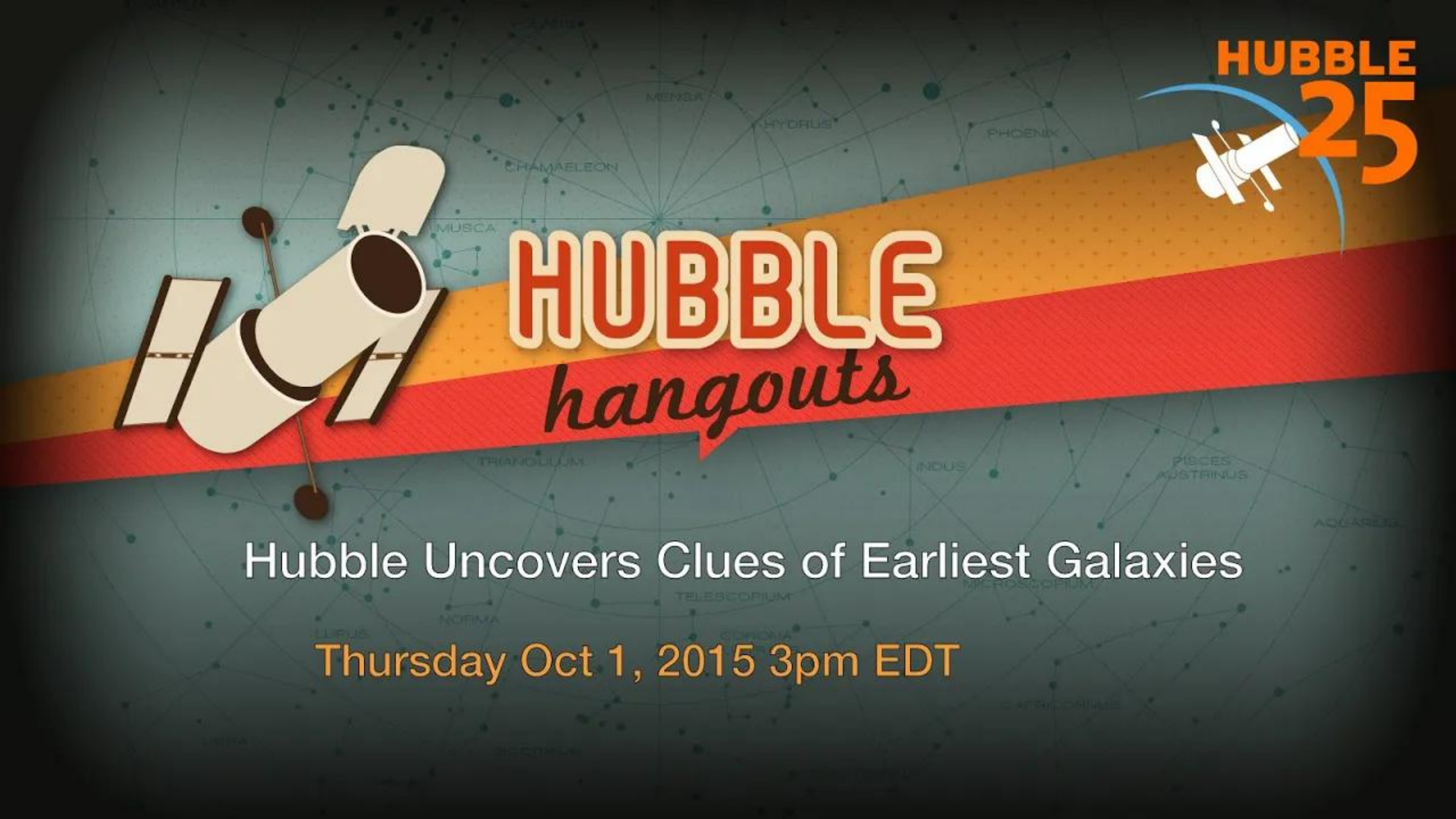
HUBBLE
25
HUBBLE
hangouts
Hubble Uncovers Clues of Earliest Galaxies
Thursday Oct 1, 2015 3pm EDT

1
00:00:09,039 --> 00:00:07,210
hello everybody and welcome to this

2
00:00:10,600 --> 00:00:09,049
week's Hubble hang out my name is Tony

3
00:00:12,009 --> 00:00:10,610
Darnell I work at the Space Telescope

4
00:00:14,079 --> 00:00:12,019
Science Institute and we've done it

5
00:00:15,699 --> 00:00:14,089
again we've got another great Hubble

6
00:00:17,380 --> 00:00:15,709
hangout plan for you this week

7
00:00:19,630 --> 00:00:17,390
astronomers using the Hubble Space

8
00:00:22,630 --> 00:00:19,640
Telescope have generated the most

9
00:00:25,180 --> 00:00:22,640
accurate statistical description yet of

10
00:00:28,000 --> 00:00:25,190
faint early galaxies as they existed in

11
00:00:29,350 --> 00:00:28,010
the universe 500 million years after the

12
00:00:31,720 --> 00:00:29,360
Big Bang we're going to talk about these

13
00:00:33,130 --> 00:00:31,730

findings in just a little bit with the

14
00:00:36,700 --> 00:00:33,140
sum of the astronomers that have made

15
00:00:39,310 --> 00:00:36,710
these these analyses public to us but

16
00:00:41,140 --> 00:00:39,320
before I get started I got something I

17
00:00:44,590 --> 00:00:41,150
want to say real quick I just found this

18
00:00:46,000 --> 00:00:44,600
out yesterday now sometimes before a hub

19
00:00:47,830 --> 00:00:46,010
will hang out what I'll do is I'll go on

20
00:00:48,760 --> 00:00:47,840
periscope and i'll do a hubble Q&A and

21
00:00:50,020 --> 00:00:48,770
i'll talk with you guys a little bit

22
00:00:51,639 --> 00:00:50,030
maybe to get some people jazzed up about

23
00:00:53,860 --> 00:00:51,649
the hangout but it always is that

24
00:00:55,150 --> 00:00:53,870
turning into a sort of a JWST Q&A more

25
00:00:56,800 --> 00:00:55,160
than that because everybody's interested

26
00:00:58,450 --> 00:00:56,810
about the new mission and how it's

27
00:01:00,729 --> 00:00:58,460
coming up how it's coming along and

28
00:01:02,440 --> 00:01:00,739
everybody always at some point we'll ask

29
00:01:04,779 --> 00:01:02,450
me the same question aren't we worried

30
00:01:06,459 --> 00:01:04,789
about launching jwst out at the l2 point

31
00:01:07,599 --> 00:01:06,469
and what if something get what if it

32
00:01:09,669 --> 00:01:07,609
gets hit by something or what if

33
00:01:11,169 --> 00:01:09,679
something goes wrong with it and it

34
00:01:13,330 --> 00:01:11,179
occurred to me yesterday that you know

35
00:01:15,069 --> 00:01:13,340
this is actually a solved problem we

36
00:01:16,690 --> 00:01:15,079
solved this problem because there's a

37
00:01:18,999 --> 00:01:16,700
when I first started my career in

38
00:01:21,459 --> 00:01:19,009

astronomy I started in the solar physics

39
00:01:23,379 --> 00:01:21,469
area and there's a there is a spacecraft

40
00:01:26,919 --> 00:01:23,389
that we launched back in let's see

41
00:01:28,209 --> 00:01:26,929
December second 1995 and it was built by

42
00:01:30,429 --> 00:01:28,219
the Europeans and operated by the

43
00:01:32,469 --> 00:01:30,439
European Space Agency but NASA had like

44
00:01:34,539 --> 00:01:32,479
12 or 13 instruments on it as well and

45
00:01:36,879 --> 00:01:34,549
they put it out the l1 point which is

46
00:01:39,370 --> 00:01:36,889
this point in between Earth and the Sun

47
00:01:40,690 --> 00:01:39,380
we're going to put JWT at l2 which is a

48
00:01:42,340 --> 00:01:40,700
million miles away and it's behind the

49
00:01:44,949 --> 00:01:42,350
earth so it's you know it's at a pretty

50
00:01:46,989 --> 00:01:44,959
far away no repair missions were planned

51
00:01:50,830 --> 00:01:46,999
it was it's been up there for nine years

52
00:01:52,719 --> 00:01:50,840
nine months and 29 days and but more

53
00:01:53,980 --> 00:01:52,729
than that it's been sitting like I said

54
00:01:56,679 --> 00:01:53,990
at the l1 point where it's in between

55
00:01:58,779 --> 00:01:56,689
the Sun and the earth where it is

56
00:02:02,109 --> 00:01:58,789
getting bombarded by coronal mass

57
00:02:03,339 --> 00:02:02,119
ejections on a regular basis while it

58
00:02:04,569 --> 00:02:03,349
measures and looks at the Sun it has a

59
00:02:07,599 --> 00:02:04,579
lot of instruments that looks at this

60
00:02:09,279 --> 00:02:07,609
the chromospheric iron 9 12 and 13

61
00:02:12,850 --> 00:02:09,289
something like that it also has three

62
00:02:13,840 --> 00:02:12,860
chronographs on board lasko c1 c2 and c3

63
00:02:16,060 --> 00:02:13,850

now that

64
00:02:17,770 --> 00:02:16,070
you see one very much but c2 and c3 I

65
00:02:20,890 --> 00:02:17,780
was I was poking around on the web page

66
00:02:24,910 --> 00:02:20,900
today just discovered discovered not

67
00:02:27,460 --> 00:02:24,920
observed but discovered it's 3,000 comet

68
00:02:29,350 --> 00:02:27,470
so it has been up there for a long time

69
00:02:32,020 --> 00:02:29,360
so we've got we this there's a precedent

70
00:02:34,030 --> 00:02:32,030
for this no repair missions now Hubble's

71
00:02:35,680 --> 00:02:34,040
great we spend every week talking about

72
00:02:38,230 --> 00:02:35,690
how great Hubble is we're celebrating 25

73
00:02:39,790 --> 00:02:38,240
years of Hubble being in orbit this year

74
00:02:41,200 --> 00:02:39,800
which is an amazing feat as the longest

75
00:02:44,050 --> 00:02:41,210
space telescope to ever have done that

76
00:02:46,000 --> 00:02:44,060
but Soho the solar Heliospheric

77
00:02:50,710 --> 00:02:46,010
Observatory has been up there will be

78
00:02:53,260 --> 00:02:50,720
Ted it will be there 10 years or no yeah

79
00:02:55,300 --> 00:02:53,270
20 years actually because this is 2015

80
00:02:58,450 --> 00:02:55,310
I'm sorry I have that wrong 19 years to

81
00:03:00,130 --> 00:02:58,460
spin up now so 20 years this december

82
00:03:01,660 --> 00:03:00,140
five years after the launch of Hubble

83
00:03:03,910 --> 00:03:01,670
Space Telescope they launched so huh so

84
00:03:06,040 --> 00:03:03,920
the next time you get all bent out of

85
00:03:07,630 --> 00:03:06,050
shape about ELQ JWST being a tell to

86
00:03:09,160 --> 00:03:07,640
think about that for a second because I

87
00:03:10,810 --> 00:03:09,170
think this is more of a solved

88
00:03:13,210 --> 00:03:10,820

engineering problem than anything else

89
00:03:15,790 --> 00:03:13,220
so I just had to get that out cuz you

90
00:03:17,460 --> 00:03:15,800
know i don't i don't know about I don't

91
00:03:23,050 --> 00:03:17,470
know about don't get bent out of shape

92
00:03:24,250 --> 00:03:23,060
little Tommy s'okay ok got it all right

93
00:03:26,470 --> 00:03:24,260
so let's get start with the tweet hang

94
00:03:27,670 --> 00:03:26,480
out I was related to a previous

95
00:03:30,070 --> 00:03:27,680
conversation we had so I wanted to get

96
00:03:32,380 --> 00:03:30,080
that out with me as she is every week

97
00:03:34,330 --> 00:03:32,390
always making fun of me and my colleague

98
00:03:36,730 --> 00:03:34,340
and friend dr. carol christian she is

99
00:03:39,010 --> 00:03:36,740
the oh let's go power each project

100
00:03:40,540 --> 00:03:39,020
scientist hi Carol welcome back glad to

101
00:03:44,080 --> 00:03:40,550
see you're in good form again thank you

102
00:03:46,450 --> 00:03:44,090
so much oh you're so welcome also also

103
00:03:48,700 --> 00:03:46,460
joining us as he does each week is the

104
00:03:50,320 --> 00:03:48,710
the md eminent scott lewis internet

105
00:03:52,780 --> 00:03:50,330
driver extraordinaire hi scott welcome

106
00:03:55,000 --> 00:03:52,790
back thank you Tony and and honestly get

107
00:03:57,880 --> 00:03:55,010
to defend Carole which I don't often do

108
00:04:00,850 --> 00:03:57,890
um it's far too easy to make fun of you

109
00:04:04,780 --> 00:04:00,860
ah this / so sure she gotta work just

110
00:04:08,020 --> 00:04:04,790
like it's low-hanging it's a mentally

111
00:04:12,180 --> 00:04:08,030
target okay that's all right payback is

112
00:04:14,860 --> 00:04:12,190
a you know what so okay all right guys I

113
00:04:17,050 --> 00:04:14,870

I see how it's gonna be but the thing

114
00:04:19,780 --> 00:04:17,060
you should work on your dog by the time

115
00:04:21,099 --> 00:04:19,790
it happens yes he's Denver you're going

116
00:04:23,170 --> 00:04:21,109
to be hearing all about you're gonna be

117
00:04:24,760 --> 00:04:23,180
hearing all about soho 20 years now if i

118
00:04:27,450 --> 00:04:24,770
were there EPO I'd be getting ready for

119
00:04:29,850 --> 00:04:27,460
a big party but anyway okay so

120
00:04:31,830 --> 00:04:29,860
as I mentioned we back back to Hubble

121
00:04:34,650 --> 00:04:31,840
and using the Hubble data astronomers at

122
00:04:37,140 --> 00:04:34,660
UC Irvine and other places have been

123
00:04:39,029 --> 00:04:37,150
using Hubble data to like I said look at

124
00:04:40,950 --> 00:04:39,039
the earliest galaxies in the universe

125
00:04:43,080 --> 00:04:40,960
which is way better than the Sun in my

126
00:04:47,129 --> 00:04:43,090
opinion also way better than anything of

127
00:04:48,719 --> 00:04:47,139
my my the subject I covet the most early

128
00:04:50,460 --> 00:04:48,729
galaxies in the universe and with me to

129
00:04:52,350 --> 00:04:50,470
talk about this is dr. Stevens

130
00:04:53,790 --> 00:04:52,360
Finkelstein Einstein he's driest Rana

131
00:04:56,309 --> 00:04:53,800
Murr at the University of Texas at

132
00:04:58,140 --> 00:04:56,319
Austin hi Steve welcome back this is

133
00:05:00,420 --> 00:04:58,150
like you you're gonna be a regular here

134
00:05:02,219 --> 00:05:00,430
on our hangouts yeah hey D'Antoni you're

135
00:05:04,700 --> 00:05:02,229
really good thank you & cat also joining

136
00:05:08,370 --> 00:05:04,710
me is a catcher in Mitchell when he is a

137
00:05:10,020 --> 00:05:08,380
PhD student at the UC Irvine he was part

138
00:05:12,749 --> 00:05:10,030

of the study that we're going that came

139
00:05:14,760 --> 00:05:12,759
out in I guess it was earlier this month

140
00:05:17,490 --> 00:05:14,770
right Katherine that's right yeah well

141
00:05:19,170 --> 00:05:17,500
last was a journal nature what was it

142
00:05:21,450 --> 00:05:19,180
called nature supplement or something

143
00:05:23,820 --> 00:05:21,460
like that nature communications that's

144
00:05:25,800 --> 00:05:23,830
what it was okay so let's take a before

145
00:05:29,129 --> 00:05:25,810
we get to your actual observations and

146
00:05:31,050 --> 00:05:29,139
the results from them let's take a step

147
00:05:32,550 --> 00:05:31,060
back and talk about something that the

148
00:05:35,700 --> 00:05:32,560
Hubble has been doing for quite a while

149
00:05:39,240 --> 00:05:35,710
which is these surveys these are sort of

150
00:05:41,460 --> 00:05:39,250
designed program observation programs

151
00:05:44,070 --> 00:05:41,470
that that Hubble does periodic leaders

152
00:05:45,899 --> 00:05:44,080
that they've been doing these with right

153
00:05:47,399 --> 00:05:45,909
now with the main one going on is called

154
00:05:49,170 --> 00:05:47,409
frontier fields just looking at six

155
00:05:50,760 --> 00:05:49,180
different areas of the sky but before

156
00:05:52,950 --> 00:05:50,770
that there was another one called clash

157
00:05:56,580 --> 00:05:52,960
and before that was one called candles

158
00:05:59,760 --> 00:05:56,590
which is the cosmic assembly

159
00:06:02,399 --> 00:05:59,770
near-infrared deep extra galactic legacy

160
00:06:03,959 --> 00:06:02,409
survey somehow that just things that

161
00:06:05,670 --> 00:06:03,969
they were trying to make that work but

162
00:06:07,350 --> 00:06:05,680
anyway that's at candles that's how

163
00:06:09,379 --> 00:06:07,360

that's what candles is it you guys use

164
00:06:13,860 --> 00:06:09,389
candles data for the survey right Katrin

165
00:06:16,920 --> 00:06:13,870
yeah that's right okay so this wasn't as

166
00:06:18,659 --> 00:06:16,930
data set that was designed for what it

167
00:06:21,029 --> 00:06:18,669
wasn't for you specifically to do this

168
00:06:23,700 --> 00:06:21,039
work but you found that it was work it

169
00:06:26,390 --> 00:06:23,710
was observations that sort of enabled

170
00:06:29,760 --> 00:06:26,400
your work correct yeah we had to do this

171
00:06:33,360 --> 00:06:29,770
complex mosaicing technique called

172
00:06:35,610 --> 00:06:33,370
self-calibration and yeah the kid the

173
00:06:40,260 --> 00:06:35,620
candles data was collected in such a way

174
00:06:41,279 --> 00:06:40,270
to maximize I think the area but for us

175
00:06:44,189 --> 00:06:41,289
that's not necessarily

176
00:06:45,839 --> 00:06:44,199
we want but when we supplemented the

177
00:06:48,119 --> 00:06:45,849
candles data with archived data we had

178
00:06:49,799 --> 00:06:48,129
plenty to work with oh really so you use

179
00:06:51,329 --> 00:06:49,809
also data from the archive as well okay

180
00:06:52,679 --> 00:06:51,339
Steve language what keep wondering why

181
00:06:56,219 --> 00:06:52,689
don't you describe candles force first

182
00:06:57,359 --> 00:06:56,229
can we start there yeah sure so so

183
00:06:59,100 --> 00:06:57,369
candles you already spell out the

184
00:07:01,260 --> 00:06:59,110
acronym it's a long reckoning but it's

185
00:07:05,459 --> 00:07:01,270
one of the largest if not the largest

186
00:07:07,079 --> 00:07:05,469
tupple program ever so back in the last

187
00:07:09,420 --> 00:07:07,089
decade there was a big program called

188
00:07:11,249 --> 00:07:09,430

goods which took optical imaging so

189
00:07:12,839 --> 00:07:11,259
visible light that our eyes can see it

190
00:07:14,549 --> 00:07:12,849
took those kind of images of a few

191
00:07:16,709 --> 00:07:14,559
regions of the sky and learned a lot of

192
00:07:18,809 --> 00:07:16,719
stuff about galaxies at at sort of

193
00:07:21,029 --> 00:07:18,819
moderate red shifts from time say two to

194
00:07:23,549 --> 00:07:21,039
two to 10 billion years after the Big

195
00:07:25,109 --> 00:07:23,559
Bang but if we want to go back closer to

196
00:07:27,179 --> 00:07:25,119
the big thing we need to look in the

197
00:07:29,070 --> 00:07:27,189
near-infrared because the expansion of

198
00:07:30,749 --> 00:07:29,080
the universe has red shifted all of the

199
00:07:32,820 --> 00:07:30,759
ultraviolet and the visible light of

200
00:07:34,859 --> 00:07:32,830
those very distant galaxies completely

201
00:07:37,619 --> 00:07:34,869
out of the optical into the infrared and

202
00:07:39,659 --> 00:07:37,629
so when Hubble installed or when Hubble

203
00:07:42,269 --> 00:07:39,669
when the astronauts installed why field

204
00:07:45,209 --> 00:07:42,279
camera 3 infrared camera on Hubble in

205
00:07:47,219 --> 00:07:45,219
2009 one of the most obvious things to

206
00:07:50,070 --> 00:07:47,229
do was to go and try and do a similar

207
00:07:51,899 --> 00:07:50,080
survey in the near infrared it does take

208
00:07:53,659 --> 00:07:51,909
a long time so there was a special call

209
00:07:57,239 --> 00:07:53,669
for very long proposals called

210
00:07:58,499 --> 00:07:57,249
multi-cycle Treasury programs and one of

211
00:08:00,059 --> 00:07:58,509
the ones that was selected was candles

212
00:08:01,679 --> 00:08:00,069
you also mentioned clash which looked at

213
00:08:03,689 --> 00:08:01,689

London clusters and also fat which

214
00:08:05,699 --> 00:08:03,699
looked at the Andromeda galaxy right we

215
00:08:07,829 --> 00:08:05,709
just had a recent hangout on well we've

216
00:08:09,480 --> 00:08:07,839
had hangouts on all of these but yeah so

217
00:08:12,509 --> 00:08:09,490
they're called multi-cycle Treasury

218
00:08:14,249 --> 00:08:12,519
programs that's right yeah and so

219
00:08:17,699 --> 00:08:14,259
candles the program candles looked at

220
00:08:19,619 --> 00:08:17,709
five different regions in the sky all

221
00:08:22,469 --> 00:08:19,629
together they're pretty small they are

222
00:08:23,429 --> 00:08:22,479
about one-fifth of a square degree so

223
00:08:24,989 --> 00:08:23,439
it's actually if you added them all

224
00:08:27,179 --> 00:08:24,999
together it's smaller than the area of

225
00:08:29,429 --> 00:08:27,189
the moon but for extra galactic surveys

226
00:08:31,409 --> 00:08:29,439
that's actually pretty huge and so the

227
00:08:33,269 --> 00:08:31,419
survey is now done the science is not

228
00:08:34,620 --> 00:08:33,279
done we're still actively working on

229
00:08:36,689 --> 00:08:34,630
papers like this great paper that

230
00:08:38,249 --> 00:08:36,699
Quechuan wrote but yeah we've been

231
00:08:41,009 --> 00:08:38,259
learning a lot of great stuff about the

232
00:08:43,170 --> 00:08:41,019
universe oh great ok I am remiss folks

233
00:08:45,059 --> 00:08:43,180
as Steve was talking I reminder I

234
00:08:46,920 --> 00:08:45,069
occurred to me that I have not told you

235
00:08:48,030 --> 00:08:46,930
that we want you to interact with us in

236
00:08:49,980 --> 00:08:48,040
this hangout we want you to ask

237
00:08:51,509 --> 00:08:49,990
questions and leave comments and you

238
00:08:53,220 --> 00:08:51,519

could do that in a variety of ways Scott

239
00:08:54,750 --> 00:08:53,230
if you're still around and I didn't lose

240
00:08:56,730 --> 00:08:54,760
you from laughing

241
00:08:58,650 --> 00:08:56,740
I mean could you could you could you

242
00:09:00,260 --> 00:08:58,660
please explain to these two are kind of

243
00:09:02,820 --> 00:09:00,270
viewers how they may interact with us

244
00:09:04,800 --> 00:09:02,830
absolutely so the best and easiest way

245
00:09:06,870 --> 00:09:04,810
for you to interact with us is while

246
00:09:09,270 --> 00:09:06,880
your life here on the bottom left screen

247
00:09:10,530 --> 00:09:09,280
on this stream is some yellow text it

248
00:09:13,020 --> 00:09:10,540
says that we are answering your

249
00:09:15,210 --> 00:09:13,030
questions live which we are so we have a

250
00:09:16,650 --> 00:09:15,220
Q&A app and we're able to see any

251
00:09:18,480 --> 00:09:16,660
questions or comments you leave there

252
00:09:20,610 --> 00:09:18,490
you can upload ones that other people

253
00:09:21,960 --> 00:09:20,620
have left and so if we see anything

254
00:09:23,460 --> 00:09:21,970
really interesting that we want to

255
00:09:25,380 --> 00:09:23,470
address we can click it it will

256
00:09:27,360 --> 00:09:25,390
timestamp it when we're answering that

257
00:09:28,950 --> 00:09:27,370
question so for those who are not

258
00:09:32,010 --> 00:09:28,960
watching live you can see when those are

259
00:09:34,860 --> 00:09:32,020
being answered we can also interact with

260
00:09:37,950 --> 00:09:34,870
us on Twitter so I'm live tweeting this

261
00:09:40,620 --> 00:09:37,960
from at Hubble telescope using the

262
00:09:42,300 --> 00:09:40,630
hashtag hubble hang out so please send

263
00:09:45,180 --> 00:09:42,310

us your questions and comments on

264
00:09:46,890 --> 00:09:45,190
Twitter using that and I will be if it's

265
00:09:49,020 --> 00:09:46,900
something really awesome i'll retweet it

266
00:09:51,000 --> 00:09:49,030
or will be responding to them on air and

267
00:09:52,260 --> 00:09:51,010
make sure to follow us because we're

268
00:09:54,510 --> 00:09:52,270
always putting out really important

269
00:09:57,240 --> 00:09:54,520
stuff there on twitter too and follow us

270
00:09:59,790 --> 00:09:57,250
over on on youtube we are hubble site

271
00:10:01,890 --> 00:09:59,800
channel on youtube and we're also on

272
00:10:04,920 --> 00:10:01,900
facebook so we have an event on facebook

273
00:10:06,840 --> 00:10:04,930
and we're also on instagram at official

274
00:10:08,640 --> 00:10:06,850
Hubble and you can see some awesome

275
00:10:10,710 --> 00:10:08,650
pictures and visuals that we put up

276
00:10:12,720 --> 00:10:10,720
there yes that's great and I have been

277
00:10:14,400 --> 00:10:12,730
remiss in getting some public some some

278
00:10:15,780 --> 00:10:14,410
pictures up on Instagram so thank you

279
00:10:17,460 --> 00:10:15,790
for mining about well I got you covered

280
00:10:20,130 --> 00:10:17,470
you of course you do that's why you're

281
00:10:22,200 --> 00:10:20,140
here yeah you got my back all right

282
00:10:23,490 --> 00:10:22,210
thank you all right so uh let's get back

283
00:10:24,780 --> 00:10:23,500
to these these moai want to talk a

284
00:10:26,670 --> 00:10:24,790
little bit more about these multi-cycle

285
00:10:28,230 --> 00:10:26,680
Treasury programs and Carol I just

286
00:10:29,700 --> 00:10:28,240
wondering can you is one of the things

287
00:10:31,560 --> 00:10:29,710
I've noticed with our hangout trenzas we

288
00:10:33,150 --> 00:10:31,570

do talk a lot about these various

289
00:10:34,290 --> 00:10:33,160
surveys we talk about fat before we've

290
00:10:35,460 --> 00:10:34,300
talked about we felt bout frontier

291
00:10:37,410 --> 00:10:35,470
fields many times and of course now

292
00:10:40,440 --> 00:10:37,420
we're on candles again is this kind of a

293
00:10:42,510 --> 00:10:40,450
trend do you think with using Hubble in

294
00:10:44,370 --> 00:10:42,520
this way where we're kind of setting

295
00:10:47,010 --> 00:10:44,380
aside blocks of time for Hubble to do

296
00:10:50,130 --> 00:10:47,020
very specific sort of large larger scale

297
00:10:52,320 --> 00:10:50,140
observations well it's it's a balance I

298
00:10:55,830 --> 00:10:52,330
mean when Hubble was first launched

299
00:10:57,660 --> 00:10:55,840
everybody wanted to use the observing

300
00:11:01,730 --> 00:10:57,670
time and there were lots of little

301
00:11:04,470 --> 00:11:01,740
projects and there are still many many

302
00:11:06,090 --> 00:11:04,480
projects that only use a few orbits

303
00:11:08,550 --> 00:11:06,100
because there's lots of interesting

304
00:11:10,410 --> 00:11:08,560
science like if you want to look at us

305
00:11:12,750 --> 00:11:10,420
epic exoplanet or you want to look at a

306
00:11:16,560 --> 00:11:12,760
stellar population of a specific galaxy

307
00:11:20,370 --> 00:11:16,570
but surveys also are important and it's

308
00:11:23,280 --> 00:11:20,380
it's also important to look at many

309
00:11:26,610 --> 00:11:23,290
objects in the survey mode using the

310
00:11:29,400 --> 00:11:26,620
same instrumentation and so the idea was

311
00:11:32,160 --> 00:11:29,410
that part of the time Hubble should be

312
00:11:34,800 --> 00:11:32,170
devoted to these multi-cycle Treasury

313
00:11:36,180 --> 00:11:34,810

programs the interesting thing about it

314
00:11:39,420 --> 00:11:36,190
is that the team is really responsible

315
00:11:43,019 --> 00:11:39,430
for the calibration and also the data

316
00:11:44,850 --> 00:11:43,029
becomes available very quickly because

317
00:11:48,540 --> 00:11:44,860
it's such a large amount of data so the

318
00:11:50,370 --> 00:11:48,550
team that proposes the observation gets

319
00:11:52,530 --> 00:11:50,380
first crack at it but they have to

320
00:11:56,010 --> 00:11:52,540
calibrate it and then put it out there

321
00:11:58,769 --> 00:11:56,020
in the archive to use and what's been

322
00:12:00,750 --> 00:11:58,779
found is that what the original team

323
00:12:03,660 --> 00:12:00,760
thought they were going to do they do

324
00:12:06,000 --> 00:12:03,670
but then lots of other science can be

325
00:12:09,030 --> 00:12:06,010
done because there are several fields

326
00:12:12,090 --> 00:12:09,040
that are looked at that are pretty much

327
00:12:15,870 --> 00:12:12,100
uniform and address either galaxies or

328
00:12:18,090 --> 00:12:15,880
or like fat the Andromeda galaxy and so

329
00:12:21,120 --> 00:12:18,100
there's lots and lots of information in

330
00:12:23,430 --> 00:12:21,130
those observations that can tell us

331
00:12:27,090 --> 00:12:23,440
about all kinds of astrophysics so they

332
00:12:28,740 --> 00:12:27,100
are very productive in time really good

333
00:12:30,329 --> 00:12:28,750
news observation yeah it sounds like a

334
00:12:32,820 --> 00:12:30,339
good use of public comment and the other

335
00:12:35,970 --> 00:12:32,830
thing is like it's kind of like we're

336
00:12:37,620 --> 00:12:35,980
always saying okay you know Hubble won't

337
00:12:39,950 --> 00:12:37,630
live forever it's been here 25 years

338
00:12:43,620 --> 00:12:39,960

what do we have to do with Hubble and

339
00:12:45,660 --> 00:12:43,630
1.we the Hubble project ask that of the

340
00:12:47,730 --> 00:12:45,670
community they said we want to do more

341
00:12:50,010 --> 00:12:47,740
surveys so it's a response to the

342
00:12:51,540 --> 00:12:50,020
community interest as well oh really i

343
00:12:52,949 --> 00:12:51,550
did not know well I said that explains

344
00:12:54,780 --> 00:12:52,959
why there's so many lately then I don't

345
00:12:56,190 --> 00:12:54,790
recall in the early stage at early days

346
00:12:57,990 --> 00:12:56,200
of Hubble course I've not been around as

347
00:12:59,670 --> 00:12:58,000
long but it seems me like this is sort

348
00:13:01,560 --> 00:12:59,680
of a trend now so that's good to know so

349
00:13:03,630 --> 00:13:01,570
Wow cuz you know what it started with

350
00:13:06,329 --> 00:13:03,640
your favorite observation that's right

351
00:13:08,370 --> 00:13:06,339
the hobby for you exact first one they

352
00:13:10,680 --> 00:13:08,380
want a pony looks the Deep Field you

353
00:13:13,650 --> 00:13:10,690
want to get started on that list I know

354
00:13:15,449 --> 00:13:13,660
okay I'm sorry are you all right I'll

355
00:13:17,400 --> 00:13:15,459
curb that but I will instead of talking

356
00:13:18,750 --> 00:13:17,410
about the Hubble Deep Field will talk

357
00:13:20,820 --> 00:13:18,760
about the deepest galaxies move that

358
00:13:22,290 --> 00:13:20,830
Hubble can see so which brings me to and

359
00:13:24,750 --> 00:13:22,300
as Carol's point as Carol

360
00:13:26,760 --> 00:13:24,760
to this candle survey was one of those

361
00:13:28,800 --> 00:13:26,770
things that had a lot of other science

362
00:13:30,420 --> 00:13:28,810
that could be done from it than what it

363
00:13:32,090 --> 00:13:30,430

wasn't originally intended from so

364
00:13:34,800 --> 00:13:32,100
Katherine tell us a little bit about

365
00:13:37,130 --> 00:13:34,810
what your work was I mean yet you

366
00:13:39,030 --> 00:13:37,140
started a little bit talking about this

367
00:13:41,010 --> 00:13:39,040
mosaicing technique that you were doing

368
00:13:44,040 --> 00:13:41,020
but tell us a little bit about how you

369
00:13:49,320 --> 00:13:44,050
started this and what the science was a

370
00:13:52,410 --> 00:13:49,330
driver behind it okay um all stuffed

371
00:13:57,630 --> 00:13:52,420
hours per day um I started working on

372
00:14:03,270 --> 00:13:57,640
two years ago so candles as in the near

373
00:14:06,750 --> 00:14:03,280
red bands if I'd Cara through P and we

374
00:14:11,580 --> 00:14:06,760
want how to love different way I think

375
00:14:14,970 --> 00:14:11,590
between the arc never so we want to be I

376
00:14:16,440 --> 00:14:14,980
ever okay so I'm getting we're getting

377
00:14:18,690 --> 00:14:16,450
are you guys hearing you're being really

378
00:14:20,670 --> 00:14:18,700
broke uppers it just me now I can hear

379
00:14:21,810 --> 00:14:20,680
idea yeah okay all right good so it

380
00:14:23,790 --> 00:14:21,820
sounds like you get your really broken

381
00:14:25,200 --> 00:14:23,800
up breaking up Katrin can you I don't

382
00:14:27,750 --> 00:14:25,210
know if there's a way to get on a wired

383
00:14:28,860 --> 00:14:27,760
connection or not or Barrois put your

384
00:14:29,850 --> 00:14:28,870
connecting your where you're breaking up

385
00:14:34,020 --> 00:14:29,860
and we can't understand what you're

386
00:14:35,520 --> 00:14:34,030
saying is they're all all right you

387
00:14:37,110 --> 00:14:35,530
could perhaps try getting out of the

388
00:14:38,820 --> 00:14:37,120

Hangout and coming back in or just

389
00:14:39,900 --> 00:14:38,830
trying to plug in a an Ethernet if

390
00:14:42,270 --> 00:14:39,910
you've got it i'm not sure if that's

391
00:14:44,040 --> 00:14:42,280
possible or not so while you're doing

392
00:14:46,710 --> 00:14:44,050
that so let me go to you Steve you have

393
00:14:49,800 --> 00:14:46,720
a sort we tell us a little about your

394
00:14:52,470 --> 00:14:49,810
role in this research and maybe maybe if

395
00:14:55,230 --> 00:14:52,480
you happen to know some of the science

396
00:15:00,210 --> 00:14:55,240
drivers early on behind it sure yeah so

397
00:15:01,740 --> 00:15:00,220
um the main thing we're after is how

398
00:15:04,020 --> 00:15:01,750
many galaxies are out there in the very

399
00:15:07,200 --> 00:15:04,030
distinct really how much light are they

400
00:15:08,520 --> 00:15:07,210
putting out because we want to know how

401
00:15:10,920 --> 00:15:08,530
something happens it's called

402
00:15:12,450 --> 00:15:10,930
reionization and so Rihanna zation is

403
00:15:14,130 --> 00:15:12,460
the process where the gas that's in

404
00:15:16,250 --> 00:15:14,140
between galaxies and the universe is

405
00:15:18,750 --> 00:15:16,260
filled with gas between at galaxies

406
00:15:20,400 --> 00:15:18,760
basically lost all their electrons so if

407
00:15:22,530 --> 00:15:20,410
this gas is mostly hydrogen which just

408
00:15:23,790 --> 00:15:22,540
has one electron when it's neutral but

409
00:15:25,290 --> 00:15:23,800
nowadays if you go out look at all that

410
00:15:26,670 --> 00:15:25,300
hydrogen gas between the galaxies is

411
00:15:28,470 --> 00:15:26,680
ionized they've lost their electrons

412
00:15:30,780 --> 00:15:28,480
it's just a proton and a neutron then

413
00:15:34,080 --> 00:15:30,790

just a proton just approach a bunch of

414
00:15:36,120 --> 00:15:34,090
protons yeah and so we think that that

415
00:15:37,530 --> 00:15:36,130
happened that process happen so

416
00:15:39,270 --> 00:15:37,540
we know I had to happen early on because

417
00:15:40,260 --> 00:15:39,280
we could look pretty far back you've

418
00:15:42,120 --> 00:15:40,270
been all the way out to a redshift of

419
00:15:43,320 --> 00:15:42,130
six or so just a little over a billion

420
00:15:45,030 --> 00:15:43,330
years after the Big Bang and everything

421
00:15:46,470 --> 00:15:45,040
is ionized and we know from our

422
00:15:48,210 --> 00:15:46,480
theoretical understanding that it had to

423
00:15:50,400 --> 00:15:48,220
be neutral at some point and so

424
00:15:51,810 --> 00:15:50,410
something had to ionize the gas this is

425
00:15:54,060 --> 00:15:51,820
this process is what we called Rihanna

426
00:15:55,320 --> 00:15:54,070
zation and people have been debating

427
00:15:57,270 --> 00:15:55,330
back and forth for a long time about

428
00:15:59,270 --> 00:15:57,280
what there was galaxies that produce the

429
00:16:01,290 --> 00:15:59,280
photons to do this or perhaps

430
00:16:02,850 --> 00:16:01,300
supermassive black holes that are

431
00:16:04,650 --> 00:16:02,860
creating lots of material and being

432
00:16:06,390 --> 00:16:04,660
entered very energetic and the earth

433
00:16:08,550 --> 00:16:06,400
we're still talking early universe right

434
00:16:11,280 --> 00:16:08,560
yeah so they were black holes around

435
00:16:13,140 --> 00:16:11,290
even at this stage well was so there's

436
00:16:14,490 --> 00:16:13,150
one at red chip seven we found one over

437
00:16:16,560 --> 00:16:14,500
age of seven and we found several rich

438
00:16:18,000 --> 00:16:16,570

of six but the current so the current

439
00:16:20,850 --> 00:16:18,010
thinking is that there are not enough

440
00:16:22,980 --> 00:16:20,860
black holes and so it must be galaxies

441
00:16:24,930 --> 00:16:22,990
and so the other way to answer that

442
00:16:26,910 --> 00:16:24,940
question is count up the galaxies and

443
00:16:29,370 --> 00:16:26,920
see if there are enough and this was one

444
00:16:30,960 --> 00:16:29,380
of the main goals of candles it's also a

445
00:16:33,150 --> 00:16:30,970
main goal of Pablo frontier fields is

446
00:16:36,120 --> 00:16:33,160
counting up all the galaxies you can see

447
00:16:38,250 --> 00:16:36,130
and are they producing enough photons to

448
00:16:41,190 --> 00:16:38,260
actually do this realization and the

449
00:16:43,380 --> 00:16:41,200
answer is actually no real it but if we

450
00:16:45,420 --> 00:16:43,390
extrapolate from what we see so we

451
00:16:47,400 --> 00:16:45,430
measure the distribution of luminosities

452
00:16:49,440 --> 00:16:47,410
and then we just start it's basically a

453
00:16:51,870 --> 00:16:49,450
histogram of galaxies brightnesses and

454
00:16:53,100 --> 00:16:51,880
it just cuts gets cut off at some point

455
00:16:55,200 --> 00:16:53,110
because Hubble can't see that deep but

456
00:16:57,360 --> 00:16:55,210
if we extrapolate that further down to

457
00:16:59,760 --> 00:16:57,370
where we think galaxies may exist what

458
00:17:00,900 --> 00:16:59,770
simulations tell us it is enough but we

459
00:17:03,030 --> 00:17:00,910
would like to observe them because

460
00:17:04,920 --> 00:17:03,040
simulations have been wrong before right

461
00:17:07,439 --> 00:17:04,930
it's just a prediction so that's what

462
00:17:09,900 --> 00:17:07,449
ketron has been has been doing so you

463
00:17:12,059 --> 00:17:09,910

really want to see them not just infer

464
00:17:13,650 --> 00:17:12,069
that they're there we really want to see

465
00:17:15,540 --> 00:17:13,660
him and so we're seeing some of them

466
00:17:17,760 --> 00:17:15,550
with the frontier fields will see even

467
00:17:22,260 --> 00:17:17,770
more with jwst will see even more with a

468
00:17:23,819 --> 00:17:22,270
jwst frontier fields program ooh even

469
00:17:26,220 --> 00:17:23,829
more unless you guys ever talk about the

470
00:17:29,340 --> 00:17:26,230
the high-definition Space Telescope if

471
00:17:30,750 --> 00:17:29,350
you had a we're not where we're going

472
00:17:32,370 --> 00:17:30,760
we're doing we're going to be doing that

473
00:17:34,350 --> 00:17:32,380
a lot more as time goes on we had we've

474
00:17:38,850 --> 00:17:34,360
had one hang out on that already yeah in

475
00:17:40,800 --> 00:17:38,860
in in other forum but so yeah so I want

476
00:17:42,930 --> 00:17:40,810
to I wanted this this idea of rihanna's

477
00:17:45,540 --> 00:17:42,940
ation is a very very interesting one to

478
00:17:48,090 --> 00:17:45,550
be but it but to sign i'm going to

479
00:17:49,380 --> 00:17:48,100
oversimplify it but it is a stage in the

480
00:17:55,140 --> 00:17:49,390
history of the universe

481
00:17:57,390 --> 00:17:55,150
we're at hydrogen atoms that were once

482
00:17:59,430 --> 00:17:57,400
had all of their uh it would basically

483
00:18:01,440 --> 00:17:59,440
permeated about the most of the dominant

484
00:18:04,350 --> 00:18:01,450
matter in the universe lost that

485
00:18:06,330 --> 00:18:04,360
electron do some mechanism you're saying

486
00:18:07,800 --> 00:18:06,340
that it could be black holes but there

487
00:18:09,420 --> 00:18:07,810
probably wasn't enough and it might be

488
00:18:15,300 --> 00:18:09,430

the galaxies but now you're saying

489
00:18:17,400 --> 00:18:15,310
probably not that either um well I right

490
00:18:19,950 --> 00:18:17,410
we just yeah well so what you would

491
00:18:21,900 --> 00:18:19,960
probably give the galaxies well if we

492
00:18:24,480 --> 00:18:21,910
can't see the galaxies that are doing it

493
00:18:26,190 --> 00:18:24,490
I see so I'm a limitation Hubble yeah so

494
00:18:28,440 --> 00:18:26,200
they're way more galaxies we can't see

495
00:18:29,850 --> 00:18:28,450
them we can't see oh yeah that being

496
00:18:31,650 --> 00:18:29,860
said there was actually another recent

497
00:18:33,600 --> 00:18:31,660
papers that came out of candles

498
00:18:36,510 --> 00:18:33,610
combining candles with Chandra x-ray

499
00:18:38,280 --> 00:18:36,520
data to show that perhaps there are a

500
00:18:40,260 --> 00:18:38,290
lot more plays are as a higher redshift

501
00:18:43,170 --> 00:18:40,270
than we think and maybe quasars could do

502
00:18:45,270 --> 00:18:43,180
it all okay so that's very recent that

503
00:18:46,890 --> 00:18:45,280
that paper came out quasars in the early

504
00:18:48,360 --> 00:18:46,900
universe so we're and what's the rough

505
00:18:50,820 --> 00:18:48,370
and so is the time periods Rihanna

506
00:18:53,430 --> 00:18:50,830
zation like what the history of this

507
00:18:54,480 --> 00:18:53,440
particular research paper around 500

508
00:18:56,070 --> 00:18:54,490
million years after the Big Bang is that

509
00:18:58,350 --> 00:18:56,080
the kind of time scale we're talking

510
00:18:59,790 --> 00:18:58,360
about here yeah so as probably we don't

511
00:19:01,950 --> 00:18:59,800
know but it was probably a process that

512
00:19:03,840 --> 00:19:01,960
took a few hundred million years and so

513
00:19:06,060 --> 00:19:03,850

our best constraints our Rionda station

514
00:19:08,910 --> 00:19:06,070
started you know maybe between redshift

515
00:19:11,250 --> 00:19:08,920
10 and 12 and ended at wretches 6 ok so

516
00:19:13,860 --> 00:19:11,260
there's there is this need then to count

517
00:19:15,360 --> 00:19:13,870
as many as we can of the galaxies that

518
00:19:17,760 --> 00:19:15,370
existed in this period of the universe

519
00:19:20,250 --> 00:19:17,770
the universe's history to determine if

520
00:19:22,050 --> 00:19:20,260
they were responsible for could have the

521
00:19:23,300 --> 00:19:22,060
energy enough to throw away all but not

522
00:19:25,860 --> 00:19:23,310
throw away with strip away these

523
00:19:28,500 --> 00:19:25,870
electrons from the early hydrogen atoms

524
00:19:30,510 --> 00:19:28,510
and this sounds like that and you're

525
00:19:33,000 --> 00:19:30,520
using Hubble to do it with candles among

526
00:19:34,770 --> 00:19:33,010
other things I wanted to talk to Karen

527
00:19:36,930 --> 00:19:34,780
about the method that he used with it

528
00:19:39,450 --> 00:19:36,940
but he hasn't returned yet is that

529
00:19:42,090 --> 00:19:39,460
something you can comment I can't really

530
00:19:44,970 --> 00:19:42,100
comment on on it I he will do a much

531
00:19:48,030 --> 00:19:44,980
better job than I will so it's plug in

532
00:19:51,210 --> 00:19:48,040
as Ethernet cable as we speak oh yeah so

533
00:19:52,830 --> 00:19:51,220
uh what he's trying to do I know you

534
00:19:55,080 --> 00:19:52,840
guys had that graphic you popped up a

535
00:19:58,410 --> 00:19:55,090
little bit ago those blue and red images

536
00:20:01,200 --> 00:19:58,420
so if you take you know all the galaxies

537
00:20:03,090 --> 00:20:01,210
that are below the Hubble detection that

538
00:20:05,010 --> 00:20:03,100

we can't resolve them we can't see them

539
00:20:06,450 --> 00:20:05,020
is actually still getting light from

540
00:20:08,760 --> 00:20:06,460
those galaxies there's just a lot of

541
00:20:10,710 --> 00:20:08,770
noise in there but those galaxies are

542
00:20:13,049 --> 00:20:10,720
distributed about the universe not in a

543
00:20:14,490 --> 00:20:13,059
random way but in a clustered way galaxy

544
00:20:16,980 --> 00:20:14,500
is like to live where other galaxies

545
00:20:19,320 --> 00:20:16,990
like to live galaxies cluster and so if

546
00:20:21,600 --> 00:20:19,330
you try to statistically look at the

547
00:20:25,200 --> 00:20:21,610
background and see if there's any kind

548
00:20:27,120 --> 00:20:25,210
of preferential clustering of the

549
00:20:28,950 --> 00:20:27,130
fluctuations of the background light in

550
00:20:30,810 --> 00:20:28,960
the image you may be able to get a

551
00:20:32,370 --> 00:20:30,820
handle on what's left so they take

552
00:20:34,799 --> 00:20:32,380
something like the candles image and

553
00:20:37,529 --> 00:20:34,809
remove all of the actual galaxies that

554
00:20:41,159 --> 00:20:37,539
we can see and try and see what's left

555
00:20:43,860 --> 00:20:41,169
essentially okay so what are we looking

556
00:20:45,779 --> 00:20:43,870
at here we've got three panels yeah and

557
00:20:48,870 --> 00:20:45,789
so so we should a sketch run again when

558
00:20:51,299 --> 00:20:48,880
he gets online Oh left one is the actual

559
00:20:53,820 --> 00:20:51,309
candles image and then the two right

560
00:20:55,470 --> 00:20:53,830
panels are two components of what is

561
00:20:56,760 --> 00:20:55,480
left after you take out the galaxy so

562
00:20:59,549 --> 00:20:56,770
all those little white dots in the left

563
00:21:00,779 --> 00:20:59,559

image you you can remove them or you or

564
00:21:02,430 --> 00:21:00,789
you the very least you mash them out

565
00:21:04,200 --> 00:21:02,440
that's actually what the holes are in

566
00:21:05,970 --> 00:21:04,210
the middle and the right panel right

567
00:21:07,799 --> 00:21:05,980
some of those dark holes correspond to

568
00:21:09,149 --> 00:21:07,809
some of the big sources so you just

569
00:21:10,529 --> 00:21:09,159
match those al you say I don't have any

570
00:21:12,149 --> 00:21:10,539
information here it's all blocked out by

571
00:21:14,730 --> 00:21:12,159
in your bike out and then you really

572
00:21:16,919 --> 00:21:14,740
just pump up what's left yeah and so it

573
00:21:18,990 --> 00:21:16,929
turns out there are two components the

574
00:21:20,190 --> 00:21:19,000
middle component was discovered at least

575
00:21:22,200 --> 00:21:20,200
to my knowledge at least robustly

576
00:21:24,060 --> 00:21:22,210
discovered last year where it was found

577
00:21:26,159 --> 00:21:24,070
that some of this background fluctuation

578
00:21:28,350 --> 00:21:26,169
is actually due to essentially homeless

579
00:21:29,640 --> 00:21:28,360
stars so stars that have been stripped

580
00:21:31,740 --> 00:21:29,650
out of their galaxies due to

581
00:21:33,149 --> 00:21:31,750
gravitational encounters this kind of

582
00:21:35,789 --> 00:21:33,159
free-floating stars out there in the

583
00:21:37,470 --> 00:21:35,799
universe ah but what ketra was able to

584
00:21:39,419 --> 00:21:37,480
do with candles with unique wavelength

585
00:21:40,980 --> 00:21:39,429
range and depth probe by candles will

586
00:21:43,230 --> 00:21:40,990
show that there was a second component

587
00:21:47,090 --> 00:21:43,240
from galaxies that had to be coming from

588
00:21:50,039 --> 00:21:47,100

the very early universe okay so nothing

589
00:21:53,669 --> 00:21:50,049
just to put a little bit of context here

590
00:21:56,549 --> 00:21:53,679
this leftmost panel is a extremely teeny

591
00:21:58,470 --> 00:21:56,559
tiny little square of the sky we're

592
00:22:00,779 --> 00:21:58,480
talking about a very tiny amount here

593
00:22:02,850 --> 00:22:00,789
odd good he looks like he's back yeah

594
00:22:04,830 --> 00:22:02,860
sorry about that and that's quite all

595
00:22:06,090 --> 00:22:04,840
right you very much better now I've got

596
00:22:07,289 --> 00:22:06,100
some more questions for you and we're

597
00:22:09,480 --> 00:22:07,299
just kind of explaining what's going on

598
00:22:11,250 --> 00:22:09,490
so this was what we're looking at in

599
00:22:12,960 --> 00:22:11,260
this panel and and steve was given us a

600
00:22:15,390 --> 00:22:12,970
little bit of background on what we're

601
00:22:16,950 --> 00:22:15,400
looking at but I was just trying to get

602
00:22:18,600 --> 00:22:16,960
some context with this when it says

603
00:22:20,519 --> 00:22:18,610
I we're looking at a real teeny tiny

604
00:22:22,230 --> 00:22:20,529
portion of the sky so why don't you

605
00:22:25,950 --> 00:22:22,240
describe for us where I'd like to learn

606
00:22:27,570 --> 00:22:25,960
a little bit about what you did to to

607
00:22:29,580 --> 00:22:27,580
sort of do this statistical analysis

608
00:22:31,230 --> 00:22:29,590
with this data and and steve has already

609
00:22:33,690 --> 00:22:31,240
said that you've taken the stars here

610
00:22:35,100 --> 00:22:33,700
and the ones that have been when you

611
00:22:37,590 --> 00:22:35,110
call them tightly striptease or stars

612
00:22:40,200 --> 00:22:37,600
they that are meant to be ripped away

613
00:22:41,399 --> 00:22:40,210

from their host galaxies well what we're

614
00:22:44,730 --> 00:22:41,409
left with is what's in them in the

615
00:22:46,680 --> 00:22:44,740
center the center panel and ran and then

616
00:22:49,320 --> 00:22:46,690
you did something I missed it about to

617
00:22:51,720 --> 00:22:49,330
get us to the to the right panel yeah so

618
00:22:53,659 --> 00:22:51,730
actually both of those the second and

619
00:22:57,659 --> 00:22:53,669
third panels were both reconstructions

620
00:23:00,990 --> 00:22:57,669
actually of model fits that we did so

621
00:23:02,730 --> 00:23:01,000
after I made mosaics in oh it is where

622
00:23:04,909 --> 00:23:02,740
you apply to model to what the

623
00:23:08,130 --> 00:23:04,919
background of this of the leftmost image

624
00:23:11,220 --> 00:23:08,140
that's right yeah so well a masked

625
00:23:16,169 --> 00:23:11,230
version of that sky so after we removed

626
00:23:19,230 --> 00:23:16,179
all the point sources we we isolated the

627
00:23:21,180 --> 00:23:19,240
background light and the statistics

628
00:23:23,940 --> 00:23:21,190
comes in because we do what's called the

629
00:23:27,269 --> 00:23:23,950
angular power spectrum it's very similar

630
00:23:28,649 --> 00:23:27,279
to what they did for the CMB uh that's a

631
00:23:31,950 --> 00:23:28,659
that's a Fourier transform technique

632
00:23:34,380 --> 00:23:31,960
right yeah exactly yeah yeah so on on

633
00:23:36,149 --> 00:23:34,390
small areas it's a Fourier transform on

634
00:23:38,399 --> 00:23:36,159
larger areas it's just a decomposition

635
00:23:41,519 --> 00:23:38,409
of the sky into the spherical harmonics

636
00:23:43,320 --> 00:23:41,529
yeah okay so and so with this is what

637
00:23:44,549 --> 00:23:43,330
this is a technique folks where if you

638
00:23:45,960 --> 00:23:44,559

have something that looks like a lot of

639
00:23:48,139 --> 00:23:45,970
noise if there's any pattern in there

640
00:23:52,289 --> 00:23:48,149
it'll come out in one of those kinds of

641
00:23:55,769 --> 00:23:52,299
transforms so so you did that we did

642
00:23:57,419 --> 00:23:55,779
that and then we have a power spectrum

643
00:24:01,230 --> 00:23:57,429
measurement for all these different

644
00:24:03,649 --> 00:24:01,240
bands and then a Santa and his postdoc

645
00:24:06,649 --> 00:24:03,659
applies these relatively complicated

646
00:24:11,370 --> 00:24:06,659
theoretical models and they fit the data

647
00:24:16,019 --> 00:24:11,380
with their models because so once once

648
00:24:17,700 --> 00:24:16,029
they fit the data they give me basically

649
00:24:20,070 --> 00:24:17,710
the model parameters and then what I do

650
00:24:23,940 --> 00:24:20,080
is I invert the power spectra from those

651
00:24:26,850 --> 00:24:23,950
models back to real space and you can

652
00:24:30,150 --> 00:24:26,860
see in the second and third figures what

653
00:24:32,400 --> 00:24:30,160
oh and then you count up ok oh

654
00:24:33,840 --> 00:24:32,410
get it now all right so you start with

655
00:24:35,670 --> 00:24:33,850
the background image of the sky and

656
00:24:37,500 --> 00:24:35,680
candles we get rid of the stars you do a

657
00:24:40,440 --> 00:24:37,510
Fourier transform of or power get a

658
00:24:42,330 --> 00:24:40,450
power spectrum of it you apply a model

659
00:24:45,180 --> 00:24:42,340
which says look if your power spectrum

660
00:24:47,130 --> 00:24:45,190
looks like this then you have this many

661
00:24:49,680 --> 00:24:47,140
galaxies in and your Galaxy model will

662
00:24:51,450 --> 00:24:49,690
look like what I say and then you took

663
00:24:52,980 --> 00:24:51,460

that model and said okay good well this

664
00:24:54,990 --> 00:24:52,990
is what we have the power spectrum does

665
00:24:57,690 --> 00:24:55,000
look like this model let me invert it

666
00:24:59,130 --> 00:24:57,700
back into space and i will show you and

667
00:25:01,230 --> 00:24:59,140
there's the end of the galaxies and then

668
00:25:05,910 --> 00:25:01,240
you count them all up that's right yeah

669
00:25:09,000 --> 00:25:05,920
okay so um and I whole process took two

670
00:25:10,680 --> 00:25:09,010
years and that whole thing but that's

671
00:25:12,930 --> 00:25:10,690
still really cool i mean i like that

672
00:25:15,330 --> 00:25:12,940
that's what so that is how and now okay

673
00:25:16,800 --> 00:25:15,340
so this is stuff that's down in the

674
00:25:18,240 --> 00:25:16,810
noise of an image when you talk about a

675
00:25:19,770 --> 00:25:18,250
background of an image this is stuff

676
00:25:22,470 --> 00:25:19,780
where everything is like you don't know

677
00:25:24,480 --> 00:25:22,480
if you're looking at noise with from the

678
00:25:26,940 --> 00:25:24,490
sky or from the instrument or from

679
00:25:29,370 --> 00:25:26,950
Hubble or from whatever or if you're

680
00:25:31,500 --> 00:25:29,380
looking at actual signal is did you get

681
00:25:34,530 --> 00:25:31,510
that from the Fourier transform is that

682
00:25:38,190 --> 00:25:34,540
yeah well we're looking at correlation

683
00:25:39,870 --> 00:25:38,200
so a lot of the noise is uncorrelated so

684
00:25:41,040 --> 00:25:39,880
what I did is I made well you got to

685
00:25:43,560 --> 00:25:41,050
describe what you mean by that what I

686
00:25:48,300 --> 00:25:43,570
mean the noise is uncorrelated with what

687
00:25:49,620 --> 00:25:48,310
uh with itself so noise is not

688
00:25:54,420 --> 00:25:49,630

correlated with itself that's a

689
00:25:57,960 --> 00:25:54,430
definition no matter so so what I did is

690
00:26:01,350 --> 00:25:57,970
I made uh two different images of the

691
00:26:03,330 --> 00:26:01,360
same area of sky for each filter so what

692
00:26:05,100 --> 00:26:03,340
I would do is I would take one image

693
00:26:07,050 --> 00:26:05,110
that has the exact same sky as the other

694
00:26:09,930 --> 00:26:07,060
like to the pixel they're aligned but

695
00:26:11,160 --> 00:26:09,940
but different filters sit same filter or

696
00:26:12,720 --> 00:26:11,170
a different filter but let's let's just

697
00:26:14,370 --> 00:26:12,730
talk about the auto power spectra so for

698
00:26:19,160 --> 00:26:14,380
the same filter I would make two maps

699
00:26:22,500 --> 00:26:19,170
and if I if I took the power spectrum of

700
00:26:24,990 --> 00:26:22,510
those two maps together then what would

701
00:26:28,290 --> 00:26:25,000
happen is that the the uncorrelated

702
00:26:31,800 --> 00:26:28,300
noise would drop out of it okay that

703
00:26:33,990 --> 00:26:31,810
makes sense yes I think well enough in a

704
00:26:35,430 --> 00:26:34,000
sense enough I think so okay so you were

705
00:26:37,230 --> 00:26:35,440
able to and that gives you you obviously

706
00:26:39,300 --> 00:26:37,240
have some confidence level then in what

707
00:26:41,310 --> 00:26:39,310
you're what you've got here yeah sure so

708
00:26:43,840 --> 00:26:41,320
so to get them basically the noise power

709
00:26:46,210 --> 00:26:43,850
spectrum is i would subtract those two

710
00:26:47,260 --> 00:26:46,220
maps from each other and that in

711
00:26:49,480 --> 00:26:47,270
principle would take out the

712
00:26:51,789 --> 00:26:49,490
astrophysical signal and then I would

713
00:26:54,820 --> 00:26:51,799

take the power spectrum of that and I

714
00:26:56,529 --> 00:26:54,830
with the galaxies and that way mom yeah

715
00:26:59,500 --> 00:26:56,539
well that would be our error bars part

716
00:27:02,080 --> 00:26:59,510
of our Arab oh okay good awesome well

717
00:27:03,909 --> 00:27:02,090
good all right so uh in a minute I'm

718
00:27:05,320 --> 00:27:03,919
going to get to what your answer was and

719
00:27:08,049 --> 00:27:05,330
what you found after doing all of that

720
00:27:09,430 --> 00:27:08,059
but woot vanderheide is asking and then

721
00:27:12,549 --> 00:27:09,440
it's got a few wouldn't mind I had asked

722
00:27:13,960 --> 00:27:12,559
you to grab a diagram for me that sort

723
00:27:15,820 --> 00:27:13,970
of shows the oakley you've got something

724
00:27:17,200 --> 00:27:15,830
else up what he got up so what did it no

725
00:27:18,610 --> 00:27:17,210
no well we'll come right back to that

726
00:27:22,120 --> 00:27:18,620
but if I could get you to put up that

727
00:27:23,740 --> 00:27:22,130
map for me or that diagram for me he is

728
00:27:25,270 --> 00:27:23,750
asking and I want to go back to the side

729
00:27:28,000 --> 00:27:25,280
this period of rihanna's ation because

730
00:27:30,700 --> 00:27:28,010
it's important he's asking when and how

731
00:27:33,100 --> 00:27:30,710
did Rihanna zation occur now let this

732
00:27:34,960 --> 00:27:33,110
diagram kind of shows a history of the

733
00:27:38,680 --> 00:27:34,970
universe this is one of my favorite kind

734
00:27:40,600 --> 00:27:38,690
of descriptions of the way in which

735
00:27:43,000 --> 00:27:40,610
things happened in the universe so Steve

736
00:27:46,200 --> 00:27:43,010
can you give us some sense of where in

737
00:27:49,690 --> 00:27:46,210
this thing the rihanna's ation would lie

738
00:27:52,120 --> 00:27:49,700

I think I'm reading it right now it

739
00:27:54,250 --> 00:27:52,130
looks like the second slice from the

740
00:27:58,419 --> 00:27:54,260
right the kind of purple one we're sort

741
00:27:59,560 --> 00:27:58,429
of the first galaxies are forming so so

742
00:28:01,630 --> 00:27:59,570
this point where says structure

743
00:28:04,750 --> 00:28:01,640
formation that's what we're talking

744
00:28:06,070 --> 00:28:04,760
about here and and so we're looking you

745
00:28:08,919 --> 00:28:06,080
know this is what about a billion years

746
00:28:10,510 --> 00:28:08,929
or so after the Big Bang and the way if

747
00:28:11,919 --> 00:28:10,520
you go backward you see all kinds of

748
00:28:13,510 --> 00:28:11,929
very strange things happening not the

749
00:28:15,190 --> 00:28:13,520
least of which is inflation but that's

750
00:28:17,860 --> 00:28:15,200
all outside of the order of this thing

751
00:28:19,000 --> 00:28:17,870
but this is when we're talking about in

752
00:28:20,799 --> 00:28:19,010
the history of the universe so about a

753
00:28:23,890 --> 00:28:20,809
billion a little bit before that years

754
00:28:25,450 --> 00:28:23,900
after the Big Bang as far as how Rihanna

755
00:28:27,159 --> 00:28:25,460
Rihanna zation occurred that's what

756
00:28:30,070 --> 00:28:27,169
we're trying to figure out now right

757
00:28:32,710 --> 00:28:30,080
guys that's right so as well as Steve

758
00:28:34,870 --> 00:28:32,720
was saying it thought that it could be

759
00:28:35,830 --> 00:28:34,880
due to black holes well it could be

760
00:28:37,659 --> 00:28:35,840
doing this but then there probably

761
00:28:39,220 --> 00:28:37,669
wasn't enough this early on in the

762
00:28:40,539 --> 00:28:39,230
universe's history and now they're

763
00:28:43,270 --> 00:28:40,549

trying to determine if there are enough

764
00:28:46,120 --> 00:28:43,280
galaxies in the early universe to have

765
00:28:48,279 --> 00:28:46,130
had the energy to do this and and what

766
00:28:50,710 --> 00:28:48,289
Catron's been doing is try to figure out

767
00:28:54,640 --> 00:28:50,720
using these Fourier analysis techniques

768
00:28:56,350 --> 00:28:54,650
and modeling how many that were so

769
00:28:57,640 --> 00:28:56,360
you've got your error bars catcher and

770
00:28:59,560 --> 00:28:57,650
you've got you if you figured out

771
00:29:02,440 --> 00:28:59,570
out you party got a pretty good idea of

772
00:29:05,530 --> 00:29:02,450
your little slice of sky there how many

773
00:29:08,350 --> 00:29:05,540
galaxies did you find well what's the so

774
00:29:11,440 --> 00:29:08,360
what'd you find out how many are there

775
00:29:14,410 --> 00:29:11,450
enough galaxies do you think to do this

776
00:29:19,840 --> 00:29:14,420
kind of reorganization and how many are

777
00:29:23,590 --> 00:29:19,850
there i yes there are enough we found

778
00:29:26,650 --> 00:29:23,600
that there are an order of ten times as

779
00:29:28,330 --> 00:29:26,660
many as we previously thought ten times

780
00:29:34,810 --> 00:29:28,340
more galaxies in what everybody thought

781
00:29:38,200 --> 00:29:34,820
before yeah so a typical deep survey for

782
00:29:40,840 --> 00:29:38,210
Hubble usually takes really long

783
00:29:42,550 --> 00:29:40,850
integrations over a smaller area and

784
00:29:44,530 --> 00:29:42,560
what they pick up is really the

785
00:29:47,770 --> 00:29:44,540
brightest sources at these really old

786
00:29:50,710 --> 00:29:47,780
epochs but what we're doing is picking

787
00:29:53,290 --> 00:29:50,720
up a signal from kind of the more

788
00:29:56,470 --> 00:29:53,300

character characteristic population okay

789
00:30:01,960 --> 00:29:56,480
that's not as bright so is what Scott

790
00:30:03,400 --> 00:30:01,970
showing now uh describing that what is

791
00:30:07,570 --> 00:30:03,410
this showing actually I don't get it

792
00:30:10,680 --> 00:30:07,580
yeah so the this is a the brightness of

793
00:30:14,230 --> 00:30:10,690
the background light as a function of

794
00:30:16,120 --> 00:30:14,240
wavelength so this wave links at the

795
00:30:18,930 --> 00:30:16,130
bottom and brightest okay yeah that's

796
00:30:21,280 --> 00:30:18,940
right so the star-formation rate is is

797
00:30:24,640 --> 00:30:21,290
directly proportional to the amplitude

798
00:30:28,120 --> 00:30:24,650
of our power spectra and that's shown

799
00:30:30,910 --> 00:30:28,130
with those yellow points so the two

800
00:30:32,410 --> 00:30:30,920
right word yellow yellow points are the

801
00:30:33,610 --> 00:30:32,420
whip see three bands and those are the

802
00:30:37,240 --> 00:30:33,620
two bands where we're picking up this

803
00:30:38,470 --> 00:30:37,250
very important yeah yeah and then you go

804
00:30:41,500 --> 00:30:38,480
to the shorter bands and the signal just

805
00:30:43,750 --> 00:30:41,510
totally drops out and that doesn't

806
00:30:45,910 --> 00:30:43,760
contain any high redshift component in

807
00:30:49,420 --> 00:30:45,920
it so based on the amplitude of that

808
00:30:52,110 --> 00:30:49,430
brightness we can kind of deduce the

809
00:30:55,390 --> 00:30:52,120
amount of star formation that's going on

810
00:30:57,190 --> 00:30:55,400
which tells you then how many galaxies

811
00:30:58,300 --> 00:30:57,200
there are yeah that's right I'm trying

812
00:30:59,830 --> 00:30:58,310
to get to the connection between the

813
00:31:02,020 --> 00:30:59,840

galaxies what's that red line there that

814
00:31:03,550 --> 00:31:02,030
just peeks at the near-infrared what

815
00:31:04,870 --> 00:31:03,560
what's the wave I can't see because

816
00:31:08,080 --> 00:31:04,880
everybody's thumbnails what's the

817
00:31:10,510 --> 00:31:08,090
wavelength um that's right around one

818
00:31:11,299 --> 00:31:10,520
micron all those are microns okay one

819
00:31:13,549 --> 00:31:11,309
right

820
00:31:15,259 --> 00:31:13,559
have one Mike okay good so it Peaks

821
00:31:17,060 --> 00:31:15,269
right around mount one micron and so

822
00:31:19,180 --> 00:31:17,070
this is where candles was giving you a

823
00:31:21,799 --> 00:31:19,190
lot of data you said you also used uh

824
00:31:25,220 --> 00:31:21,809
archived data for this as well yeah I

825
00:31:28,039 --> 00:31:25,230
did so Steve mentioned a good survey so

826
00:31:31,249 --> 00:31:28,049
this does not be before candles yeah

827
00:31:34,279 --> 00:31:31,259
that's right i think in 2004 gia Velasco

828
00:31:37,580 --> 00:31:34,289
had a lot of observations in the

829
00:31:41,509 --> 00:31:37,590
advanced camera for surveys the ACS it's

830
00:31:45,499 --> 00:31:41,519
been on Hubble so what actually happened

831
00:31:47,840 --> 00:31:45,509
I think on the fourth servicing mission

832
00:31:51,950 --> 00:31:47,850
of Hubble they replaced so the readout

833
00:31:54,440 --> 00:31:51,960
box for acs and that introduced some

834
00:31:56,259 --> 00:31:54,450
correlated noise into the instrument so

835
00:31:59,720 --> 00:31:56,269
we actually couldn't use that much

836
00:32:04,690 --> 00:31:59,730
candles data from acs because of that so

837
00:32:07,759 --> 00:32:04,700
we had to use archive data and we used

838
00:32:12,169 --> 00:32:07,769

the majority of the ACS data is from the

839
00:32:15,019 --> 00:32:12,179
archive from between 2001 and 2011 I

840
00:32:16,909 --> 00:32:15,029
think okay all right so you found 10

841
00:32:18,649 --> 00:32:16,919
times more galaxies and we're previously

842
00:32:20,029 --> 00:32:18,659
thought in this period of the universe

843
00:32:25,789 --> 00:32:20,039
you think there's more than enough now

844
00:32:27,230 --> 00:32:25,799
to come to uh to understand the i don't

845
00:32:29,119 --> 00:32:27,240
know if i should say the engine of

846
00:32:30,289 --> 00:32:29,129
rihanna's ation or not but something

847
00:32:34,129 --> 00:32:30,299
that at least there's an X there's a

848
00:32:36,619 --> 00:32:34,139
driver behind some of it at least what

849
00:32:39,619 --> 00:32:36,629
it can you would it be helpful to go

850
00:32:42,440 --> 00:32:39,629
back any further than this particular

851
00:32:43,940 --> 00:32:42,450
period that candles was looking at or is

852
00:32:47,480 --> 00:32:43,950
this pretty much as far back you need to

853
00:32:49,730 --> 00:32:47,490
go Colin I mean yeah cosmological ear in

854
00:32:51,799 --> 00:32:49,740
the universe is this about as it would

855
00:32:56,930 --> 00:32:51,809
help to go any further back well if we

856
00:33:02,029 --> 00:32:56,940
could we would and why can't you well

857
00:33:03,289 --> 00:33:02,039
said was right right so what vui you see

858
00:33:05,509 --> 00:33:03,299
Rob go over this you've pretty much

859
00:33:08,480 --> 00:33:05,519
reached a limit of where Hubble can

860
00:33:10,850 --> 00:33:08,490
lease in terms of candles can do Carolyn

861
00:33:13,549 --> 00:33:10,860
gasps planning for their TARDIS yet they

862
00:33:14,960 --> 00:33:13,559
are waiting and exactly so I mean I

863
00:33:16,460 --> 00:33:14,970

don't Carol I don't know if you know

864
00:33:18,139 --> 00:33:16,470
this or not but is it possible to do

865
00:33:19,940 --> 00:33:18,149
anything more with this do you think

866
00:33:21,440 --> 00:33:19,950
with the frontier fields because

867
00:33:23,509 --> 00:33:21,450
frontier fields is cheating a little bit

868
00:33:25,160 --> 00:33:23,519
frontier fields is using lenses galaxy

869
00:33:27,440 --> 00:33:25,170
lenses to kind of boost the power

870
00:33:30,590 --> 00:33:27,450
bubble is there a chance you think maybe

871
00:33:32,600 --> 00:33:30,600
biting you mean science Aang yeah no I

872
00:33:35,540 --> 00:33:32,610
think our guests are better suited to

873
00:33:40,520 --> 00:33:35,550
answer the thing is that yeah it looks

874
00:33:42,560 --> 00:33:40,530
back um part of the thing I mean for me

875
00:33:46,280 --> 00:33:42,570
thinking about the frontier fields data

876
00:33:48,350 --> 00:33:46,290
you've got this lensing stuff going on

877
00:33:50,450 --> 00:33:48,360
so talking about how you're going to

878
00:33:51,950 --> 00:33:50,460
handle the instrumentation and how

879
00:33:54,920 --> 00:33:51,960
you're going to subtract out the lens

880
00:33:59,210 --> 00:33:54,930
galaxies and the behind galaxies and see

881
00:34:01,310 --> 00:33:59,220
what noise you have left um I would

882
00:34:03,230 --> 00:34:01,320
think it would be possible but you

883
00:34:05,870 --> 00:34:03,240
should I what do you hope what do you

884
00:34:08,300 --> 00:34:05,880
think lens models to do that what do you

885
00:34:10,760 --> 00:34:08,310
think Catrin are you do you think they

886
00:34:13,520 --> 00:34:10,770
are less shy than I am about that kind

887
00:34:15,650 --> 00:34:13,530
of day does that complicate things

888
00:34:17,450 --> 00:34:15,660

having to undo the lensing models with

889
00:34:21,830 --> 00:34:17,460
with with frontier fields would that

890
00:34:23,409 --> 00:34:21,840
help you at all or no um well I think

891
00:34:26,300 --> 00:34:23,419
that's a fundamentally different

892
00:34:28,610 --> 00:34:26,310
technique than what we're doing here but

893
00:34:30,320 --> 00:34:28,620
it people do do that yeah okay all right

894
00:34:32,270 --> 00:34:30,330
so probably not is basically yet so I

895
00:34:33,770 --> 00:34:32,280
think I think the bigger issue there and

896
00:34:35,600 --> 00:34:33,780
Catrin can correct me if I'm wrong is

897
00:34:37,190 --> 00:34:35,610
that the area that you get for each

898
00:34:39,830 --> 00:34:37,200
frontier fields cluster is much smaller

899
00:34:41,630 --> 00:34:39,840
yeah and one of the candles familes and

900
00:34:44,210 --> 00:34:41,640
so you've been basically on you're going

901
00:34:45,680 --> 00:34:44,220
a little deeper but I think it's yeah

902
00:34:47,810 --> 00:34:45,690
it's not really adding that much area

903
00:34:49,100 --> 00:34:47,820
and then you know you have to mask out

904
00:34:50,780 --> 00:34:49,110
everything that's in the image and

905
00:34:52,400 --> 00:34:50,790
there's a lot more galaxies and an image

906
00:34:54,409 --> 00:34:52,410
of a galaxy cluster than in the candles

907
00:34:55,940 --> 00:34:54,419
field and so not only you starting from

908
00:34:57,770 --> 00:34:55,950
a smaller image you then have to mask a

909
00:35:00,380 --> 00:34:57,780
bunch of it out so you're losing a bunch

910
00:35:02,630 --> 00:35:00,390
of space you're losing more pixels okay

911
00:35:04,160 --> 00:35:02,640
so so so candles really was the ideal

912
00:35:07,190 --> 00:35:04,170
data set to help with this with this

913
00:35:09,100 --> 00:35:07,200

kind of research then not so much I

914
00:35:12,400 --> 00:35:09,110
think you kind of need annex

915
00:35:15,500 --> 00:35:12,410
unobstructed view and that's why

916
00:35:17,240 --> 00:35:15,510
telescopes like Jay Davis tea and high

917
00:35:18,590 --> 00:35:17,250
definition of space telescope of

918
00:35:21,200 --> 00:35:18,600
interest because if you want to keep

919
00:35:24,350 --> 00:35:21,210
picking away at this problem down at

920
00:35:27,800 --> 00:35:24,360
this level of noise um you really need

921
00:35:31,640 --> 00:35:27,810
more powerful and bigger telescope and

922
00:35:33,230 --> 00:35:31,650
and more powerful I'm so happy you went

923
00:35:36,290 --> 00:35:33,240
there Carol so let's talk about that

924
00:35:38,690 --> 00:35:36,300
person Katherine can you comment on that

925
00:35:42,200 --> 00:35:38,700
just a little bit i mean the the

926
00:35:43,609 --> 00:35:42,210
so we've done we've done a lot of work

927
00:35:45,349 --> 00:35:43,619
with Hubble about as much as Hubble can

928
00:35:47,780 --> 00:35:45,359
do with this kind of research with

929
00:35:49,520 --> 00:35:47,790
finding these early galaxies in what way

930
00:35:51,230 --> 00:35:49,530
does it help let me ask you this I know

931
00:35:53,060 --> 00:35:51,240
jwst is probably going to be able to

932
00:35:55,210 --> 00:35:53,070
help in this way but what way are you

933
00:36:00,290 --> 00:35:55,220
helping jwst I want to start there first

934
00:36:01,370 --> 00:36:00,300
um directly or indirectly well indirect

935
00:36:04,099 --> 00:36:01,380
I mean aren't you kind of setting the

936
00:36:06,950 --> 00:36:04,109
stage for the signatures and the early

937
00:36:09,410 --> 00:36:06,960
work that if Hubble if you push JWST for

938
00:36:12,950 --> 00:36:09,420

example like you do Hubble and you get

939
00:36:15,440 --> 00:36:12,960
you can help jws team a little bit with

940
00:36:19,120 --> 00:36:15,450
its maybe pushing the boundaries a

941
00:36:21,770 --> 00:36:19,130
little bit am I wrong hopefully oh yeah

942
00:36:24,020 --> 00:36:21,780
maybe they'll be inclined to accept

943
00:36:27,020 --> 00:36:24,030
proposals with this kind of observation

944
00:36:28,700 --> 00:36:27,030
pattern I say ok good so I and of course

945
00:36:34,130 --> 00:36:28,710
then the next question is is jwst gonna

946
00:36:35,240 --> 00:36:34,140
help with this oh absolutely yeah so

947
00:36:37,490 --> 00:36:35,250
there's a chance that they could even

948
00:36:39,560 --> 00:36:37,500
resolve these individual galaxies but

949
00:36:42,560 --> 00:36:39,570
yeah because right now what you're

950
00:36:45,530 --> 00:36:42,570
looking at in noise or in background I

951
00:36:47,180 --> 00:36:45,540
shouldn't call it noise is JW might

952
00:36:49,069 --> 00:36:47,190
actually be able to lose resolve correct

953
00:36:52,460 --> 00:36:49,079
yeah this is so everything I do is

954
00:36:53,930 --> 00:36:52,470
unresolved it's just blobs of over and

955
00:36:55,190 --> 00:36:53,940
under densities right that's an

956
00:36:56,900 --> 00:36:55,200
important point because you're relying

957
00:36:59,720 --> 00:36:56,910
on these power spectra to point out the

958
00:37:01,849 --> 00:36:59,730
features of these things for you and to

959
00:37:03,859 --> 00:37:01,859
identify them in these models to sort of

960
00:37:05,750 --> 00:37:03,869
unravel what you're looking at but here

961
00:37:08,210 --> 00:37:05,760
JW will actually provide observations

962
00:37:09,230 --> 00:37:08,220
correct yeah and the resolution and the

963
00:37:13,160 --> 00:37:09,240

sensitivity is going to be so much

964
00:37:15,230 --> 00:37:13,170
higher that they might even resolve them

965
00:37:18,079 --> 00:37:15,240
individually and then of course after

966
00:37:19,579 --> 00:37:18,089
that we've got even bigger HD st as

967
00:37:22,250 --> 00:37:19,589
Carol pointed out coming out a salute

968
00:37:24,200 --> 00:37:22,260
what about wlb that's what's to you

969
00:37:26,089 --> 00:37:24,210
missed talking about is that it you know

970
00:37:28,910 --> 00:37:26,099
you picking away at this problem and

971
00:37:32,059 --> 00:37:28,920
then you you so I think what's being

972
00:37:35,180 --> 00:37:32,069
said here is that you can infer that

973
00:37:36,650 --> 00:37:35,190
those objects exist but you really want

974
00:37:38,990 --> 00:37:36,660
to see them that's right that's a good

975
00:37:40,220 --> 00:37:39,000
point so right now I'm furring based on

976
00:37:42,440 --> 00:37:40,230
power spectra that they're there and

977
00:37:44,270 --> 00:37:42,450
models that suggested they should be

978
00:37:45,530 --> 00:37:44,280
there but we haven't actually took put

979
00:37:47,180 --> 00:37:45,540
our fingers on them yet and said yes

980
00:37:48,890 --> 00:37:47,190
there's one and that's where the

981
00:37:52,069 --> 00:37:48,900
frontier fields can't help out they are

982
00:37:53,239 --> 00:37:52,079
not going to see them all but we are

983
00:37:54,920 --> 00:37:53,249
we're working on the frontier fields of

984
00:37:56,539 --> 00:37:54,930
my group we're finding a lot of very

985
00:37:57,920 --> 00:37:56,549
very faint galaxies that little good

986
00:37:59,809 --> 00:37:57,930
major that Hubble is able to see before

987
00:38:01,459 --> 00:37:59,819
so maybe we can do another hangout on

988
00:38:02,569 --> 00:38:01,469

that sometime of course you're right dad

989
00:38:03,949 --> 00:38:02,579
paper we haven't done the frontier

990
00:38:04,910 --> 00:38:03,959
fields one in a while so yes I

991
00:38:06,049 --> 00:38:04,920
definitely like to talk a little bit

992
00:38:07,449 --> 00:38:06,059
more about what's going on there so

993
00:38:09,739 --> 00:38:07,459
that's great that's great news okay

994
00:38:11,959 --> 00:38:09,749
first key meant to W first w first would

995
00:38:13,759 --> 00:38:11,969
also be very useful for these types of

996
00:38:15,799 --> 00:38:13,769
analyses because it's because that's not

997
00:38:16,910 --> 00:38:15,809
very wide yields that's right good I'm

998
00:38:18,289 --> 00:38:16,920
glad you do because that's going to be

999
00:38:20,029 --> 00:38:18,299
the reason I wanted to bring it up was

1000
00:38:23,120 --> 00:38:20,039
because that's gonna be before HD st so

1001
00:38:24,380 --> 00:38:23,130
uh so W so W first we'll be able to

1002
00:38:25,640 --> 00:38:24,390
contribute to this quite a bit actually

1003
00:38:27,079 --> 00:38:25,650
I would imagine because it can look at

1004
00:38:29,449 --> 00:38:27,089
you Jerry's at the sky yeah absolutely

1005
00:38:31,579 --> 00:38:29,459
can look at huge areas but it's a it's a

1006
00:38:33,739 --> 00:38:31,589
Hubble size telescope but a single a

1007
00:38:36,829 --> 00:38:33,749
single picture with W first is something

1008
00:38:38,779 --> 00:38:36,839
like a hundred times the area of a

1009
00:38:40,670 --> 00:38:38,789
single picture with Hubble so Katherine

1010
00:38:43,999 --> 00:38:40,680
I know this is a loaded question but the

1011
00:38:47,299 --> 00:38:44,009
the European on track your grad student

1012
00:38:50,029 --> 00:38:47,309
ready to become a PhD are you are you

1013
00:38:52,940 --> 00:38:50,039

excited about using hjw ste and then

1014
00:38:57,079 --> 00:38:52,950
following by a w first and are you going

1015
00:38:59,059 --> 00:38:57,089
to be getting your PhD soon I get a

1016
00:39:03,289 --> 00:38:59,069
terrible question are you getting your

1017
00:39:05,269 --> 00:39:03,299
ph a terrible quail you on track are you

1018
00:39:07,069 --> 00:39:05,279
yeah i actually i think i'll probably

1019
00:39:10,069 --> 00:39:07,079
get him about it next year we're gonna

1020
00:39:13,400 --> 00:39:10,079
view you a few you're not so I mean ever

1021
00:39:16,699 --> 00:39:13,410
for you to phd comics I'm not ask you

1022
00:39:18,170 --> 00:39:16,709
out to me I said it was a loaded

1023
00:39:20,439 --> 00:39:18,180
question I did not mean it in any other

1024
00:39:22,339 --> 00:39:20,449
way other than way I said it so good

1025
00:39:24,439 --> 00:39:22,349
well that's good so that's so good

1026
00:39:26,029 --> 00:39:24,449
because we this you're the generation of

1027
00:39:28,160 --> 00:39:26,039
astronomers I point this out because

1028
00:39:31,459 --> 00:39:28,170
you're the generation of astronomers for

1029
00:39:32,870 --> 00:39:31,469
which jwst is prime suited to help and I

1030
00:39:35,180 --> 00:39:32,880
just wanted to know how what your

1031
00:39:38,569 --> 00:39:35,190
thoughts are on the possibilities of

1032
00:39:41,410 --> 00:39:38,579
using a telescope like that uh yeah i

1033
00:39:44,660 --> 00:39:41,420
mean it it it would be very amazing i

1034
00:39:48,349 --> 00:39:44,670
had the opportunity of it i guess it's a

1035
00:39:51,319 --> 00:39:48,359
few years away 28 yeah so you've got

1036
00:39:54,199 --> 00:39:51,329
time see you don't worry i get your you

1037
00:39:56,749 --> 00:39:54,209
get your time to finish yeah i'll

1038
00:39:58,459 --> 00:39:56,759

probably finish before that and

1039
00:40:00,890 --> 00:39:58,469
hopefully there are postdoc

1040
00:40:03,079 --> 00:40:00,900
opportunities that would allow such a

1041
00:40:05,070 --> 00:40:03,089
study good alright well that's good to

1042
00:40:07,200 --> 00:40:05,080
know and i wish you best of luck in the

1043
00:40:09,420 --> 00:40:07,210
and in the course of your research I and

1044
00:40:11,400 --> 00:40:09,430
this particular result is I find very

1045
00:40:12,840 --> 00:40:11,410
fascinating one so I want to thank you

1046
00:40:15,660 --> 00:40:12,850
for taking the time out to talk to us

1047
00:40:19,770 --> 00:40:15,670
about this let me look and see if I can

1048
00:40:21,840 --> 00:40:19,780
find any the Q&A app just to co-own a

1049
00:40:23,460 --> 00:40:21,850
Hubble huggers yes good evening Hubble

1050
00:40:26,400 --> 00:40:23,470
huggers or good afternoon depending on

1051
00:40:29,730 --> 00:40:26,410
your your time your time I have I had a

1052
00:40:33,960 --> 00:40:29,740
question and trying to understand the

1053
00:40:39,360 --> 00:40:33,970
way that the data is handled so are

1054
00:40:41,850 --> 00:40:39,370
there are you are you having to deal

1055
00:40:44,640 --> 00:40:41,860
with a lot of calibration and instrument

1056
00:40:48,020 --> 00:40:44,650
effects to make absolutely sure that

1057
00:40:53,400 --> 00:40:48,030
what you are seeing is a real signature

1058
00:40:56,160 --> 00:40:53,410
from an Astrophysical you know density

1059
00:40:58,590 --> 00:40:56,170
of Astrophysical objects I mean it seems

1060
00:41:03,200 --> 00:40:58,600
like when you work around and the noise

1061
00:41:06,630 --> 00:41:03,210
like that it is very difficult yeah

1062
00:41:11,880 --> 00:41:06,640
that's a good question how do you know

1063
00:41:14,220 --> 00:41:11,890

though we do simulations okay I I'll do

1064
00:41:17,490 --> 00:41:14,230
so we have a huge collection of these

1065
00:41:19,250 --> 00:41:17,500
raw individual exposures which make up a

1066
00:41:22,560 --> 00:41:19,260
small subsection of the whole mosaic

1067
00:41:25,380 --> 00:41:22,570
okay so what I'll do is I'll inject some

1068
00:41:28,080 --> 00:41:25,390
signal into these into these individual

1069
00:41:31,050 --> 00:41:28,090
frames a signal that I know very well

1070
00:41:33,750 --> 00:41:31,060
and then I'll mosaic them and then I

1071
00:41:36,480 --> 00:41:33,760
will see how well my mosaicing routine

1072
00:41:38,580 --> 00:41:36,490
is removing offsets and things like this

1073
00:41:40,470 --> 00:41:38,590
and then I'll take that into

1074
00:41:43,350 --> 00:41:40,480
consideration with the final power

1075
00:41:45,030 --> 00:41:43,360
spectra and add the air the total error

1076
00:41:48,680 --> 00:41:45,040
budget is also a function of that of

1077
00:41:51,690 --> 00:41:48,690
those simulations so I spent probably

1078
00:41:54,900 --> 00:41:51,700
4-5 months just running simulations to

1079
00:41:59,820 --> 00:41:54,910
kind of quantify the noise and get a

1080
00:42:01,260 --> 00:41:59,830
hold on the different errors so I mean I

1081
00:42:03,030 --> 00:42:01,270
think this is an important point about

1082
00:42:05,280 --> 00:42:03,040
the way that you know you just don't

1083
00:42:07,320 --> 00:42:05,290
take an observation and voila you have

1084
00:42:09,660 --> 00:42:07,330
this amazing result is that there's

1085
00:42:11,460 --> 00:42:09,670
there's you know getting the data

1086
00:42:14,220 --> 00:42:11,470
calibrating it make sure it's the best

1087
00:42:17,310 --> 00:42:14,230
data you can clean it as best you can

1088
00:42:19,020 --> 00:42:17,320

then you have modeling which is trying

1089
00:42:22,140 --> 00:42:19,030
to look at what the astrophysics under

1090
00:42:23,970 --> 00:42:22,150
I and then and a lot of things you do

1091
00:42:26,310 --> 00:42:23,980
simulations where you put a known thing

1092
00:42:28,380 --> 00:42:26,320
in you see if you can get back out and

1093
00:42:30,930 --> 00:42:28,390
that and that kind of thing i think it's

1094
00:42:34,260 --> 00:42:30,940
it's it's interesting that that shows up

1095
00:42:36,590 --> 00:42:34,270
in many different areas of astrophysics

1096
00:42:41,040 --> 00:42:36,600
and trying to understand the data that

1097
00:42:42,120 --> 00:42:41,050
that comes out yeah and also what I was

1098
00:42:45,930 --> 00:42:42,130
talking about before how I had two

1099
00:42:47,340 --> 00:42:45,940
images for each field for yes so when i

1100
00:42:48,930 --> 00:42:47,350
subtract those two images from each

1101
00:42:51,720 --> 00:42:48,940
other all the astrophysical signal

1102
00:42:54,720 --> 00:42:51,730
should go away and it does yes should

1103
00:42:57,750 --> 00:42:54,730
and it does yeah oh that's good that's

1104
00:43:00,240 --> 00:42:57,760
good that's good but if yet it is a very

1105
00:43:04,500 --> 00:43:00,250
long process from the initial exposure

1106
00:43:06,300 --> 00:43:04,510
to the final results alright gotta got a

1107
00:43:08,520 --> 00:43:06,310
dart go ahead Caroll are you done well I

1108
00:43:10,950 --> 00:43:08,530
had what yeah one other question and

1109
00:43:14,070 --> 00:43:10,960
trying to understand so so if you tried

1110
00:43:15,930 --> 00:43:14,080
to do this with one field it would be a

1111
00:43:17,580 --> 00:43:15,940
little more I would think I don't know

1112
00:43:19,470 --> 00:43:17,590
would be a little more difficult but the

1113
00:43:22,770 --> 00:43:19,480

fact that you have these mosaics and

1114
00:43:24,870 --> 00:43:22,780
that you have several data sets allows

1115
00:43:28,380 --> 00:43:24,880
you to understand the instrument better

1116
00:43:29,610 --> 00:43:28,390
son it seems like the instrument you

1117
00:43:31,700 --> 00:43:29,620
would be able to understand the

1118
00:43:34,650 --> 00:43:31,710
signature of the instrument itself

1119
00:43:37,080 --> 00:43:34,660
pretty well so that you know you're not

1120
00:43:39,030 --> 00:43:37,090
being fooled by some funny effect from

1121
00:43:41,280 --> 00:43:39,040
the instrument right actually met Renee

1122
00:43:45,800 --> 00:43:41,290
CS right that there was a change and

1123
00:43:49,680 --> 00:43:45,810
then it it it was a yeah there's this uh

1124
00:43:51,150 --> 00:43:49,690
Eureka package that a big group of smart

1125
00:43:54,060 --> 00:43:51,160
people at Space Telescope or writing

1126
00:43:56,370 --> 00:43:54,070
wait which I mean it's really amazing

1127
00:43:58,230 --> 00:43:56,380
because they they're basically doing all

1128
00:43:59,340 --> 00:43:58,240
the hard work they're finding all of

1129
00:44:00,750 --> 00:43:59,350
these things that you're talking about

1130
00:44:02,700 --> 00:44:00,760
the instrumental effects and finding

1131
00:44:04,800 --> 00:44:02,710
ways to kind of ameliorate all of the

1132
00:44:06,840 --> 00:44:04,810
different things that could go on so I

1133
00:44:09,510 --> 00:44:06,850
I'm just running Python scripts that

1134
00:44:11,100 --> 00:44:09,520
call these functions that people smarter

1135
00:44:13,230 --> 00:44:11,110
than me i've already written that's

1136
00:44:15,450 --> 00:44:13,240
right no you that that's a big effort

1137
00:44:17,490 --> 00:44:15,460
here at the in suits called Eureka re ka

1138
00:44:19,380 --> 00:44:17,500

and it's a really important astronomy

1139
00:44:22,230 --> 00:44:19,390
develop our software package for people

1140
00:44:23,220 --> 00:44:22,240
who use Hubble data so I'm glad glad you

1141
00:44:25,470 --> 00:44:23,230
gave the shout out I'm sure they'll

1142
00:44:30,030 --> 00:44:25,480
appreciate it I was using it today

1143
00:44:31,800 --> 00:44:30,040
earlier nah yeah endorsement Oh

1144
00:44:33,060 --> 00:44:31,810
and they'll be happy here that's them

1145
00:44:34,560 --> 00:44:33,070
with our science software branch here at

1146
00:44:37,230 --> 00:44:34,570
the Institute so that's really great I

1147
00:44:38,790 --> 00:44:37,240
have a dark-matter question from Michael

1148
00:44:40,770 --> 00:44:38,800
jobin hi Michael welcome back as I'm

1149
00:44:43,050 --> 00:44:40,780
always glad to see your questions he

1150
00:44:47,220 --> 00:44:43,060
wants to know how do we know dark matter

1151
00:44:49,500 --> 00:44:47,230
is a kind of particle only or not just

1152
00:44:51,750 --> 00:44:49,510
some bodies of some sort that we can't

1153
00:44:55,110 --> 00:44:51,760
see yet but you want to comment on that

1154
00:44:56,970 --> 00:44:55,120
Steve maybe or is it a cuddle sure no

1155
00:44:58,350 --> 00:44:56,980
welcome to that I saw the question min

1156
00:45:02,120 --> 00:44:58,360
ago and I was like oh that's a good

1157
00:45:04,350 --> 00:45:02,130
question ah so did we always give you a

1158
00:45:05,430 --> 00:45:04,360
particle physicist provide a much better

1159
00:45:08,400 --> 00:45:05,440
answer but I will provide an

1160
00:45:09,960 --> 00:45:08,410
Astrophysical answer which is we can see

1161
00:45:13,020 --> 00:45:09,970
that the densities and the Centers of

1162
00:45:14,730 --> 00:45:13,030
galaxies are really high and this is

1163
00:45:16,860 --> 00:45:14,740

just a guess but I'm guessing that if it

1164
00:45:18,510 --> 00:45:16,870
was due to actual regular matter like

1165
00:45:20,430 --> 00:45:18,520
say a bunch of asteroids or something

1166
00:45:23,220 --> 00:45:20,440
like that there would have to be so many

1167
00:45:24,810 --> 00:45:23,230
did either a you would see them or be

1168
00:45:26,790 --> 00:45:24,820
they would prevent things from moving

1169
00:45:28,080 --> 00:45:26,800
around in their orbits so stars and

1170
00:45:30,210 --> 00:45:28,090
other things will be smashing into it

1171
00:45:32,700 --> 00:45:30,220
all the time and that would cause things

1172
00:45:35,870 --> 00:45:32,710
to glow and we would see it good

1173
00:45:38,070 --> 00:45:35,880
question that is that is an answer there

1174
00:45:39,660 --> 00:45:38,080
that's right there's a lot about dark

1175
00:45:41,250 --> 00:45:39,670
matter we're still trying to find out so

1176
00:45:43,860 --> 00:45:41,260
according to the press release I was

1177
00:45:45,540 --> 00:45:43,870
just reading here and the next area open

1178
00:45:47,850 --> 00:45:45,550
that follows from what you guys are

1179
00:45:50,160 --> 00:45:47,860
doing is that you want to kind of look

1180
00:45:51,810 --> 00:45:50,170
in the x-rays next to see what's going

1181
00:45:54,210 --> 00:45:51,820
on with some of this primordial stuff

1182
00:45:56,910 --> 00:45:54,220
that's out there because the earliest

1183
00:45:58,680 --> 00:45:56,920
stars they were they were very large and

1184
00:46:02,550 --> 00:45:58,690
they collapsed really quickly because

1185
00:46:03,690 --> 00:46:02,560
they were so large and so and so they

1186
00:46:05,310 --> 00:46:03,700
did this thing called up what was I

1187
00:46:07,590 --> 00:46:05,320
forget the name now because the core

1188
00:46:09,090 --> 00:46:07,600

core collapse I forget when I i forget

1189
00:46:11,610 --> 00:46:09,100
the kind of supernova it was it was a

1190
00:46:14,970 --> 00:46:11,620
very special kind anyway and those would

1191
00:46:16,590 --> 00:46:14,980
show up in the x-ray so are there any

1192
00:46:18,060 --> 00:46:16,600
plans for you guys to be doing some

1193
00:46:21,510 --> 00:46:18,070
x-ray work or is that other members of

1194
00:46:24,000 --> 00:46:21,520
the team I actually just sent a draft

1195
00:46:27,180 --> 00:46:24,010
around about extra cross-correlations

1196
00:46:29,940 --> 00:46:27,190
yesterday so the collaborators so yeah

1197
00:46:32,100 --> 00:46:29,950
we are we are doing that we r cross

1198
00:46:35,400 --> 00:46:32,110
correlating x-ray background maps with

1199
00:46:37,380 --> 00:46:35,410
the maps that i made in Hubble so the

1200
00:46:38,880 --> 00:46:37,390
idea is that if there's a black hole

1201
00:46:41,040 --> 00:46:38,890
signature in the really early universe

1202
00:46:42,900 --> 00:46:41,050
they would leave imprints on the cosmic

1203
00:46:43,750 --> 00:46:42,910
infrared background which is what we

1204
00:46:45,850 --> 00:46:43,760
have maps up

1205
00:46:48,400 --> 00:46:45,860
so if we cross-correlate maps between

1206
00:46:50,230 --> 00:46:48,410
the near infrared and the x-ray then if

1207
00:46:51,700 --> 00:46:50,240
there's a strong correlation that that

1208
00:46:55,120 --> 00:46:51,710
kind of hints that may be that the

1209
00:46:56,410 --> 00:46:55,130
possibilities is true oh boy this is one

1210
00:46:58,120 --> 00:46:56,420
of those moments where I just you know I

1211
00:47:00,400 --> 00:46:58,130
just hit it just hit me of course there

1212
00:47:01,900 --> 00:47:00,410
would be a background infrared map all I

1213
00:47:03,070 --> 00:47:01,910

ever think we always think about is

1214
00:47:05,440 --> 00:47:03,080
microwave background you know where I

1215
00:47:07,510 --> 00:47:05,450
was thinking about that is there is this

1216
00:47:09,430 --> 00:47:07,520
this infrared map is it is it the whole

1217
00:47:10,780 --> 00:47:09,440
sky thing or is that most of the sky or

1218
00:47:12,910 --> 00:47:10,790
no it's that it's what we've been

1219
00:47:15,790 --> 00:47:12,920
talking about it's the the whole the

1220
00:47:17,170 --> 00:47:15,800
whole maps the whole the whole cluster

1221
00:47:21,010 --> 00:47:17,180
the whole candles feel then the whole

1222
00:47:22,840 --> 00:47:21,020
clans cluster survey well I after all of

1223
00:47:24,340 --> 00:47:22,850
the work that I did to try to get

1224
00:47:27,010 --> 00:47:24,350
mosaics in all the fields I can only do

1225
00:47:30,130 --> 00:47:27,020
it in two fields okay because it's kind

1226
00:47:31,930 --> 00:47:30,140
of a data constraint but yeah basically

1227
00:47:33,250 --> 00:47:31,940
just cross correlating with the maps

1228
00:47:36,100 --> 00:47:33,260
that i already have from the work that i

1229
00:47:38,670 --> 00:47:36,110
did in this paper i can just cross

1230
00:47:41,140 --> 00:47:38,680
correlate with x-ray maps and

1231
00:47:42,790 --> 00:47:41,150
investigate that very good okay well

1232
00:47:44,920 --> 00:47:42,800
that's great all right well I don't know

1233
00:47:45,970 --> 00:47:44,930
if there's any other quick on emma is

1234
00:47:48,250 --> 00:47:45,980
there anything i'm missing on twitter

1235
00:47:50,320 --> 00:47:48,260
anything you want to point out or we

1236
00:47:52,600 --> 00:47:50,330
good to go no I think we're pretty good

1237
00:47:55,030 --> 00:47:52,610
okay all right all right folks well i

1238
00:47:57,760 --> 00:47:55,040

guess i will do it this week next week

1239
00:48:00,310 --> 00:47:57,770
we all have a hangout plan for you that

1240
00:48:02,140 --> 00:48:00,320
i'm gonna have I Carol I don't get what

1241
00:48:04,840 --> 00:48:02,150
it says a you Mick can you describe what

1242
00:48:07,870 --> 00:48:04,850
that what that was what it was what we

1243
00:48:11,080 --> 00:48:07,880
got next week America is that well I

1244
00:48:15,970 --> 00:48:11,090
also want to say NASA's is pushing a

1245
00:48:19,300 --> 00:48:15,980
little bit in October the exoplanet

1246
00:48:21,220 --> 00:48:19,310
research there's also the division of

1247
00:48:26,380 --> 00:48:21,230
planetary science to have any meeting

1248
00:48:29,350 --> 00:48:26,390
and all that so au mech was known to

1249
00:48:32,590 --> 00:48:29,360
have is an exoplanet system is known to

1250
00:48:34,840 --> 00:48:32,600
have a disc and it has been observed

1251
00:48:38,470 --> 00:48:34,850
both by Hubble and other instrumentation

1252
00:48:42,070 --> 00:48:38,480
and seems to have some funny things

1253
00:48:43,780 --> 00:48:42,080
about the disk and so this woman we're

1254
00:48:45,370 --> 00:48:43,790
going to talk with the authors about how

1255
00:48:47,080 --> 00:48:45,380
they use the Hubble data and what they

1256
00:48:49,270 --> 00:48:47,090
are learning about this disk you know

1257
00:48:50,980 --> 00:48:49,280
this one isn't it's not like oh oh it

1258
00:48:52,900 --> 00:48:50,990
has a disk you know it's it's known to

1259
00:48:55,180 --> 00:48:52,910
have a debris disk and so it's like

1260
00:48:57,540 --> 00:48:55,190
they're now kind of looking at it and

1261
00:49:01,140 --> 00:48:57,550
seeing this is another case all

1262
00:49:03,270 --> 00:49:01,150
so using multiple telescopes observing

1263
00:49:07,200 --> 00:49:03,280

something over a period of time so it

1264
00:49:09,360 --> 00:49:07,210
shows why that kind of research is

1265
00:49:12,000 --> 00:49:09,370
worthwhile so it's basically about an

1266
00:49:13,590 --> 00:49:12,010
exoplanet and that is next week folks so

1267
00:49:15,180 --> 00:49:13,600
I hope you'll join us i want to thank i

1268
00:49:16,950 --> 00:49:15,190
want to thank you guys for don't think

1269
00:49:19,440 --> 00:49:16,960
our guests catcher Mitchell when he's uh

1270
00:49:20,550 --> 00:49:19,450
from UC Irvine thank you so much for

1271
00:49:22,410 --> 00:49:20,560
taking the time out to talk to us about

1272
00:49:24,240 --> 00:49:22,420
your research it's been an awesome stuff

1273
00:49:26,400 --> 00:49:24,250
and I hope you'll come back after you do

1274
00:49:28,710 --> 00:49:26,410
the x-ray stuff and yeah and follow up

1275
00:49:30,510 --> 00:49:28,720
okay good luck today and good luck to

1276
00:49:31,980 --> 00:49:30,520
you everyone thanks for and dr. Stephen

1277
00:49:34,470 --> 00:49:31,990
Finkelstein he's also the astronomer

1278
00:49:35,790 --> 00:49:34,480
from University of Texas at Austin thank

1279
00:49:37,530 --> 00:49:35,800
you Steve for coming back it's always

1280
00:49:39,300 --> 00:49:37,540
great to have you on a hangouts and he's

1281
00:49:42,270 --> 00:49:39,310
going to be back with us at the end of

1282
00:49:43,560 --> 00:49:42,280
the month so well I was it I didn't look

1283
00:49:45,570 --> 00:49:43,570
that far ahead is that true great

1284
00:49:48,420 --> 00:49:45,580
outstanding I look forward to talking to

1285
00:49:51,090 --> 00:49:48,430
you again ste absolutely it don't look

1286
00:49:52,620 --> 00:49:51,100
good all right all right Carol Scott

1287
00:49:56,460 --> 00:49:52,630
thank you very much oh that's different

1288
00:49:57,750 --> 00:49:56,470

mom yeah thank you uh that's it for this

1289
00:50:00,150 --> 00:49:57,760
week's folks thank you all for watching

1290
00:50:02,520 --> 00:50:00,160
and as always don't forget about soho

1291
00:50:05,310 --> 00:50:02,530
i'm telling you you don't forget how

1292
00:50:10,130 --> 00:50:05,320
soho that's right twenty years no we're

1293
00:50:17,820 --> 00:50:12,990
don't you see no no no all right that's