:13:32,870 --> 00:13:30,480
observations now some of these

352
00:13:35,670 --> 00:13:32,880
observations are

353
00:13:37,030 --> 00:13:35,680
intended to augment existing data in the

354
00:13:38,389 --> 00:13:37,040
archive

355
00:13:40,389 --> 00:13:38,399
uh

356
00:13:43,190 --> 00:13:40,399
some some data sets in the archive which

357
00:13:46,310 --> 00:13:43,200
were designed for obtaining science

358
00:13:49,110 --> 00:13:46,320
uh with a little bit more observation

359
00:13:50,150 --> 00:13:49,120
can in fact um

360
00:13:51,829 --> 00:13:50,160
be

361
00:13:53,030 --> 00:13:51,839
make a much nicer

362
00:13:54,629 --> 00:13:53,040
image so

363
00:13:56,949 --> 00:13:54,639

we have some time to make those

364
00:13:58,949 --> 00:13:56,959
observations now in some cases we will

365
00:14:00,710 --> 00:13:58,959
produce images

366
00:14:02,550 --> 00:14:00,720
without any previous

367
00:14:04,790 --> 00:14:02,560
data in the archive and

368
00:14:07,670 --> 00:14:04,800
this horsehead image is one of those

369
00:14:10,310 --> 00:14:07,680
in in addition this was intended to

370
00:14:11,670 --> 00:14:10,320
commemorate as we said the anniversary

371
00:14:14,150 --> 00:14:11,680
of hubble's launch

372
00:14:17,670 --> 00:14:14,160
and we have done that numerous times so

373
00:14:18,629 --> 00:14:17,680
we've been able to use this uh telescope

374
00:14:21,910 --> 00:14:18,639
time

375
00:14:24,150 --> 00:14:21,920
to take images which we then uh release

376
00:14:26,150 --> 00:14:24,160
as a commemoration of the anniversary

377
00:14:28,629 --> 00:14:26,160
and that's what we did this time so we

378
00:14:33,269 --> 00:14:28,639
designed these observations and got the

379
00:14:35,750 --> 00:14:33,279
data and jennifer is going to

380
00:14:37,189 --> 00:14:35,760
talk about how those data were initially

381
00:14:37,990 --> 00:14:37,199
processed

382
00:14:39,030 --> 00:14:38,000
um

383
00:14:41,189 --> 00:14:39,040
so

384
00:14:44,310 --> 00:14:41,199
take it away jennifer

385
00:14:46,629 --> 00:14:44,320
hi thanks zolt okay

386
00:14:48,790 --> 00:14:46,639
um should i go ahead

387
00:14:51,030 --> 00:14:48,800
yes go ahead okay hi

388
00:14:53,189 --> 00:14:51,040

um so i'm going to give you a bit of a

389
00:14:56,230 --> 00:14:53,199
behind-the-scenes look at how one

390
00:14:58,550 --> 00:14:56,240
designs an observing program with hubble

391
00:15:00,470 --> 00:14:58,560
and then i'll show you some what raw

392
00:15:02,470 --> 00:15:00,480
images look like coming down directly

393
00:15:04,230 --> 00:15:02,480
from the telescope how they

394
00:15:06,790 --> 00:15:04,240
look as they pass through our different

395
00:15:09,189 --> 00:15:06,800
stages of our calibration pipeline

396
00:15:11,269 --> 00:15:09,199
and then how i do some manual work to

397
00:15:13,750 --> 00:15:11,279
really stitch the images together to

398
00:15:17,030 --> 00:15:13,760
form the larger mosaic in the two

399
00:15:27,590 --> 00:15:19,430
so i will go ahead and start sharing my

400
00:15:30,389 --> 00:15:29,110
okay

401
00:15:32,470 --> 00:15:30,399
so

402
00:15:34,230 --> 00:15:32,480
this actually is a ground-based image

403
00:15:36,870 --> 00:15:34,240
which is what we start with

404
00:15:39,350 --> 00:15:36,880
and we take the infrared camera

405
00:15:41,509 --> 00:15:39,360
footprint and we overlay it onto the

406
00:15:43,670 --> 00:15:41,519
image to try to figure out

407
00:15:44,629 --> 00:15:43,680
what where we will be observing this is

408
00:15:46,230 --> 00:15:44,639
our

409
00:15:47,430 --> 00:15:46,240
planning tool for scheduling

410
00:15:49,990 --> 00:15:47,440
observations

411
00:15:51,910 --> 00:15:50,000
so there's the infrared camera and as

412
00:15:53,990 --> 00:15:51,920
you can see it's quite a bit smaller

413
00:15:56,230 --> 00:15:54,000

than the actual horse head itself and so

414
00:15:57,990 --> 00:15:56,240
what we will do is

415
00:16:01,509 --> 00:15:58,000
move the camera around

416
00:16:05,590 --> 00:16:01,519
and then stitch the individual exposures

417
00:16:10,389 --> 00:16:07,910
now actually all of hubble's cameras

418
00:16:13,110 --> 00:16:10,399
have populations of pixels that are

419
00:16:15,590 --> 00:16:13,120
either unstable or have poor response to

420
00:16:18,069 --> 00:16:15,600
light and so we do a little trick

421
00:16:20,150 --> 00:16:18,079
by taking that

422
00:16:22,069 --> 00:16:20,160
first frame and then we do a small shift

423
00:16:23,749 --> 00:16:22,079
so you can see here i'm blinking back

424
00:16:24,710 --> 00:16:23,759
and forth

425
00:16:27,749 --> 00:16:24,720
we've

426
00:16:32,069 --> 00:16:27,759
shifted the telescope by a small amount

427
00:16:35,269 --> 00:16:32,079
and what we can then do is use

428
00:16:37,749 --> 00:16:35,279
the shifted image to replace the pixels

429
00:16:39,749 --> 00:16:37,759
that were bad in the first image so that

430
00:16:41,749 --> 00:16:39,759
therefore then we kind of correct those

431
00:16:43,269 --> 00:16:41,759
artifacts

432
00:16:44,629 --> 00:16:43,279
and i'll talk more about that later when

433
00:16:47,430 --> 00:16:44,639
i show

434
00:16:51,269 --> 00:16:47,440
the actual images

435
00:16:53,670 --> 00:16:51,279
so then we step the telescope around and

436
00:16:54,710 --> 00:16:53,680
this is the full 3x3 mosaic that we

437
00:16:57,509 --> 00:16:54,720
created

438
00:16:59,430 --> 00:16:57,519

which consists of 18 images in the

439
00:17:01,430 --> 00:16:59,440
infrared

440
00:17:03,829 --> 00:17:01,440
now hubble actually has several

441
00:17:06,069 --> 00:17:03,839
operational

442
00:17:08,470 --> 00:17:06,079
on the telescope right now and so for

443
00:17:11,669 --> 00:17:08,480
this program we actually turned on the

444
00:17:13,829 --> 00:17:11,679
advanced camera for surveys as well

445
00:17:15,429 --> 00:17:13,839
and that sees light in the visible part

446
00:17:18,710 --> 00:17:15,439
of the spectrum as opposed to this

447
00:17:21,029 --> 00:17:18,720
infrared light and so these are actually

448
00:17:22,150 --> 00:17:21,039
called parallel observations which is

449
00:17:24,390 --> 00:17:22,160
essentially

450
00:17:25,350 --> 00:17:24,400
turning both cameras on at once and it

451
00:17:28,069 --> 00:17:25,360
gives us

452
00:17:29,990 --> 00:17:28,079
a freebie image of the uh

453
00:17:33,029 --> 00:17:30,000
of the pink squares that are just to the

454
00:17:34,549 --> 00:17:33,039
right of the horse head and so this data

455
00:17:35,909 --> 00:17:34,559
actually will be

456
00:17:37,350 --> 00:17:35,919
released

457
00:17:39,590 --> 00:17:37,360
very soon

458
00:17:42,549 --> 00:17:39,600
for now we'll just focus on the the

459
00:17:44,710 --> 00:17:42,559
infrared observations

460
00:17:46,950 --> 00:17:44,720
so hubble's observing schedule is

461
00:17:48,950 --> 00:17:46,960
actually created a week at a time so

462
00:17:51,110 --> 00:17:48,960
once this program was ready to go we

463
00:17:53,029 --> 00:17:51,120

uploaded we uploaded all the commands to

464
00:17:56,310 --> 00:17:53,039
this telescope

465
00:17:58,150 --> 00:17:56,320
and the data were executed and then we

466
00:18:00,630 --> 00:17:58,160
get the images back

467
00:18:02,789 --> 00:18:00,640
from the telescope and if you've ever

468
00:18:05,190 --> 00:18:02,799
wondered what does a raw infrared image

469
00:18:06,789 --> 00:18:05,200
look like that comes back

470
00:18:08,390 --> 00:18:06,799
when i first looked at this one i said i

471
00:18:09,750 --> 00:18:08,400
don't see any horse head here where is

472
00:18:10,870 --> 00:18:09,760
it

473
00:18:12,230 --> 00:18:10,880
um

474
00:18:14,150 --> 00:18:12,240
well

475
00:18:17,590 --> 00:18:14,160
i'll go to the next image which is the

476
00:18:20,070 --> 00:18:17,600
same 44 second image but now

477
00:18:21,669 --> 00:18:20,080
signal from the detector electronics has

478
00:18:22,870 --> 00:18:21,679
been removed

479
00:18:24,710 --> 00:18:22,880
and so

480
00:18:26,549 --> 00:18:24,720
you can see that there's a couple of

481
00:18:28,070 --> 00:18:26,559
bright stars in the image which show

482
00:18:31,110 --> 00:18:28,080
through in the raw image and they're

483
00:18:33,350 --> 00:18:31,120
also in this calibrated image but you

484
00:18:35,590 --> 00:18:33,360
can now see in the lower right corner

485
00:18:38,390 --> 00:18:35,600
the top part of the horse head and in

486
00:18:43,430 --> 00:18:38,400
addition numerous uh stars and galaxies

487
00:18:46,070 --> 00:18:43,440
in the background of the sky itself

488
00:18:47,909 --> 00:18:46,080

so that's um that's kind of amazing that

489
00:18:49,270 --> 00:18:47,919
the uh the detector

490
00:18:51,110 --> 00:18:49,280
uh it looks like you're you're pulling

491
00:18:53,110 --> 00:18:51,120
signal out of out of nothing i'm pulling

492
00:18:54,870 --> 00:18:53,120
up something out of the air there

493
00:18:57,110 --> 00:18:54,880
yes so it's actually a fairly simple

494
00:18:59,029 --> 00:18:57,120
just subtraction of the detector

495
00:19:00,230 --> 00:18:59,039
electronics we do this calibration to

496
00:19:01,190 --> 00:19:00,240
figure out

497
00:19:02,710 --> 00:19:01,200
um

498
00:19:04,789 --> 00:19:02,720
what that response is and we just

499
00:19:07,510 --> 00:19:04,799
subtract that right out and bam there

500
00:19:08,870 --> 00:19:07,520
here comes the image

501
00:19:10,789 --> 00:19:08,880
i think it's amazing for a lot of our

502
00:19:12,230 --> 00:19:10,799
viewers to see that for the first time

503
00:19:13,590 --> 00:19:12,240
yeah

504
00:19:16,870 --> 00:19:13,600
so

505
00:19:19,590 --> 00:19:16,880
and now this image is actually what a

506
00:19:21,830 --> 00:19:19,600
sub sample of 16 sub images which make

507
00:19:24,710 --> 00:19:21,840
up the full exposure and this is the

508
00:19:25,909 --> 00:19:24,720
full exposure which is a 20 sorry a 12

509
00:19:27,430 --> 00:19:25,919
minute stack

510
00:19:29,750 --> 00:19:27,440
and the primary difference here i'm

511
00:19:31,029 --> 00:19:29,760
going to blink between the two

512
00:19:33,669 --> 00:19:31,039
you may be able to see there's

513
00:19:36,230 --> 00:19:33,679

populations of bright white pixels which

514
00:19:38,390 --> 00:19:36,240
go away when we do the stack those are

515
00:19:40,549 --> 00:19:38,400
actually high energy particles from the

516
00:19:41,350 --> 00:19:40,559
sun called cosmic rays

517
00:19:42,230 --> 00:19:41,360
and

518
00:19:43,909 --> 00:19:42,240
so

519
00:19:47,190 --> 00:19:43,919
with this stack we're able to remove

520
00:19:52,070 --> 00:19:49,669
and next we actually

521
00:19:55,029 --> 00:19:52,080
this is

522
00:19:57,830 --> 00:19:55,039
a further combination down the down the

523
00:20:00,150 --> 00:19:57,840
path we take the two pairs of images

524
00:20:02,950 --> 00:20:00,160
that have been slightly shifted

525
00:20:05,830 --> 00:20:02,960
we correct for geometric distortion of

526
00:20:07,510 --> 00:20:05,840
the camera sounds very technical here

527
00:20:10,789 --> 00:20:07,520
but what you'll notice is that what

528
00:20:14,310 --> 00:20:10,799
started out as a square looking image

529
00:20:17,190 --> 00:20:14,320
now becomes more rectangular and what we

530
00:20:19,029 --> 00:20:17,200
do is we take out geometric distortion

531
00:20:22,230 --> 00:20:19,039
which ends up making all of the pixels

532
00:20:24,070 --> 00:20:22,240
equal area on the sky

533
00:20:26,230 --> 00:20:24,080
in addition you'll you may be able to

534
00:20:29,110 --> 00:20:26,240
see this but there's still some white

535
00:20:31,750 --> 00:20:29,120
pixels in this stacked image and those

536
00:20:33,430 --> 00:20:31,760
are actually bad detector pixels and so

537
00:20:35,830 --> 00:20:33,440
when i talked about how we shift the

538
00:20:37,669 --> 00:20:35,840

telescope by a small amount we can

539
00:20:39,669 --> 00:20:37,679
actually fill those in from the second

540
00:20:44,310 --> 00:20:39,679
exposure and we get this higher signal

541
00:20:44,320 --> 00:20:47,590
all right so

542
00:20:51,590 --> 00:20:48,950
next

543
00:20:54,390 --> 00:20:51,600
now this is an image where i just take

544
00:20:55,750 --> 00:20:54,400
all of the nine individual tiles and put

545
00:20:57,750 --> 00:20:55,760
them together

546
00:20:59,350 --> 00:20:57,760
with a new software we have here called

547
00:21:02,470 --> 00:20:59,360
astro drizzle which takes out the

548
00:21:04,070 --> 00:21:02,480
distortion and it knows about where we

549
00:21:05,590 --> 00:21:04,080
pointed the telescope and it tries to

550
00:21:08,070 --> 00:21:05,600
put them all together

551
00:21:09,750 --> 00:21:08,080
and it's a three and a half hour

552
00:21:11,190 --> 00:21:09,760
combined exposure

553
00:21:12,710 --> 00:21:11,200
and you'll notice

554
00:21:14,549 --> 00:21:12,720
the first thing that jumps out is it's

555
00:21:16,870 --> 00:21:14,559
not really continuous across the image

556
00:21:18,789 --> 00:21:16,880
there's offsets in how it's estimated

557
00:21:21,830 --> 00:21:18,799
the sky background and so i actually go

558
00:21:23,830 --> 00:21:21,840
in and measure the sky and

559
00:21:24,710 --> 00:21:23,840
take that out so we have this is the

560
00:21:27,190 --> 00:21:24,720
final

561
00:21:31,990 --> 00:21:27,200
nice combined image in

562
00:21:37,430 --> 00:21:34,549
and this is the corresponding exposure

563
00:21:39,190 --> 00:21:37,440

time map so just to go back to the

564
00:21:40,870 --> 00:21:39,200
original planning of the observations

565
00:21:44,310 --> 00:21:40,880
you can see how this is stitched

566
00:21:46,230 --> 00:21:44,320
together from non-individual

567
00:21:47,029 --> 00:21:46,240
uh pointings

568
00:21:49,270 --> 00:21:47,039
and

569
00:21:51,990 --> 00:21:49,280
you can also see the the black little

570
00:21:54,149 --> 00:21:52,000
circles here are regions on the detector

571
00:21:56,070 --> 00:21:54,159
which have poor response to light and so

572
00:21:58,549 --> 00:21:56,080
we do this shift so that we can fill

573
00:22:02,630 --> 00:22:00,549
in the final image so you get a nice

574
00:22:05,669 --> 00:22:02,640
clean composite

575
00:22:08,789 --> 00:22:05,679
and now we do one other little trick

576
00:22:11,110 --> 00:22:08,799
the white images sorry the white

577
00:22:13,270 --> 00:22:11,120
regions are actually

578
00:22:15,669 --> 00:22:13,280
regions of higher exposure time so

579
00:22:19,669 --> 00:22:15,679
that's where there's overlap between the

580
00:22:22,630 --> 00:22:19,679
tiles and we can use stars and galaxies

581
00:22:24,390 --> 00:22:22,640
that fall in those regions to solve

582
00:22:27,029 --> 00:22:24,400
for

583
00:22:28,870 --> 00:22:27,039
any resid remaining shifts between the

584
00:22:30,789 --> 00:22:28,880
images so really to just kind of fine

585
00:22:33,270 --> 00:22:30,799
tune it's like tightening a wheel kind

586
00:22:36,230 --> 00:22:33,280
of tighten up the alignment and get this

587
00:22:39,029 --> 00:22:36,240
this thing together a little bit better

588
00:22:42,070 --> 00:22:39,039

so i'm actually going to zoom in here to

589
00:22:45,350 --> 00:22:42,080
the region that's shown in the blue box

590
00:22:48,149 --> 00:22:45,360
just it'll show you um the overlap

591
00:22:50,070 --> 00:22:48,159
regions in the upper right corner of the

592
00:22:51,590 --> 00:22:50,080
mosaic

593
00:22:53,909 --> 00:22:51,600
and so this is

594
00:22:56,230 --> 00:22:53,919
what it looks like in that stacked image

595
00:22:58,710 --> 00:22:56,240
and i'm going to blink with the one

596
00:23:00,390 --> 00:22:58,720
after i've aligned after i've fine-tuned

597
00:23:02,470 --> 00:23:00,400
the alignment

598
00:23:05,270 --> 00:23:02,480
so i'm not sure if this shows how this

599
00:23:07,510 --> 00:23:05,280
shows up out there for the viewers but

600
00:23:09,990 --> 00:23:07,520
what you end up seeing is there's some

601
00:23:12,950 --> 00:23:10,000
shifts in between the little squares

602
00:23:14,630 --> 00:23:12,960
and in addition i've circled in blue

603
00:23:16,470 --> 00:23:14,640
some little sources some of those are

604
00:23:17,990 --> 00:23:16,480
stars and galaxies those are the ones

605
00:23:19,909 --> 00:23:18,000
that we use to

606
00:23:22,470 --> 00:23:19,919
to correct the alignment

607
00:23:24,070 --> 00:23:22,480
and in the original image those were

608
00:23:25,990 --> 00:23:24,080
actually rejected

609
00:23:27,590 --> 00:23:26,000
they were they were the software

610
00:23:29,029 --> 00:23:27,600
identified them as bad pixels because

611
00:23:31,029 --> 00:23:29,039
they were there in one but not in the

612
00:23:34,149 --> 00:23:31,039
other but then when we get the alignment

613
00:23:36,549 --> 00:23:34,159

correct then they all pop back in

614
00:23:39,270 --> 00:23:36,559
and so that's kind of the behind the

615
00:23:41,110 --> 00:23:39,280
scenes on how do you create these large

616
00:23:43,990 --> 00:23:41,120
mosaics

617
00:23:46,070 --> 00:23:44,000
and i just wanted to advertise that

618
00:23:49,110 --> 00:23:46,080
all of this processing now

619
00:23:51,190 --> 00:23:49,120
is resulted in these high-level data

620
00:23:53,190 --> 00:23:51,200
products and these are available for the

621
00:23:56,230 --> 00:23:53,200
public they're available for anyone

622
00:23:58,789 --> 00:23:56,240
who'd like to go in grab the fits images

623
00:24:01,190 --> 00:23:58,799
for these advanced image processors you

624
00:24:02,870 --> 00:24:01,200
can go uh go in and get the two filter

625
00:24:05,270 --> 00:24:02,880
images and you can make your own color

626
00:24:07,110 --> 00:24:05,280
composite or for scientists who want to

627
00:24:09,029 --> 00:24:07,120
go in and actually do science

628
00:24:11,110 --> 00:24:09,039
this is the first release of this data

629
00:24:13,590 --> 00:24:11,120
it's available for anyone who wants to

630
00:24:14,470 --> 00:24:13,600
do science research on this target right

631
00:24:16,310 --> 00:24:14,480
now

632
00:24:20,070 --> 00:24:16,320
and we're very excited to make this

633
00:24:21,590 --> 00:24:20,080
available to the public and additionally

634
00:24:23,590 --> 00:24:21,600
another thing you can do is when you get

635
00:24:25,830 --> 00:24:23,600
the individual filter images you can

636
00:24:27,669 --> 00:24:25,840
play with the dynamic range and

637
00:24:30,470 --> 00:24:27,679
look at things like focusing on the

638
00:24:32,390 --> 00:24:30,480

background galaxy zoom right

639
00:24:34,710 --> 00:24:32,400
right up to the horse head and look at

640
00:24:36,950 --> 00:24:34,720
the fine details of the filament

641
00:24:38,710 --> 00:24:36,960
filamentary dust and gas features and

642
00:24:41,269 --> 00:24:38,720
it's just absolutely a beautiful data

643
00:24:49,350 --> 00:24:41,279
set so i'd encourage anybody who wants

644
00:24:53,029 --> 00:24:51,830
so i'll hand it over to zolt uh

645
00:24:55,190 --> 00:24:53,039
who will be

646
00:24:58,789 --> 00:24:55,200
showing how you take those two filter

647
00:25:00,549 --> 00:24:58,799
images now and create a color composite

648
00:25:02,710 --> 00:25:00,559
all right

649
00:25:04,230 --> 00:25:02,720
thanks jennifer really appreciate that

650
00:25:07,750 --> 00:25:04,240
and uh

651
00:25:09,669 --> 00:25:07,760
this is uh just a phenomenal data set

652
00:25:10,789 --> 00:25:09,679
so i will go back

653
00:25:14,149 --> 00:25:10,799
um

654
00:25:20,710 --> 00:25:14,159
to my little presentation here

655
00:25:20,720 --> 00:25:23,590
okay

656
00:25:29,909 --> 00:25:26,310
and so uh

657
00:25:31,510 --> 00:25:29,919
jennifer showed basically one

658
00:25:33,590 --> 00:25:31,520
went through the process for one image

659
00:25:35,669 --> 00:25:33,600
but we actually took data through two

660
00:25:38,310 --> 00:25:35,679
different filters these are both

661
00:25:40,230 --> 00:25:38,320
infrared filters in the infrared cam

662
00:25:42,630 --> 00:25:40,240
from the infrared camera

663
00:25:45,830 --> 00:25:42,640

so these are the two

664
00:25:47,110 --> 00:25:45,840
nicely composited nicely mosaic data

665
00:25:49,350 --> 00:25:47,120
sets that we

666
00:25:51,590 --> 00:25:49,360
ended up with uh

667
00:25:53,909 --> 00:25:51,600
so one of the uh there's there as i said

668
00:25:55,350 --> 00:25:53,919
two filters in the infrared

669
00:25:57,430 --> 00:25:55,360
one is

670
00:25:59,990 --> 00:25:57,440
1.1 microns

671
00:26:01,110 --> 00:26:00,000
and the other is 1.6 microns so they're

672
00:26:02,950 --> 00:26:01,120
not too

673
00:26:04,390 --> 00:26:02,960
far apart in terms of wavelength but

674
00:26:05,990 --> 00:26:04,400
they

675
00:26:07,750 --> 00:26:06,000
as you might see

676
00:26:09,510 --> 00:26:07,760
they they do show slightly different

677
00:26:10,710 --> 00:26:09,520
things and

678
00:26:13,269 --> 00:26:10,720
uh

679
00:26:16,310 --> 00:26:13,279
but but our goal was to produce a color

680
00:26:17,990 --> 00:26:16,320
image and so using these two data sets

681
00:26:19,110 --> 00:26:18,000
we can produce a color image now

682
00:26:21,350 --> 00:26:19,120
normally

683
00:26:24,630 --> 00:26:21,360
we use three

684
00:26:28,470 --> 00:26:24,640
three images uh because we normally work

685
00:26:30,789 --> 00:26:28,480
with a three color visual model

686
00:26:32,950 --> 00:26:30,799
we use the three primary colors red

687
00:26:35,990 --> 00:26:32,960
green and blue

688
00:26:38,470 --> 00:26:36,000

and using those three primary colors and

689
00:26:40,950 --> 00:26:38,480
the ratios and the brightness at any

690
00:26:44,470 --> 00:26:40,960
pixel in those three

691
00:26:45,669 --> 00:26:44,480
colors determines the final color of of

692
00:26:47,350 --> 00:26:45,679
the image

693
00:26:50,310 --> 00:26:47,360
and you can from those three colors you

694
00:26:51,669 --> 00:26:50,320
can construct essentially any color that

695
00:26:53,750 --> 00:26:51,679
that we can see

696
00:26:56,789 --> 00:26:53,760
now in this case we only had two filters

697
00:26:59,750 --> 00:26:56,799
to work with and so we used two colors

698
00:27:01,350 --> 00:26:59,760
now if we use two complementary colors

699
00:27:02,950 --> 00:27:01,360
in this case blue

700
00:27:06,549 --> 00:27:02,960
and red

701
00:27:09,029 --> 00:27:06,559
to assign to the black and white images

702
00:27:12,789 --> 00:27:09,039
those will also add to

703
00:27:14,950 --> 00:27:12,799
to white to gray so

704
00:27:16,149 --> 00:27:14,960
so this is what we did we

705
00:27:20,630 --> 00:27:16,159
we

706
00:27:24,470 --> 00:27:20,640
assigned blue

707
00:27:26,710 --> 00:27:24,480
to the 1.1 micron image and red to the

708
00:27:28,950 --> 00:27:26,720
1.6 micron image which is a longer

709
00:27:30,549 --> 00:27:28,960
wavelength a redder color now we're

710
00:27:32,310 --> 00:27:30,559
talking about infrared light here light

711
00:27:34,230 --> 00:27:32,320
that we cannot see

712
00:27:36,390 --> 00:27:34,240
but there are still colors within the

713
00:27:38,149 --> 00:27:36,400

infrared in a sense they're different

714
00:27:39,990 --> 00:27:38,159
wavelengths the different wavelengths of

715
00:27:42,549 --> 00:27:40,000
visible light produce the different

716
00:27:45,510 --> 00:27:42,559
colors for our perception

717
00:27:47,430 --> 00:27:45,520
uh in the same way in the infrared

718
00:27:49,430 --> 00:27:47,440
there are different wavelengths of light

719
00:27:51,750 --> 00:27:49,440
in essence different colors

720
00:27:53,909 --> 00:27:51,760
even though we can't perceive them

721
00:27:56,389 --> 00:27:53,919
but we can produce a multi-color image

722
00:27:57,990 --> 00:27:56,399
in the infrared just like we can produce

723
00:27:59,909 --> 00:27:58,000
a multi-color image in the visible so

724
00:28:01,430 --> 00:27:59,919
that's what we did again we assigned

725
00:28:03,430 --> 00:28:01,440
blue to the

726
00:28:06,149 --> 00:28:03,440
shorter wavelength image and red to the

727
00:28:09,669 --> 00:28:06,159
longer wavelength image

728
00:28:11,269 --> 00:28:09,679
we composite those two images together

729
00:28:12,950 --> 00:28:11,279
in a way which

730
00:28:15,669 --> 00:28:12,960
which blends them

731
00:28:17,510 --> 00:28:15,679
and this is the result we come up with

732
00:28:19,029 --> 00:28:17,520
you can see there's a range of colors

733
00:28:20,710 --> 00:28:19,039
there's some stuff that looks bluer and

734
00:28:23,430 --> 00:28:20,720
some stuff that looks redder because we

735
00:28:25,909 --> 00:28:23,440
have a red image and a blue image

736
00:28:27,750 --> 00:28:25,919
it's a little bit pale and and very

737
00:28:29,110 --> 00:28:27,760
ghostly

738
00:28:30,789 --> 00:28:29,120

and the first thing we notice when we

739
00:28:33,190 --> 00:28:30,799
look at this image is that it's kind of

740
00:28:35,350 --> 00:28:33,200
a negative of the visible light image

741
00:28:37,190 --> 00:28:35,360
i'll say a little bit more about that

742
00:28:39,510 --> 00:28:37,200
later i want to talk a little bit more

743
00:28:41,190 --> 00:28:39,520
about the technical stuff about about

744
00:28:43,909 --> 00:28:41,200
putting the image together

745
00:28:46,230 --> 00:28:43,919
so again this is the kind of draft first

746
00:28:49,110 --> 00:28:46,240
draft of the image as we first see it

747
00:28:50,549 --> 00:28:49,120
when we composite the two color filter

748
00:28:52,710 --> 00:28:50,559
images together

749
00:28:54,389 --> 00:28:52,720
we can apply some adjustments we can

750
00:28:59,190 --> 00:28:54,399
apply adjust the

751
00:29:01,669 --> 00:28:59,200
contrast uh tweak the color a little bit

752
00:29:04,230 --> 00:29:01,679
and and this is more what we this is

753
00:29:06,630 --> 00:29:04,240
more of a final image we've also

754
00:29:08,950 --> 00:29:06,640
cropped it i'll go back to the previous

755
00:29:12,389 --> 00:29:08,960
image this is the full mosaic image and

756
00:29:13,830 --> 00:29:12,399
you can see interestingly that

757
00:29:16,310 --> 00:29:13,840
what i always

758
00:29:18,950 --> 00:29:16,320
often have to

759
00:29:21,190 --> 00:29:18,960
marvel at is is how

760
00:29:23,190 --> 00:29:21,200
uh precise and repeatable hubble

761
00:29:26,470 --> 00:29:23,200
observations are so

762
00:29:28,950 --> 00:29:26,480
the images and the two filters

763
00:29:30,710 --> 00:29:28,960

are at nine different locations

764
00:29:32,470 --> 00:29:30,720
and in fact there are dither positions

765
00:29:34,710 --> 00:29:32,480
as jennifer was describing so there's

766
00:29:37,430 --> 00:29:34,720
actually 18 different positions of the

767
00:29:39,830 --> 00:29:37,440
telescope had but in the two filters

768
00:29:41,590 --> 00:29:39,840
those those positions

769
00:29:42,470 --> 00:29:41,600
absolutely overlapped

770
00:29:44,710 --> 00:29:42,480
um

771
00:29:47,990 --> 00:29:44,720
so you can see that the edges are all

772
00:29:50,870 --> 00:29:48,000
are all overlapped in both the images we

773
00:29:52,149 --> 00:29:50,880
we cropped off those uh somewhat uneven

774
00:29:55,430 --> 00:29:52,159
edges and ended up with this nice

775
00:29:57,110 --> 00:29:55,440
rectangular image so this is our final

776
00:29:59,430 --> 00:29:57,120
image and there's a lot of interesting

777
00:30:00,630 --> 00:29:59,440
things we can immediately see in this

778
00:30:03,190 --> 00:30:00,640
image

779
00:30:05,510 --> 00:30:03,200
but before i get to that i want to talk

780
00:30:07,029 --> 00:30:05,520
and one of the things we do aside from

781
00:30:09,430 --> 00:30:07,039
color adjustments and contrast

782
00:30:10,310 --> 00:30:09,440
adjustments so forth is

783
00:30:11,990 --> 00:30:10,320
is

784
00:30:13,510 --> 00:30:12,000
sort of clean up the image a little bit

785
00:30:15,590 --> 00:30:13,520
and there are some additional

786
00:30:17,430 --> 00:30:15,600
instrumental artifacts that are

787
00:30:19,750 --> 00:30:17,440
introduced which don't get taken out by

788
00:30:21,590 --> 00:30:19,760

the routine processing that jennifer was

789
00:30:24,389 --> 00:30:21,600
was describing

790
00:30:28,070 --> 00:30:24,399
one of which is as one of these um

791
00:30:30,870 --> 00:30:28,080
patches of uh essentially dead pixels so

792
00:30:33,590 --> 00:30:30,880
at the upper left corner of the this of

793
00:30:36,070 --> 00:30:33,600
this slide you see sort of a

794
00:30:38,070 --> 00:30:36,080
almost circular patch of kind of gray

795
00:30:39,190 --> 00:30:38,080
and black pixels

796
00:30:43,669 --> 00:30:39,200
this is what

797
00:30:49,029 --> 00:30:46,389
imaginatively called the death star

798
00:30:51,669 --> 00:30:49,039
the area on the detector which which is

799
00:30:53,190 --> 00:30:51,679
uh the detector doesn't work in that

800
00:30:54,070 --> 00:30:53,200
small area

801
00:30:54,870 --> 00:30:54,080
now

802
00:30:56,950 --> 00:30:54,880
most

803
00:30:59,830 --> 00:30:56,960
this happens this is one spot on the

804
00:31:02,549 --> 00:30:59,840
detector so we've taken our nine fields

805
00:31:05,350 --> 00:31:02,559
in the image those that spot is in each

806
00:31:07,110 --> 00:31:05,360
of those nine fields but fortunately

807
00:31:08,310 --> 00:31:07,120
there was enough overlap we designed the

808
00:31:10,630 --> 00:31:08,320
observations this way so there was

809
00:31:11,909 --> 00:31:10,640
enough overlap in the rest of the image

810
00:31:14,470 --> 00:31:11,919
so that

811
00:31:16,470 --> 00:31:14,480
there was good a good image to overlap

812
00:31:20,070 --> 00:31:16,480
the place where the death star was on

813
00:31:21,830 --> 00:31:20,080

this corner on this edge of the image uh

814
00:31:24,070 --> 00:31:21,840
there was no other image to overlap

815
00:31:26,389 --> 00:31:24,080
there so it appears and we didn't want

816
00:31:29,510 --> 00:31:26,399
to crop any more of the image off so we

817
00:31:30,630 --> 00:31:29,520
left we left that spot there however

818
00:31:34,070 --> 00:31:30,640
we can

819
00:31:36,470 --> 00:31:34,080
retouch that with kind of standard uh

820
00:31:38,230 --> 00:31:36,480
rubber stamp or cloning tools it's in a

821
00:31:39,909 --> 00:31:38,240
relatively blank area of the image so

822
00:31:42,789 --> 00:31:39,919
we're pretty sure that there's not

823
00:31:45,190 --> 00:31:42,799
anything significant back there so we we

824
00:31:46,789 --> 00:31:45,200
essentially retouched it we retouched it

825
00:31:48,310 --> 00:31:46,799
out with no

826
00:31:50,070 --> 00:31:48,320
great ill effect on the right hand side

827
00:31:51,909 --> 00:31:50,080
you see on the left hand side is a

828
00:31:53,269 --> 00:31:51,919
single filter image

829
00:31:54,549 --> 00:31:53,279
on the right hand side is the color

830
00:31:55,590 --> 00:31:54,559
composite

831
00:31:57,669 --> 00:31:55,600
with

832
00:32:00,389 --> 00:31:57,679
all the color compositing and

833
00:32:01,509 --> 00:32:00,399
adjustments done and also with that that

834
00:32:03,750 --> 00:32:01,519
little patch

835
00:32:04,630 --> 00:32:03,760
retouched

836
00:32:06,389 --> 00:32:04,640
yes

837
00:32:07,830 --> 00:32:06,399
i would just like to point out that the

838
00:32:10,470 --> 00:32:07,840

purpose of this is not to change the

839
00:32:13,269 --> 00:32:10,480
image but it is to correct for defects

840
00:32:15,350 --> 00:32:13,279
of the observing so that we want the

841
00:32:17,590 --> 00:32:15,360
uh the universe pixels to come through

842
00:32:19,750 --> 00:32:17,600
we're not changing anything to try and

843
00:32:21,269 --> 00:32:19,760
you know play with it we're really just

844
00:32:22,710 --> 00:32:21,279
getting rid of the the defects and the

845
00:32:24,710 --> 00:32:22,720
observation system

846
00:32:26,950 --> 00:32:24,720
right it's stuff that the the telescope

847
00:32:28,789 --> 00:32:26,960
and cameras put in and not what's uh

848
00:32:30,549 --> 00:32:28,799
we're not chained we're hoping we're not

849
00:32:32,230 --> 00:32:30,559
changing anything that's actually out

850
00:32:33,909 --> 00:32:32,240
there on the sky

851
00:32:35,029 --> 00:32:33,919
the bottom pair of images is a little

852
00:32:37,269 --> 00:32:35,039
bit different

853
00:32:38,389 --> 00:32:37,279
uh so this shows a piece of the image

854
00:32:40,789 --> 00:32:38,399
that's up in the

855
00:32:42,789 --> 00:32:40,799
up in the top edge and you can see a

856
00:32:44,070 --> 00:32:42,799
fairly bright star that's right there at

857
00:32:45,430 --> 00:32:44,080
the edge of the image on the left hand

858
00:32:47,430 --> 00:32:45,440
side part of the

859
00:32:49,110 --> 00:32:47,440
slide lower left part of the slide

860
00:32:51,509 --> 00:32:49,120
there's a very fairly bright star that's

861
00:32:53,430 --> 00:32:51,519
right on the edge of the frame now

862
00:32:54,630 --> 00:32:53,440
we're not really fond of having stars

863
00:32:56,149 --> 00:32:54,640

right at the edge of the frame because

864
00:32:58,230 --> 00:32:56,159
they become more distracting than

865
00:33:00,149 --> 00:32:58,240
anything else so we wanted to crop that

866
00:33:01,190 --> 00:33:00,159
out now if we crop that out we're left

867
00:33:04,070 --> 00:33:01,200
with these

868
00:33:05,830 --> 00:33:04,080
lines on the image which uh astronomers

869
00:33:07,669 --> 00:33:05,840
call diffraction spikes

870
00:33:10,389 --> 00:33:07,679
which are the result of light bouncing

871
00:33:13,830 --> 00:33:10,399
around in the in the telescope structure

872
00:33:16,470 --> 00:33:13,840
and uh causing this light to to appear

873
00:33:18,470 --> 00:33:16,480
in on on the image itself and again it's

874
00:33:19,350 --> 00:33:18,480
not something that's

875
00:33:21,990 --> 00:33:19,360
uh

876
00:33:23,430 --> 00:33:22,000
an obvious part of the star itself it's

877
00:33:25,190 --> 00:33:23,440
it's part of the

878
00:33:27,190 --> 00:33:25,200
result of the optics and the camera and

879
00:33:29,909 --> 00:33:27,200
the telescope rather

880
00:33:31,110 --> 00:33:29,919
so we removed the star and so we thought

881
00:33:33,190 --> 00:33:31,120
we really ought to remove the

882
00:33:35,669 --> 00:33:33,200
diffraction spikes as well since a

883
00:33:36,870 --> 00:33:35,679
diffraction spike without a star is is

884
00:33:38,950 --> 00:33:36,880
pretty weird

885
00:33:40,470 --> 00:33:38,960
so we went ahead and took those

886
00:33:42,389 --> 00:33:40,480
diffraction spikes out we really didn't

887
00:33:43,430 --> 00:33:42,399
have to do a very much else this was a

888
00:33:47,350 --> 00:33:43,440

really very

889
00:33:49,830 --> 00:33:48,630
so now

890
00:33:51,430 --> 00:33:49,840
i'd like to concentrate a little bit of

891
00:33:53,990 --> 00:33:51,440
what we're seeing in this in this

892
00:33:57,110 --> 00:33:54,000
amazing image so here's a comparison

893
00:33:58,070 --> 00:33:57,120
between our 2001 with the 2 image on the

894
00:34:01,590 --> 00:33:58,080
left

895
00:34:03,350 --> 00:34:01,600
and our brand new with with c3 image

896
00:34:04,870 --> 00:34:03,360
infrared image on the right so again the

897
00:34:07,190 --> 00:34:04,880
image on the left was made in visible

898
00:34:08,869 --> 00:34:07,200
light and the image on the right is made

899
00:34:10,310 --> 00:34:08,879
in infrared light so immediately you can

900
00:34:11,589 --> 00:34:10,320
see there's a big difference in the

901
00:34:13,669 --> 00:34:11,599
sense that

902
00:34:16,790 --> 00:34:13,679
almost everything that's dark in the

903
00:34:18,629 --> 00:34:16,800
visible light image is bright in the

904
00:34:20,629 --> 00:34:18,639
infrared light image except for the

905
00:34:23,109 --> 00:34:20,639
stars now there aren't as many stars

906
00:34:25,109 --> 00:34:23,119
visible in the visible light image which

907
00:34:27,190 --> 00:34:25,119
is one of the other major differences so

908
00:34:28,710 --> 00:34:27,200
we see a lot more stars and that's

909
00:34:31,589 --> 00:34:28,720
primarily because

910
00:34:34,790 --> 00:34:31,599
uh the starlight the visible star light

911
00:34:36,869 --> 00:34:34,800
is being absorbed by the dust that's the

912
00:34:39,030 --> 00:34:36,879
relatively dense dust in this region

913
00:34:42,790 --> 00:34:39,040

which is causing this whole

914
00:34:44,869 --> 00:34:42,800
appearance of this of this object

915
00:34:47,270 --> 00:34:44,879
also again the the

916
00:34:48,869 --> 00:34:47,280
darkest areas of the nebula are actually

917
00:34:51,430 --> 00:34:48,879
in the visible are

918
00:34:53,589 --> 00:34:51,440
brighter in the infrared

919
00:34:55,030 --> 00:34:53,599
another uh because we're seeing that

920
00:34:58,550 --> 00:34:55,040
we're seeing the

921
00:35:01,190 --> 00:34:58,560
uh glow of that dust uh

922
00:35:02,390 --> 00:35:01,200
whereas in the in the visible the the

923
00:35:05,430 --> 00:35:02,400
dust is is

924
00:35:07,270 --> 00:35:05,440
is is uh absorbing all the light that's

925
00:35:09,510 --> 00:35:07,280
coming from behind it

926
00:35:11,190 --> 00:35:09,520
uh and also in the the top part of the

927
00:35:13,829 --> 00:35:11,200
image you see that's very bright in the

928
00:35:15,430 --> 00:35:13,839
visible light and very dark in the

929
00:35:16,630 --> 00:35:15,440
infrared in fact it's entirely

930
00:35:18,550 --> 00:35:16,640
transparent

931
00:35:20,310 --> 00:35:18,560
in the infrared what we're seeing

932
00:35:22,150 --> 00:35:20,320
on the top part of the image in the

933
00:35:24,390 --> 00:35:22,160
infrared light is seeing

934
00:35:27,510 --> 00:35:24,400
straight through this nebular region

935
00:35:29,190 --> 00:35:27,520
this very region of very fairly dense

936
00:35:31,270 --> 00:35:29,200
gas and dust we're seeing right through

937
00:35:34,310 --> 00:35:31,280
it and we're seeing stars but we're also

938
00:35:35,349 --> 00:35:34,320

seeing very distant galaxies

939
00:35:37,270 --> 00:35:35,359
uh

940
00:35:39,430 --> 00:35:37,280
in fact i believe i have another slide

941
00:35:41,030 --> 00:35:39,440
which zooms farther in

942
00:35:43,990 --> 00:35:41,040
and you can see these galaxies very

943
00:35:45,910 --> 00:35:44,000
clearly there's nice little spirals and

944
00:35:47,750 --> 00:35:45,920
actually they're large galaxies just

945
00:35:50,150 --> 00:35:47,760
like our own they're giant galaxies but

946
00:35:53,910 --> 00:35:50,160
they're very very far away so they look

947
00:35:55,750 --> 00:35:53,920
tiny we're seeing uh face on spirals

948
00:35:57,589 --> 00:35:55,760
we're seeing edge on spirals we're

949
00:35:58,950 --> 00:35:57,599
probably seeing a few ellipticals here

950
00:36:00,230 --> 00:35:58,960
and there

951
00:36:02,470 --> 00:36:00,240
uh

952
00:36:04,470 --> 00:36:02,480
and in fact it looks there's a you know

953
00:36:05,990 --> 00:36:04,480
it's a pretty dense region of galaxies

954
00:36:07,589 --> 00:36:06,000
i'm wondering if it's even a cluster of

955
00:36:09,670 --> 00:36:07,599
galaxies

956
00:36:11,270 --> 00:36:09,680
uh so these are the this is i would add

957
00:36:13,190 --> 00:36:11,280
that this is actually also a kind of

958
00:36:14,950 --> 00:36:13,200
analogous to the hubble deep field

959
00:36:18,390 --> 00:36:14,960
images where they look at a blank part

960
00:36:20,710 --> 00:36:18,400
of the sky and these little baby

961
00:36:22,550 --> 00:36:20,720
galaxies from early in the universe the

962
00:36:23,990 --> 00:36:22,560
light just comes through so since we

963
00:36:26,950 --> 00:36:24,000

have this kind of deep

964
00:36:28,870 --> 00:36:26,960
exposure this is this is light from the

965
00:36:31,510 --> 00:36:28,880
universe really in its infancy that's

966
00:36:32,870 --> 00:36:31,520
coming through behind the horse head

967
00:36:34,470 --> 00:36:32,880
yes and you have to remember too that

968
00:36:35,430 --> 00:36:34,480
this is infrared light so we're seeing

969
00:36:36,550 --> 00:36:35,440
light

970
00:36:39,349 --> 00:36:36,560
it's a little bit different from the

971
00:36:41,589 --> 00:36:39,359
usual uh deep images but in in fact

972
00:36:44,790 --> 00:36:41,599
that's true almost every

973
00:36:46,790 --> 00:36:44,800
uh fairly long exposure with hubble you

974
00:36:48,230 --> 00:36:46,800
see this field of galaxies back there so

975
00:36:50,870 --> 00:36:48,240
that's really what the universe looks

976
00:36:52,870 --> 00:36:50,880
like back there there are places like

977
00:36:54,790 --> 00:36:52,880
like the orion region where

978
00:36:56,950 --> 00:36:54,800
invisible light this is this is

979
00:36:59,430 --> 00:36:56,960
primarily obscured we don't see this at

980
00:37:02,069 --> 00:36:59,440
all but now in the infrared it becomes

981
00:37:03,670 --> 00:37:02,079
transparent we can see this background

982
00:37:05,990 --> 00:37:03,680
uh

983
00:37:07,589 --> 00:37:06,000
background and galaxies

984
00:37:09,270 --> 00:37:07,599
so uh

985
00:37:12,069 --> 00:37:09,280
the other the last thing we kind of want

986
00:37:14,790 --> 00:37:12,079
to talk about was a 3d visualization

987
00:37:17,190 --> 00:37:14,800
that we made and this is playing

988
00:37:18,870 --> 00:37:17,200

this is a little movie

989
00:37:21,510 --> 00:37:18,880
of uh this

990
00:37:23,109 --> 00:37:21,520
visualization that we made so

991
00:37:24,230 --> 00:37:23,119
we have no

992
00:37:26,950 --> 00:37:24,240
actual

993
00:37:27,829 --> 00:37:26,960
information uh numerical information

994
00:37:30,310 --> 00:37:27,839
about

995
00:37:32,310 --> 00:37:30,320
what them looks like in three in the

996
00:37:33,670 --> 00:37:32,320
third dimension however we have some

997
00:37:35,270 --> 00:37:33,680
pretty good ideas by looking at the

998
00:37:37,750 --> 00:37:35,280
image and kind of understanding what

999
00:37:39,829 --> 00:37:37,760
this area

1000
00:37:41,510 --> 00:37:39,839
is in fact

1001
00:37:43,589 --> 00:37:41,520
we have pretty good idea what this

1002
00:37:46,150 --> 00:37:43,599
should look like in in the third

1003
00:37:48,710 --> 00:37:46,160
dimension so what we've done is produced

1004
00:37:51,829 --> 00:37:48,720
this visualization

1005
00:37:53,990 --> 00:37:51,839
with 3d modeling techniques uh combined

1006
00:37:57,349 --> 00:37:54,000
with the actual image

1007
00:37:58,550 --> 00:37:57,359
and produce this uh visualization so

1008
00:38:00,550 --> 00:37:58,560
uh

1009
00:38:02,950 --> 00:38:00,560
frank would you like to talk a little

1010
00:38:05,030 --> 00:38:02,960
bit more about how we produce this and

1011
00:38:06,710 --> 00:38:05,040
some of the background for this

1012
00:38:08,310 --> 00:38:06,720
okay but i'm going to use your slides

1013
00:38:10,870 --> 00:38:08,320

right yes

1014
00:38:13,190 --> 00:38:10,880
so let me go back to this

1015
00:38:15,750 --> 00:38:13,200
uh right

1016
00:38:17,030 --> 00:38:15,760
um so why don't you

1017
00:38:18,950 --> 00:38:17,040
so we're going to go to the next slider

1018
00:38:20,230 --> 00:38:18,960
we want to play this yeah let's go to

1019
00:38:21,109 --> 00:38:20,240
the next slide

1020
00:38:23,190 --> 00:38:21,119
okay

1021
00:38:25,990 --> 00:38:23,200
or you can try playing it again i i what

1022
00:38:29,270 --> 00:38:27,510
is it playing

1023
00:38:30,310 --> 00:38:29,280
i lost it on

1024
00:38:31,589 --> 00:38:30,320
oh

1025
00:38:33,829 --> 00:38:31,599
i see it

1026
00:38:36,310 --> 00:38:33,839
okay

1027
00:38:39,510 --> 00:38:36,320
i don't see it

1028
00:38:44,310 --> 00:38:41,670
result i've got your

1029
00:38:46,710 --> 00:38:44,320
there we go now it's back up

1030
00:38:51,510 --> 00:38:46,720
okay

1031
00:38:54,150 --> 00:38:51,520
you can see it plays a little steppy

1032
00:38:57,349 --> 00:38:54,160
here we can i will post the url on the

1033
00:38:58,790 --> 00:38:57,359
hangout page so you can go to the

1034
00:39:01,030 --> 00:38:58,800
space the

1035
00:39:03,829 --> 00:39:01,040
hubble site website and download it

1036
00:39:06,470 --> 00:39:03,839
so this is the 3d visualization um

1037
00:39:09,109 --> 00:39:06,480
broken apart into planes

1038
00:39:12,390 --> 00:39:09,119

our group here with zolt myself

1039
00:39:14,150 --> 00:39:12,400
greg bacon lisa fattare tiffany davis

1040
00:39:16,550 --> 00:39:14,160
we've been doing this ever since the

1041
00:39:18,950 --> 00:39:16,560
imax film hubble 3d

1042
00:39:21,589 --> 00:39:18,960
where we had to create these stereo 3d

1043
00:39:23,670 --> 00:39:21,599
visualizations for an imac screen

1044
00:39:25,430 --> 00:39:23,680
and one of the simplest ways to do

1045
00:39:29,030 --> 00:39:25,440
stereo 3d

1046
00:39:30,950 --> 00:39:29,040
is what we call decoupage 3d

1047
00:39:33,510 --> 00:39:30,960
if you remember the old decoupages which

1048
00:39:35,109 --> 00:39:33,520
were these physical images that were cut

1049
00:39:37,349 --> 00:39:35,119
out and then stacked on top of each

1050
00:39:39,030 --> 00:39:37,359
other to give the illusion of 3d

1051
00:39:40,150 --> 00:39:39,040
well we do the same sort of thing in a

1052
00:39:43,349 --> 00:39:40,160
computer

1053
00:39:45,349 --> 00:39:43,359
and so you can see the uh one two three

1054
00:39:48,150 --> 00:39:45,359
four five

1055
00:39:51,270 --> 00:39:48,160
six different planes we have here uh

1056
00:39:53,109 --> 00:39:51,280
various objects in the horse head uh the

1057
00:39:55,270 --> 00:39:53,119
foreground plane is stars which we'll

1058
00:39:58,870 --> 00:39:55,280
talk about in a second the background

1059
00:39:59,670 --> 00:39:58,880
plane uh as galaxies which are put in at

1060
00:40:47,990 --> 00:39:59,680
a

1061
00:40:51,589 --> 00:40:48,000
um so

1062
00:40:54,470 --> 00:40:51,599
in the uh we take them in to a

1063
00:40:57,430 --> 00:40:54,480

3d 3d modeling program and then we

1064
00:40:59,670 --> 00:40:57,440
actually sculpt these objects to the uh

1065
00:41:01,670 --> 00:40:59,680
scientific ideas of uh of their

1066
00:41:04,230 --> 00:41:01,680
three-dimensional shape so we have

1067
00:41:06,550 --> 00:41:04,240
multiple layers inside our

1068
00:41:09,589 --> 00:41:06,560
computer graphics model um and each of

1069
00:41:11,670 --> 00:41:09,599
those layers is then sculpted uh in 3d

1070
00:41:13,190 --> 00:41:11,680
with those layers uh placed you know

1071
00:41:14,150 --> 00:41:13,200
slightly in front or slightly behind

1072
00:41:16,710 --> 00:41:14,160
each other

1073
00:41:18,630 --> 00:41:16,720
uh to give the full 3d effect

1074
00:41:19,990 --> 00:41:18,640
you can also see at

1075
00:41:22,550 --> 00:41:20,000
over on the right hand side of the

1076
00:41:29,910 --> 00:41:25,349
midway up you can see the virtual camera

1077
00:41:32,150 --> 00:41:29,920
which then flies through this 3d 3d

1078
00:41:35,349 --> 00:41:32,160
the 3d model okay let's go on to the

1079
00:41:37,510 --> 00:41:35,359
next slide and it'll probably take a few

1080
00:41:39,589 --> 00:41:37,520
seconds for me to see it there we go

1081
00:41:41,190 --> 00:41:39,599
much faster this time

1082
00:41:45,349 --> 00:41:41,200
all right now you can see the camera's

1083
00:41:50,470 --> 00:41:48,550
done the texture map of the nebula

1084
00:41:53,510 --> 00:41:50,480
but what's in green there are all these

1085
00:41:56,230 --> 00:41:53,520
tiny little rectangles these are the

1086
00:41:57,589 --> 00:41:56,240
individual stars that have been cut out

1087
00:41:59,270 --> 00:41:57,599
of the image

1088
00:42:01,430 --> 00:41:59,280

we showed them as a single plane in the

1089
00:42:02,390 --> 00:42:01,440
beginning but actually we took that

1090
00:42:04,710 --> 00:42:02,400
single plane

1091
00:42:06,470 --> 00:42:04,720
we took some scientific software called

1092
00:42:08,069 --> 00:42:06,480
source extractor

1093
00:42:09,910 --> 00:42:08,079
analyze the image found where each one

1094
00:42:12,630 --> 00:42:09,920
of those stars was cut out a tiny

1095
00:42:14,309 --> 00:42:12,640
postage stamp around it and then placed

1096
00:42:15,510 --> 00:42:14,319
those stars in three dimensions around

1097
00:42:18,230 --> 00:42:15,520
the nebula

1098
00:42:20,630 --> 00:42:18,240
now again we don't know the exact 3d

1099
00:42:23,510 --> 00:42:20,640
positions for each one of these stars

1100
00:42:26,470 --> 00:42:23,520
so uh what we've done is required

1101
00:42:28,790 --> 00:42:26,480
yeah sorry i

1102
00:42:34,950 --> 00:42:28,800
changed the slide when i didn't mean to

1103
00:42:41,750 --> 00:42:37,589
okay um and so we use a statistical

1104
00:42:44,069 --> 00:42:41,760
model to rep to place these stars um

1105
00:42:45,750 --> 00:42:44,079
around the in front of the nebula now a

1106
00:42:47,670 --> 00:42:45,760
couple of these stars we knew were

1107
00:42:49,430 --> 00:42:47,680
really close to the nebula

1108
00:42:50,630 --> 00:42:49,440
especially that one star at the very top

1109
00:42:53,829 --> 00:42:50,640
of the horse head

1110
00:42:55,030 --> 00:42:53,839
so we went in by hand and placed that

1111
00:42:56,550 --> 00:42:55,040
where we

1112
00:42:58,630 --> 00:42:56,560
most likely thought it most likely

1113
00:43:00,870 --> 00:42:58,640

existed and a couple other stars that

1114
00:43:02,309 --> 00:43:00,880
had some red coloring to them that you

1115
00:43:03,829 --> 00:43:02,319
could tell are

1116
00:43:05,829 --> 00:43:03,839
getting on just on the surface of the

1117
00:43:07,670 --> 00:43:05,839
gas of the nebula we could place those

1118
00:43:10,150 --> 00:43:07,680
by hand the other ones were placed

1119
00:43:11,030 --> 00:43:10,160
mostly with a statistical model to keep

1120
00:43:12,790 --> 00:43:11,040
them

1121
00:43:16,069 --> 00:43:12,800
close to the nebula this is just a

1122
00:43:18,390 --> 00:43:16,079
subset of the stars shown in this image

1123
00:43:20,230 --> 00:43:18,400
there were a lot more stars wider that

1124
00:43:22,309 --> 00:43:20,240
could actually be distributed in the

1125
00:43:23,670 --> 00:43:22,319
foreground and then also in the

1126
00:43:26,069 --> 00:43:23,680
background

1127
00:43:27,750 --> 00:43:26,079
so we have one more slide

1128
00:43:29,030 --> 00:43:27,760
uh yes

1129
00:43:30,150 --> 00:43:29,040
um

1130
00:43:31,349 --> 00:43:30,160
if you're

1131
00:43:32,950 --> 00:43:31,359
if

1132
00:43:35,510 --> 00:43:32,960
you don't have any more to say about the

1133
00:43:37,910 --> 00:43:35,520
3d stuff no i just uh i'll tell them

1134
00:43:40,390 --> 00:43:37,920
that i'll post the url

1135
00:43:42,550 --> 00:43:40,400
on the page right now oh by the way

1136
00:43:45,030 --> 00:43:42,560
i've also posted for there's somebody

1137
00:43:46,790 --> 00:43:45,040
who made a wonderful comment about uh

1138
00:43:50,390 --> 00:43:46,800

how incredible to see both visible and

1139
00:43:53,670 --> 00:43:50,400
infrared um i posted an animated gif

1140
00:43:54,630 --> 00:43:53,680
of the uh visible to infrared on the the

1141
00:43:56,309 --> 00:43:54,640
page

1142
00:43:58,230 --> 00:43:56,319
and i'll post the uh

1143
00:44:00,790 --> 00:43:58,240
i'll post the url for the movie right

1144
00:44:02,470 --> 00:44:00,800
now so back to result thanks i really

1145
00:44:04,309 --> 00:44:02,480
just wanted to before wrapping up i

1146
00:44:07,109 --> 00:44:04,319
really just wanted to mention that the

1147
00:44:09,589 --> 00:44:07,119
shameless plug for our follow-on mission

1148
00:44:11,349 --> 00:44:09,599
the james webb space telescope

1149
00:44:12,870 --> 00:44:11,359
and and this image that we're talking

1150
00:44:15,349 --> 00:44:12,880
about today this infrared image of the

1151
00:44:17,109 --> 00:44:15,359
horse that is really kind of a preview

1152
00:44:19,349 --> 00:44:17,119
of what we're expecting to see with

1153
00:44:20,470 --> 00:44:19,359
james webb so james webb

1154
00:44:22,950 --> 00:44:20,480
is a

1155
00:44:25,589 --> 00:44:22,960
scientific follow-on to the hubble space

1156
00:44:27,589 --> 00:44:25,599
telescope and it will continue the

1157
00:44:28,950 --> 00:44:27,599
exploration that hubble has done

1158
00:44:33,109 --> 00:44:28,960
and and

1159
00:44:35,990 --> 00:44:33,119
more deeply and more extensively and

1160
00:44:38,950 --> 00:44:36,000
to do that really requires it to be an

1161
00:44:41,430 --> 00:44:38,960
infrared instrument so james webb is a

1162
00:44:44,390 --> 00:44:41,440
is entirely will operate entirely in the

1163
00:44:45,990 --> 00:44:44,400

infrared and we will see stuff very

1164
00:44:47,270 --> 00:44:46,000
similar to what we're seeing today with

1165
00:44:49,670 --> 00:44:47,280
the horse head

1166
00:44:51,109 --> 00:44:49,680
only we'll see you know all the kinds of

1167
00:44:54,150 --> 00:44:51,119
things that hubble has been looking at

1168
00:44:55,990 --> 00:44:54,160
over its now 23-year lifetime

1169
00:44:58,550 --> 00:44:56,000
james webb will be looking at in the

1170
00:45:00,470 --> 00:44:58,560
infrared and hoping to see

1171
00:45:03,349 --> 00:45:00,480
the very very farthest things away that

1172
00:45:04,630 --> 00:45:03,359
we can we can detect in the universe and

1173
00:45:07,430 --> 00:45:04,640
lots of other

1174
00:45:09,109 --> 00:45:07,440
cool stuff so this is a nice preview to

1175
00:45:09,829 --> 00:45:09,119
what james webb will

1176
00:45:12,630 --> 00:45:09,839
do

1177
00:45:16,470 --> 00:45:12,640
and then i just had one just one final

1178
00:45:21,750 --> 00:45:18,790
recapitulates what we've been talking

1179
00:45:23,190 --> 00:45:21,760
about that we're seeing this this nice

1180
00:45:25,349 --> 00:45:23,200
infrared image

1181
00:45:27,670 --> 00:45:25,359
taken with hubble space telescope it was

1182
00:45:29,349 --> 00:45:27,680
done in commemoration for hubble's 23rd

1183
00:45:30,230 --> 00:45:29,359
anniversary

1184
00:45:35,270 --> 00:45:30,240
uh

1185
00:45:36,069 --> 00:45:35,280
executed by the hubble heritage program

1186
00:45:39,910 --> 00:45:36,079
which

1187
00:45:40,950 --> 00:45:39,920
hopes to to find uh the visually best

1188
00:45:42,630 --> 00:45:40,960

images

1189
00:45:44,829 --> 00:45:42,640
we produced a color composite image from

1190
00:45:48,069 --> 00:45:44,839
those data and produced a 3d

1191
00:45:49,829 --> 00:45:48,079
visualization and i think that's it well

1192
00:45:51,750 --> 00:45:49,839
that's fantastic zolt

1193
00:45:54,069 --> 00:45:51,760
i'm going to come back to myself for a

1194
00:45:55,270 --> 00:45:54,079
second and ask a couple questions of you

1195
00:45:57,430 --> 00:45:55,280
zolt if you want to get rid of your

1196
00:45:59,430 --> 00:45:57,440
screen so we can see your face

1197
00:46:01,750 --> 00:45:59,440
um actually jennifer let me ask you

1198
00:46:02,950 --> 00:46:01,760
first um when you were giving your

1199
00:46:06,309 --> 00:46:02,960
presentation

1200
00:46:07,990 --> 00:46:06,319
um i noticed that there were you said 18

1201
00:46:10,069 --> 00:46:08,000
different pointings but then we had two

1202
00:46:11,910 --> 00:46:10,079
filters so are we we're really talking

1203
00:46:14,069 --> 00:46:11,920
like 36 different observations with

1204
00:46:16,230 --> 00:46:14,079
hubble

1205
00:46:19,109 --> 00:46:16,240
the resolution yes the 36 and the

1206
00:46:21,109 --> 00:46:19,119
infrared and then 36 actually parallel

1207
00:46:23,109 --> 00:46:21,119
observations taken with the advanced

1208
00:46:24,630 --> 00:46:23,119
camera

1209
00:46:26,870 --> 00:46:24,640
well actually no that's not that's not

1210
00:46:29,430 --> 00:46:26,880
quite right there's 18 with the advanced

1211
00:46:31,270 --> 00:46:29,440
camera we didn't we kept the same filter

1212
00:46:33,670 --> 00:46:31,280
with the advanced camera whereas for the

1213
00:46:35,670 --> 00:46:33,680

infrared detector we switched between

1214
00:46:36,870 --> 00:46:35,680
filters so yes there's 36 for the

1215
00:46:39,430 --> 00:46:36,880
infrared

1216
00:46:41,589 --> 00:46:39,440
and there's 18 and

1217
00:46:43,190 --> 00:46:41,599
in the advanced camera visible light

1218
00:46:45,510 --> 00:46:43,200
image

1219
00:46:48,470 --> 00:46:45,520
okay and then um what's the resolution

1220
00:46:49,990 --> 00:46:48,480
of each of those uh observations so

1221
00:46:53,270 --> 00:46:50,000
what's the total number of pixels we

1222
00:46:55,349 --> 00:46:53,280
really have on this and this image

1223
00:46:58,150 --> 00:46:55,359
well the infrared camera is about a

1224
00:46:59,030 --> 00:46:58,160
thousand pixels across

1225
00:47:02,710 --> 00:46:59,040
so

1226
00:47:05,750 --> 00:47:02,720
three thousand by three thousand

1227
00:47:07,109 --> 00:47:05,760
and each pixel is about point one arc

1228
00:47:09,510 --> 00:47:07,119
seconds

1229
00:47:11,910 --> 00:47:09,520
um i think the full if you want to do it

1230
00:47:16,390 --> 00:47:11,920
in light years it's about two and a half

1231
00:47:19,990 --> 00:47:18,710
okay and let me just point out for the

1232
00:47:25,589 --> 00:47:20,000
people uh

1233
00:47:27,190 --> 00:47:25,599
our website the full resolution image

1234
00:47:29,270 --> 00:47:27,200
that we have for you to download is two

1235
00:47:31,109 --> 00:47:29,280
thousand seven hundred and four pixels

1236
00:47:32,710 --> 00:47:31,119
by twenty two thousand eight hundred and

1237
00:47:35,670 --> 00:47:32,720
twenty six pixels

1238
00:47:37,349 --> 00:47:35,680

so we aren't hiding a single pixel

1239
00:47:40,309 --> 00:47:37,359
from you you get to see every single

1240
00:47:41,910 --> 00:47:40,319
pixel that jennifer uh

1241
00:47:43,750 --> 00:47:41,920
we cut off as i mentioned we cut off a

1242
00:47:45,670 --> 00:47:43,760
little bit on the edges to clean up that

1243
00:47:47,670 --> 00:47:45,680
slightly ragged edge and we there's some

1244
00:47:48,950 --> 00:47:47,680
overlap so that's why we're not we don't

1245
00:47:51,030 --> 00:47:48,960
have the full

1246
00:47:52,790 --> 00:47:51,040
extent of three

1247
00:47:54,550 --> 00:47:52,800
or nine times

1248
00:47:56,470 --> 00:47:54,560
a thousand pixels

1249
00:47:58,550 --> 00:47:56,480
right but if you go to the archive you

1250
00:48:00,710 --> 00:47:58,560
can get the full face and

1251
00:48:02,790 --> 00:48:00,720
uh zolt says they cleaned up some things

1252
00:48:05,109 --> 00:48:02,800
well those are just at the edges because

1253
00:48:06,790 --> 00:48:05,119
as i said we did this strategy where we

1254
00:48:08,710 --> 00:48:06,800
shifted the telescope and we've actually

1255
00:48:11,670 --> 00:48:08,720
filled in all these bad pic these

1256
00:48:13,670 --> 00:48:11,680
regions so if you get those these images

1257
00:48:14,790 --> 00:48:13,680
they are pristine

1258
00:48:17,589 --> 00:48:14,800
beautiful

1259
00:48:19,510 --> 00:48:17,599
just extraordinary high quality products

1260
00:48:23,349 --> 00:48:19,520
so i would encourage you to if you're

1261
00:48:26,470 --> 00:48:24,870
okay so that's like over seven and a

1262
00:48:28,309 --> 00:48:26,480
half million pixels for you to look at

1263
00:48:31,829 --> 00:48:28,319

and zolta had a question for you you

1264
00:48:34,150 --> 00:48:31,839
mentioned the hubble heritage project uh

1265
00:48:35,829 --> 00:48:34,160
just how many images has the heritage

1266
00:48:37,109 --> 00:48:35,839
project done over the years how long has

1267
00:48:38,309 --> 00:48:37,119
it been going tell a little bit more

1268
00:48:40,549 --> 00:48:38,319
about that

1269
00:48:42,630 --> 00:48:40,559
uh the heritage project was established

1270
00:48:44,950 --> 00:48:42,640
in 1998

1271
00:48:47,510 --> 00:48:44,960
quite a while ago now back when our

1272
00:48:50,870 --> 00:48:47,520
primary camera was wide field cam

1273
00:48:51,829 --> 00:48:50,880
planetary camera 2 with pictu

1274
00:48:54,630 --> 00:48:51,839
and

1275
00:48:55,990 --> 00:48:54,640
it was started by a small team a small

1276
00:48:57,109 --> 00:48:56,000
group of astronomers here at the

1277
00:48:58,630 --> 00:48:57,119
institute

1278
00:49:00,950 --> 00:48:58,640
who felt that

1279
00:49:03,670 --> 00:49:00,960
while it was good for the science

1280
00:49:05,990 --> 00:49:03,680
results to get out from the telescope we

1281
00:49:09,510 --> 00:49:06,000
felt that the images were such high

1282
00:49:11,670 --> 00:49:09,520
quality and so aesthetically beautiful

1283
00:49:13,510 --> 00:49:11,680
that we really needed a concerted effort

1284
00:49:16,470 --> 00:49:13,520
to

1285
00:49:18,230 --> 00:49:16,480
really showcase the the really most

1286
00:49:20,069 --> 00:49:18,240
beautiful images from hubble and so

1287
00:49:20,870 --> 00:49:20,079
that's what we've been doing ever since

1288
00:49:23,430 --> 00:49:20,880

then

1289
00:49:24,470 --> 00:49:23,440
we had nominally we put out one image a

1290
00:49:27,510 --> 00:49:24,480
month

1291
00:49:30,630 --> 00:49:27,520
so you can do the math uh

1292
00:49:32,390 --> 00:49:30,640
you know one a month since 1998 that's a

1293
00:49:35,069 --> 00:49:32,400
couple hundred images so

1294
00:49:37,030 --> 00:49:35,079
if you go to

1295
00:49:39,910 --> 00:49:37,040
heritage.stsci.edu you will see every

1296
00:49:43,190 --> 00:49:39,920
single one of our images along with some

1297
00:49:45,109 --> 00:49:43,200
ancillary information some more in-depth

1298
00:49:47,910 --> 00:49:45,119
discussion of

1299
00:49:48,630 --> 00:49:47,920
it varies from release to release what

1300
00:49:56,309 --> 00:49:48,640
we

1301
00:49:58,230 --> 00:49:56,319
highlight the people involved

1302
00:50:00,150 --> 00:49:58,240
sometimes we will uh highlight a

1303
00:50:00,950 --> 00:50:00,160
scientist that was involved with these

1304
00:50:03,109 --> 00:50:00,960
uh

1305
00:50:05,430 --> 00:50:03,119
observations or the science behind the

1306
00:50:06,950 --> 00:50:05,440
observations sometimes we'll highlight a

1307
00:50:08,470 --> 00:50:06,960
team member or

1308
00:50:09,990 --> 00:50:08,480
somebody else that may have had

1309
00:50:12,549 --> 00:50:10,000
something to do with what we're

1310
00:50:15,589 --> 00:50:12,559
releasing so it's a pretty varied bunch

1311
00:50:17,910 --> 00:50:15,599
of stuff out there and we try to

1312
00:50:19,670 --> 00:50:17,920
try to have a different angle on it than

1313
00:50:21,589 --> 00:50:19,680

than the science

1314
00:50:23,990 --> 00:50:21,599
kind of newsy science releases that we

1315
00:50:26,390 --> 00:50:24,000
also do

1316
00:50:27,829 --> 00:50:26,400
and i think that it shows off the fact

1317
00:50:29,990 --> 00:50:27,839
that you know

1318
00:50:31,589 --> 00:50:30,000
that we here at the space telescope

1319
00:50:33,829 --> 00:50:31,599
science institute we know that we're

1320
00:50:34,790 --> 00:50:33,839
doing this for research science

1321
00:50:36,630 --> 00:50:34,800
but

1322
00:50:39,349 --> 00:50:36,640
we still appreciate that it has such

1323
00:50:41,270 --> 00:50:39,359
incredible artistic beauty that we can't

1324
00:50:43,510 --> 00:50:41,280
help but get that kind of

1325
00:50:46,309 --> 00:50:43,520
those kind of images out to the public

1326
00:50:47,990 --> 00:50:46,319
all right there was one question here on

1327
00:50:49,589 --> 00:50:48,000
the website that says

1328
00:50:51,430 --> 00:50:49,599
i need read something that a science

1329
00:50:54,309 --> 00:50:51,440
writer recently wrote

1330
00:50:55,910 --> 00:50:54,319
referring to the horse head as a pimple

1331
00:50:56,950 --> 00:50:55,920
um

1332
00:50:58,390 --> 00:50:56,960
and

1333
00:51:01,109 --> 00:50:58,400
well let me just say that i don't think

1334
00:51:02,950 --> 00:51:01,119
that pimple is the right term for it uh

1335
00:51:05,270 --> 00:51:02,960
because well when you think of a pimple

1336
00:51:07,349 --> 00:51:05,280
a pimple is growing out of the skin let

1337
00:51:09,030 --> 00:51:07,359
me get my hands into the

1338
00:51:11,510 --> 00:51:09,040

you know you think of a pimple that's

1339
00:51:14,710 --> 00:51:11,520
growing up when actually what this is

1340
00:51:17,829 --> 00:51:14,720
going is this is being eroded away

1341
00:51:21,270 --> 00:51:17,839
um the light from the bright star sigma

1342
00:51:23,589 --> 00:51:21,280
orionis um which is above the horse head

1343
00:51:25,270 --> 00:51:23,599
is actually eating away the gas the the

1344
00:51:26,390 --> 00:51:25,280
high energy radiation ultraviolet

1345
00:51:28,950 --> 00:51:26,400
radiation

1346
00:51:30,710 --> 00:51:28,960
um it's ionizing the gas and causing it

1347
00:51:32,309 --> 00:51:30,720
to cause it causing

1348
00:51:35,430 --> 00:51:32,319
eating away at the

1349
00:51:37,270 --> 00:51:35,440
lesser gas uh lesser lower density gas

1350
00:51:39,109 --> 00:51:37,280
and the higher density gas is remaining

1351
00:51:41,109 --> 00:51:39,119
which is what you see in the horse head

1352
00:51:44,069 --> 00:51:41,119
so that dark silhouette is the denser

1353
00:51:45,829 --> 00:51:44,079
gas that's resisting the erosion from uh

1354
00:51:48,230 --> 00:51:45,839
sigma orionis did you want to add

1355
00:51:50,470 --> 00:51:48,240
something yeah i think what they might

1356
00:51:53,109 --> 00:51:50,480
be referring to is

1357
00:51:55,109 --> 00:51:53,119
kind of coincident with our image

1358
00:51:56,950 --> 00:51:55,119
an image was released by the herschel

1359
00:51:59,270 --> 00:51:56,960
telescope which is

1360
00:52:02,390 --> 00:51:59,280
a telescope that's dedicated to looking

1361
00:52:05,990 --> 00:52:02,400
in the infrared now herschel has a much

1362
00:52:09,430 --> 00:52:06,000
wider field of view than hubble does so

1363
00:52:11,589 --> 00:52:09,440

it's it at any one spot

1364
00:52:14,710 --> 00:52:11,599
the resolution is lower than what hubble

1365
00:52:17,190 --> 00:52:14,720
can see but it can see in one exposure a

1366
00:52:20,470 --> 00:52:17,200
much wider area of sky

1367
00:52:23,349 --> 00:52:20,480
so they also released an image of the

1368
00:52:26,069 --> 00:52:23,359
orion region but it's a much wider area

1369
00:52:27,990 --> 00:52:26,079
and you see a huge amount of

1370
00:52:30,230 --> 00:52:28,000
this glowing stuff glowing in the

1371
00:52:32,870 --> 00:52:30,240
infrared and off in the corner you see

1372
00:52:35,190 --> 00:52:32,880
this little blip on the side

1373
00:52:37,270 --> 00:52:35,200
and that's the horsehead nebula and the

1374
00:52:38,790 --> 00:52:37,280
neat thing about that to me is that yeah

1375
00:52:41,510 --> 00:52:38,800
and it kind of looks like a pimple on

1376
00:52:43,430 --> 00:52:41,520
this giant cloud of gas but the neat

1377
00:52:45,910 --> 00:52:43,440
thing to me is it's how complementary it

1378
00:52:48,230 --> 00:52:45,920
is with our image that we're able to

1379
00:52:49,910 --> 00:52:48,240
really zoom in and see this

1380
00:52:53,670 --> 00:52:49,920
little area

1381
00:52:54,549 --> 00:52:53,680
of view of the sky is a tiny little

1382
00:52:58,069 --> 00:52:54,559
piece

1383
00:53:00,710 --> 00:52:58,079
uh in reality it's this gigantic multi

1384
00:53:01,990 --> 00:53:00,720
light year across thing

1385
00:53:03,349 --> 00:53:02,000
but

1386
00:53:06,230 --> 00:53:03,359
if you look at the herschel image you

1387
00:53:07,589 --> 00:53:06,240
see this really large really complex

1388
00:53:10,230 --> 00:53:07,599

region

1389
00:53:12,710 --> 00:53:10,240
and it's really impressive so it's this

1390
00:53:15,510 --> 00:53:12,720
nice complementarity between different

1391
00:53:17,270 --> 00:53:15,520
astronomical observatories

1392
00:53:18,870 --> 00:53:17,280
i would agree with you and i want that

1393
00:53:20,309 --> 00:53:18,880
that leads me to the last thing we want

1394
00:53:22,309 --> 00:53:20,319
to end with

1395
00:53:24,390 --> 00:53:22,319
is that the horsehead nebula is a

1396
00:53:26,710 --> 00:53:24,400
temporary structure

1397
00:53:28,309 --> 00:53:26,720
because it's being eroded by the

1398
00:53:31,589 --> 00:53:28,319
ultraviolet radiation from sigmar

1399
00:53:33,510 --> 00:53:31,599
arionis uh folks have estimated that it

1400
00:53:36,150 --> 00:53:33,520
will actually disappear

1401
00:53:38,390 --> 00:53:36,160
in about five million years

1402
00:53:40,150 --> 00:53:38,400
so you can be glad we've got hubble up

1403
00:53:41,910 --> 00:53:40,160
there to take those observations now

1404
00:53:44,309 --> 00:53:41,920
because you know five million years from

1405
00:53:45,910 --> 00:53:44,319
now we won't have the thor said nebula

1406
00:53:48,069 --> 00:53:45,920
of course we'll have other beautiful

1407
00:53:50,150 --> 00:53:48,079
structures to look at at that time and

1408
00:53:52,390 --> 00:53:50,160
the telescopes uh that time we'll have

1409
00:53:53,430 --> 00:53:52,400
uh probably take much more amazing

1410
00:53:54,790 --> 00:53:53,440
images

1411
00:53:57,430 --> 00:53:54,800
all right any last thoughts from you

1412
00:53:59,510 --> 00:53:57,440
jennifer

1413
00:54:02,069 --> 00:53:59,520

just i think it's neat how we can look

1414
00:54:04,390 --> 00:54:02,079
out into space and kind of identify

1415
00:54:06,309 --> 00:54:04,400
patterns or things that look familiar to

1416
00:54:08,790 --> 00:54:06,319
us like a horse's head i mean it there's

1417
00:54:09,750 --> 00:54:08,800
nothing really in particular

1418
00:54:11,829 --> 00:54:09,760
uh

1419
00:54:12,790 --> 00:54:11,839
particularly that different about this

1420
00:54:16,470 --> 00:54:12,800
part of

1421
00:54:18,790 --> 00:54:16,480
the surrounding regions it just so

1422
00:54:20,470 --> 00:54:18,800
happens that it sparks our imagination

1423
00:54:22,470 --> 00:54:20,480
and makes us think of something familiar

1424
00:54:24,790 --> 00:54:22,480
like a horse's head and it

1425
00:54:25,750 --> 00:54:24,800
gets people excited and um

1426
00:54:30,309 --> 00:54:25,760
just a

1427
00:54:32,230 --> 00:54:30,319
observations to be a part of

1428
00:54:33,589 --> 00:54:32,240
all right thank you very much

1429
00:54:35,430 --> 00:54:33,599
and uh thank you zolt do you have any

1430
00:54:37,430 --> 00:54:35,440
last comment or you

1431
00:54:39,750 --> 00:54:37,440
no you you counted out i

1432
00:54:41,030 --> 00:54:39,760
i think jennifer's comment was was right

1433
00:54:42,230 --> 00:54:41,040
on the money and

1434
00:54:44,150 --> 00:54:42,240
really appreciate it we didn't really

1435
00:54:46,870 --> 00:54:44,160
talk about why we call this thing the

1436
00:54:48,870 --> 00:54:46,880
horse head so that kind of explains it

1437
00:54:52,150 --> 00:54:48,880
okay all right thank you all for

1438
00:54:56,150 --> 00:54:52,160

attending this hubble hangout on the

1439
00:54:57,750 --> 00:54:56,160
23rd year uh 24th anniversary of hubble

1440
00:54:59,910 --> 00:54:57,760
and we look forward to bringing more

1441
00:55:01,190 --> 00:54:59,920
hubble hangouts to you i apologize for

1442
00:55:04,710 --> 00:55:01,200
the technical difficulties at the

1443
00:55:08,549 --> 00:55:06,390
zolt had had a few technical problems

1444
00:55:10,230 --> 00:55:08,559
and tony darnell who has hosted these

1445
00:55:13,109 --> 00:55:10,240
before and was supposed to host this one

1446
00:55:15,430 --> 00:55:13,119
is on vacation so i had to learn

1447
00:55:17,030 --> 00:55:15,440
how to host it and uh we will be we'll

1448
00:55:19,750 --> 00:55:17,040
do much better next time all right thank