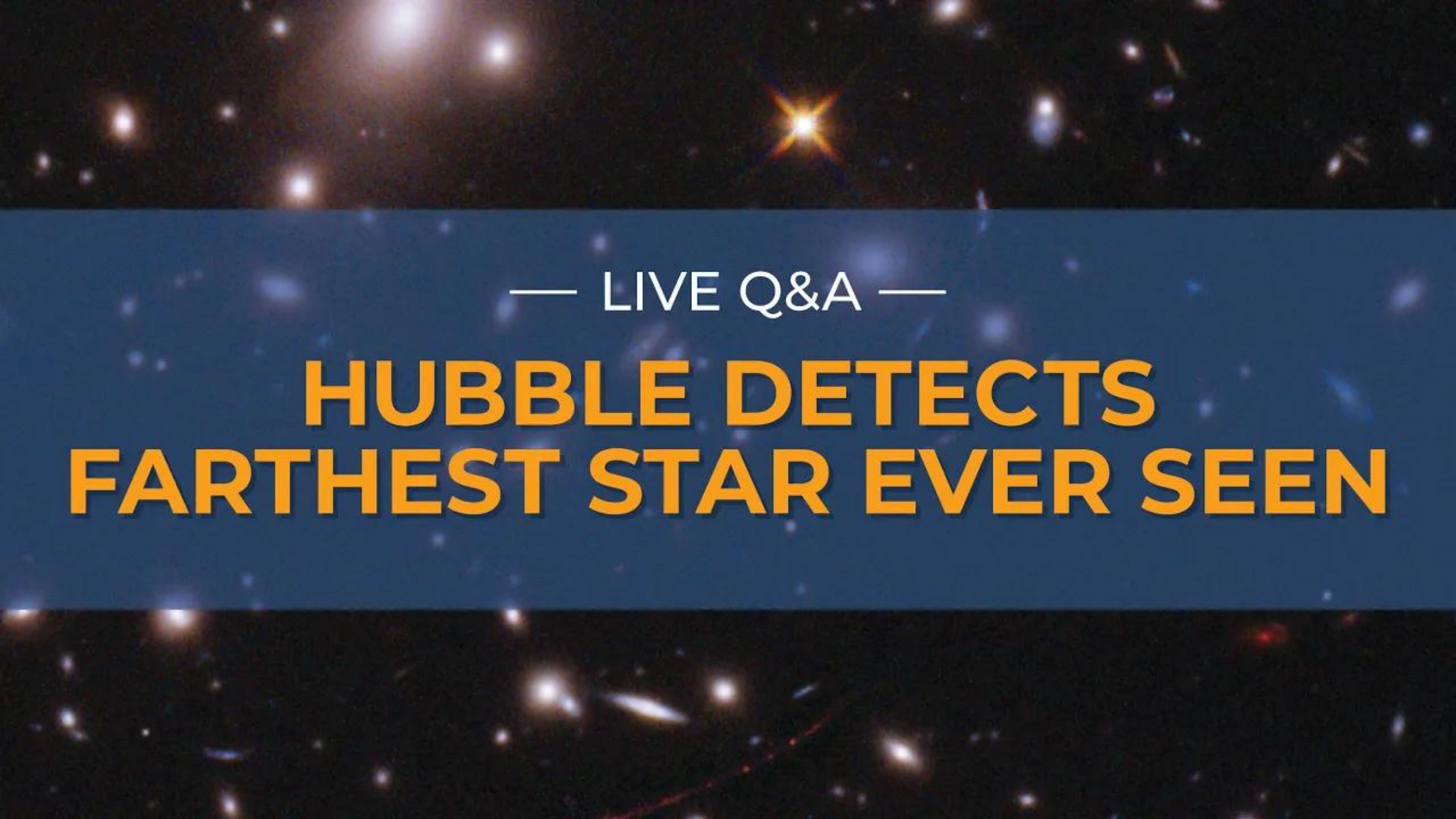
— LIVE Q&A —
HUBBLE DETECTS
FARTHEST STAR EVER SEEN

1
00:00:13,430 --> 00:00:11,350
hi everyone welcome to nasa's goddard

2
00:00:14,950 --> 00:00:13,440
space flight center my name is elizabeth

3
00:00:16,790 --> 00:00:14,960
and i'm the social media lead here for

4
00:00:18,630 --> 00:00:16,800
the hubble space telescope and we're

5
00:00:20,470 --> 00:00:18,640
live now with some really big news from

6
00:00:22,790 --> 00:00:20,480
hubble and here to tell us more about it

7
00:00:24,310 --> 00:00:22,800
we have dr jane rigby with us and she's

8
00:00:26,070 --> 00:00:24,320
a co-author of the result that we're

9
00:00:28,070 --> 00:00:26,080
going to be talking about and also the

10
00:00:29,429 --> 00:00:28,080
operations project scientist for the

11
00:00:30,390 --> 00:00:29,439
recently launched james webb space

12
00:00:32,630 --> 00:00:30,400
telescope

13
00:00:34,310 --> 00:00:32,640

and we also have with us dr patty boyd

14
00:00:36,150 --> 00:00:34,320
who previously worked as the deputy

15
00:00:37,910 --> 00:00:36,160
operations project scientist for hubble

16
00:00:39,670 --> 00:00:37,920
and now works as the chief of nasa's

17
00:00:41,590 --> 00:00:39,680
exoplanets and stellar astrophysics

18
00:00:43,270 --> 00:00:41,600
laboratory thank you both so much for

19
00:00:45,190 --> 00:00:43,280
joining me today i'm really excited to

20
00:00:46,630 --> 00:00:45,200
hear about this hubble news and for

21
00:00:48,389 --> 00:00:46,640
anyone watching live if you have

22
00:00:49,590 --> 00:00:48,399
questions during the stream please feel

23
00:00:51,110 --> 00:00:49,600
free to comment them and we're going to

24
00:00:52,069 --> 00:00:51,120
do our best to get to some at the end of

25
00:00:53,510 --> 00:00:52,079
the show

26
00:00:55,990 --> 00:00:53,520
but for now i think we should just jump

27
00:00:57,670 --> 00:00:56,000
right in so patty uh sounds like hubble

28
00:00:59,349 --> 00:00:57,680
just broke a pretty impressive record

29
00:01:01,189 --> 00:00:59,359
could you tell us what hubble discovered

30
00:01:02,470 --> 00:01:01,199
sure i would love to and it's really

31
00:01:05,350 --> 00:01:02,480
exciting to talk about this

32
00:01:07,510 --> 00:01:05,360
record-setting star so like so many

33
00:01:10,149 --> 00:01:07,520
other discoveries from hubble it starts

34
00:01:11,510 --> 00:01:10,159
with an image a very beautiful image and

35
00:01:14,070 --> 00:01:11,520
one of the first things that you can see

36
00:01:15,830 --> 00:01:14,080
in that image are galaxies and those

37
00:01:18,390 --> 00:01:15,840
galaxies are actually gravitationally

38
00:01:20,230 --> 00:01:18,400

bound in a cluster those are fascinating

39
00:01:22,630 --> 00:01:20,240
objects in the universe they have a huge

40
00:01:25,030 --> 00:01:22,640
amount of mass and what's very special

41
00:01:27,030 --> 00:01:25,040
about this particular image in addition

42
00:01:29,510 --> 00:01:27,040
to that beautiful cluster of galaxies is

43
00:01:33,190 --> 00:01:29,520
it actually contains an image of a

44
00:01:35,350 --> 00:01:33,200
single star whose light left that object

45
00:01:37,429 --> 00:01:35,360
when the universe itself was less than a

46
00:01:38,789 --> 00:01:37,439
billion years old so this is a rare

47
00:01:40,950 --> 00:01:38,799
event and we're really excited to learn

48
00:01:42,950 --> 00:01:40,960
more about this object yeah that sounds

49
00:01:44,550 --> 00:01:42,960
super exciting and just as a refresher

50
00:01:46,870 --> 00:01:44,560
for everyone hubble has been orbiting

51
00:01:48,630 --> 00:01:46,880
earth for almost 32 years and is still

52
00:01:50,550 --> 00:01:48,640
generating incredible science like we

53
00:01:52,469 --> 00:01:50,560
just heard about so patty could you also

54
00:01:54,230 --> 00:01:52,479
tell us just what can astronomers learn

55
00:01:55,350 --> 00:01:54,240
about our universe by examining this

56
00:01:58,310 --> 00:01:55,360
star

57
00:02:00,310 --> 00:01:58,320
neighborhood like when you look up at

58
00:02:01,990 --> 00:02:00,320
the night sky those stars are in our

59
00:02:04,230 --> 00:02:02,000
milky way galaxy they're in the same

60
00:02:06,310 --> 00:02:04,240
galaxy that we're in we're a star one of

61
00:02:08,869 --> 00:02:06,320
a hundred billion or more in the milky

62
00:02:11,350 --> 00:02:08,879
way and those stars evolved a lot like

63
00:02:12,949 --> 00:02:11,360

we did in this same milky way galaxy and

64
00:02:14,390 --> 00:02:12,959
they're about you know thousands of

65
00:02:15,830 --> 00:02:14,400
light years away from us when we look at

66
00:02:18,150 --> 00:02:15,840
them so the light that from those stars

67
00:02:19,910 --> 00:02:18,160
is coming to us thousands of years later

68
00:02:22,390 --> 00:02:19,920
when we're looking at this star called

69
00:02:24,309 --> 00:02:22,400
arendelle we're looking at the universe

70
00:02:26,949 --> 00:02:24,319
itself when it was like in its first

71
00:02:28,949 --> 00:02:26,959
billion years we're at 3.8 billion years

72
00:02:31,190 --> 00:02:28,959
now the universe has changed a lot in

73
00:02:33,190 --> 00:02:31,200
that time so arendelle is this rare

74
00:02:35,270 --> 00:02:33,200
window when we can actually look back

75
00:02:37,670 --> 00:02:35,280
and see how stars were working in those

76
00:02:39,750 --> 00:02:37,680
very early days of the universe wow

77
00:02:41,270 --> 00:02:39,760
that's very interesting thank you and

78
00:02:42,790 --> 00:02:41,280
another cool part about this observation

79
00:02:44,550 --> 00:02:42,800
is that it was only possible because of

80
00:02:47,030 --> 00:02:44,560
an astrophysical phenomenon known as

81
00:02:48,630 --> 00:02:47,040
gravitational lensing so jane can you

82
00:02:50,550 --> 00:02:48,640
kind of break down for us like what

83
00:02:53,509 --> 00:02:50,560
gravitational lensing is

84
00:02:55,430 --> 00:02:53,519
sure so we can see the star

85
00:02:58,070 --> 00:02:55,440
even though you know we're looking back

86
00:02:59,990 --> 00:02:58,080
so far in time because of two things one

87
00:03:02,070 --> 00:03:00,000
the speed of light's not that fast right

88
00:03:04,229 --> 00:03:02,080

so we're able as patti would say we look

89
00:03:05,589 --> 00:03:04,239
back in space to look back in time and

90
00:03:07,910 --> 00:03:05,599
the other is this phenomenon of

91
00:03:11,190 --> 00:03:07,920
gravitational lensing which is just the

92
00:03:13,990 --> 00:03:11,200
fact predicted by einstein that mass

93
00:03:16,470 --> 00:03:14,000
bends space and so light is traveling

94
00:03:19,110 --> 00:03:16,480
through a curved space time and so it

95
00:03:20,869 --> 00:03:19,120
acts like a mass is bending light

96
00:03:22,229 --> 00:03:20,879
gravity is bending light well if you

97
00:03:24,309 --> 00:03:22,239
think about it what happens when you're

98
00:03:26,630 --> 00:03:24,319
bending light well

99
00:03:28,390 --> 00:03:26,640
eyeglasses are bending light right there

100
00:03:29,910 --> 00:03:28,400
they're getting the light to change

101
00:03:32,869 --> 00:03:29,920
where it shows up in your eyeball so you

102
00:03:34,789 --> 00:03:32,879
can see better so it turns out that

103
00:03:36,710 --> 00:03:34,799
this phenomenon of gravitational lensing

104
00:03:39,350 --> 00:03:36,720
when you get big concentrations of mass

105
00:03:41,830 --> 00:03:39,360
either a galaxy or better yet a cluster

106
00:03:44,710 --> 00:03:41,840
of galaxies together they can act like a

107
00:03:47,589 --> 00:03:44,720
cosmic telescope and bend the light

108
00:03:50,229 --> 00:03:47,599
focus it toward

109
00:03:52,070 --> 00:03:50,239
accidentally toward us and so this is a

110
00:03:54,229 --> 00:03:52,080
really rare phenomenon

111
00:03:56,229 --> 00:03:54,239
about maybe one in a thousand a one in

112
00:03:58,390 --> 00:03:56,239
ten thousand galaxies or gravitationally

113
00:04:00,789 --> 00:03:58,400

lensed but when this happens we can take

114
00:04:02,630 --> 00:04:00,799
advantage of these cosmic telescopes and

115
00:04:05,190 --> 00:04:02,640
then observe them with our human-built

116
00:04:07,750 --> 00:04:05,200
telescopes to see way farther than we

117
00:04:09,910 --> 00:04:07,760
normally can and those background

118
00:04:10,869 --> 00:04:09,920
galaxies that are way behind the cluster

119
00:04:12,229 --> 00:04:10,879
they don't have anything to do with the

120
00:04:14,149 --> 00:04:12,239
cluster

121
00:04:16,069 --> 00:04:14,159
we see them not only much brighter than

122
00:04:17,749 --> 00:04:16,079
they really are but stretched and

123
00:04:19,830 --> 00:04:17,759
magnified kind of like they're in a fun

124
00:04:22,069 --> 00:04:19,840
house mirror and that lets us study them

125
00:04:24,790 --> 00:04:22,079
in greater detail than we normally can

126
00:04:26,230 --> 00:04:24,800
with our current telescopes okay gotcha

127
00:04:28,390 --> 00:04:26,240
that's really cool

128
00:04:29,670 --> 00:04:28,400
and so another thing i'm wondering like

129
00:04:31,110 --> 00:04:29,680
how did astronomers when they were

130
00:04:33,189 --> 00:04:31,120
making this observation know that

131
00:04:35,590 --> 00:04:33,199
arendelle was an individual star rather

132
00:04:38,230 --> 00:04:35,600
than a bigger cosmic object sure so this

133
00:04:40,710 --> 00:04:38,240
is a cool case where this is a discovery

134
00:04:42,150 --> 00:04:40,720
that was half on purpose half oh wow

135
00:04:45,670 --> 00:04:42,160
that's cool which is how a lot of

136
00:04:49,430 --> 00:04:45,680
science works so the cl the cluster and

137
00:04:51,909 --> 00:04:49,440
the lens galaxy were found in 2016 uh by

138
00:04:53,749 --> 00:04:51,919

dan cohen collaborators and so they

139
00:04:55,990 --> 00:04:53,759
found the arc and said okay that's a

140
00:04:58,629 --> 00:04:56,000
that's a very high redshift arc redshift

141
00:05:00,390 --> 00:04:58,639
six a lens galaxy a redshift six about a

142
00:05:01,430 --> 00:05:00,400
billion years after the big bang is how

143
00:05:02,550 --> 00:05:01,440
we see it

144
00:05:04,469 --> 00:05:02,560
and so

145
00:05:06,469 --> 00:05:04,479
and then brian welch a graduate student

146
00:05:08,790 --> 00:05:06,479
at johns hopkins was given the task of

147
00:05:10,550 --> 00:05:08,800
modeling this thing and and doing the

148
00:05:12,870 --> 00:05:10,560
lens model of where's all the mass in

149
00:05:15,029 --> 00:05:12,880
the cluster and getting that to

150
00:05:17,270 --> 00:05:15,039
reproduce the the distorted shapes that

151
00:05:19,270 --> 00:05:17,280
we see of the lens galaxies and as he

152
00:05:21,830 --> 00:05:19,280
was doing this there's this dot in the

153
00:05:24,710 --> 00:05:21,840
middle of the lens galaxy and try as he

154
00:05:26,870 --> 00:05:24,720
could that dot had to be really small in

155
00:05:28,710 --> 00:05:26,880
all the models like super small like the

156
00:05:31,189 --> 00:05:28,720
size of our solar system and the

157
00:05:32,310 --> 00:05:31,199
magnification had to be really high like

158
00:05:33,270 --> 00:05:32,320
thousands

159
00:05:35,510 --> 00:05:33,280
and so

160
00:05:37,590 --> 00:05:35,520
the most obvious explanation is that

161
00:05:40,230 --> 00:05:37,600
we're seeing either one star or maybe a

162
00:05:42,390 --> 00:05:40,240
couple stars but it's that it's a not

163
00:05:45,270 --> 00:05:42,400

like a big star cluster but we're seeing

164
00:05:47,990 --> 00:05:45,280
down the scales of individual star or

165
00:05:49,909 --> 00:05:48,000
multiple stars all the way out a billion

166
00:05:52,390 --> 00:05:49,919
years after the big bang

167
00:05:53,749 --> 00:05:52,400
okay wow and speaking of you know this

168
00:05:55,590 --> 00:05:53,759
star being within the first billion

169
00:05:57,350 --> 00:05:55,600
years of the big bang patty how did

170
00:05:59,029 --> 00:05:57,360
astronomers know that about this star

171
00:06:01,909 --> 00:05:59,039
how did they know it was in there

172
00:06:03,909 --> 00:06:01,919
that's a great question and so like many

173
00:06:05,990 --> 00:06:03,919
of the images that hubble takes of these

174
00:06:08,309 --> 00:06:06,000
fields these treasury fields we're

175
00:06:10,390 --> 00:06:08,319
observing them to collect as much data

176
00:06:11,830 --> 00:06:10,400
as not only the team wants to get the

177
00:06:13,430 --> 00:06:11,840
science that they want to get out but

178
00:06:14,230 --> 00:06:13,440
that the entire community can really

179
00:06:16,469 --> 00:06:14,240
like

180
00:06:18,230 --> 00:06:16,479
mine that rich archive and get a lot of

181
00:06:20,150 --> 00:06:18,240
science out so one of the ways you can

182
00:06:22,230 --> 00:06:20,160
get the most science out of an image

183
00:06:24,309 --> 00:06:22,240
like this is to observe it in multiple

184
00:06:26,629 --> 00:06:24,319
filters and the filters are basically

185
00:06:29,029 --> 00:06:26,639
different colors of light so they they

186
00:06:31,270 --> 00:06:29,039
specify a certain range of colors and so

187
00:06:33,510 --> 00:06:31,280
this is a multi-color image

188
00:06:35,590 --> 00:06:33,520

using two instruments on the telescope

189
00:06:37,909 --> 00:06:35,600
and what that allows us to do is for the

190
00:06:40,550 --> 00:06:37,919
galaxies each galaxy is going to have a

191
00:06:41,990 --> 00:06:40,560
certain brightness in those filters and

192
00:06:44,710 --> 00:06:42,000
we can look at how that brightness

193
00:06:47,189 --> 00:06:44,720
changes as a function of our filter what

194
00:06:49,430 --> 00:06:47,199
we see with these objects that are very

195
00:06:51,510 --> 00:06:49,440
far they're red shifted we call it

196
00:06:53,589 --> 00:06:51,520
redshifted as they move further from us

197
00:06:55,749 --> 00:06:53,599
the whole universe is actually expanding

198
00:06:57,670 --> 00:06:55,759
the light gets shifted into the red and

199
00:07:00,550 --> 00:06:57,680
what that will do to a galaxy spectrum

200
00:07:02,390 --> 00:07:00,560
that's far redshifted is it'll actually

201
00:07:03,990 --> 00:07:02,400
kind of block it out in the optical you

202
00:07:06,150 --> 00:07:04,000
won't see the light there it'll just

203
00:07:08,550 --> 00:07:06,160
start to peek out the redder and redder

204
00:07:10,469 --> 00:07:08,560
that filter gets so if you notice in the

205
00:07:12,710 --> 00:07:10,479
image that that smear that we're looking

206
00:07:15,029 --> 00:07:12,720
at the sunrise arc it's called it's very

207
00:07:16,710 --> 00:07:15,039
red compared to the rest of the image

208
00:07:19,270 --> 00:07:16,720
and that's why is the light's just

209
00:07:20,950 --> 00:07:19,280
starting to pick up as we go redder and

210
00:07:23,749 --> 00:07:20,960
you can use that to estimate its

211
00:07:25,909 --> 00:07:23,759
redshift and that is exactly how the

212
00:07:27,510 --> 00:07:25,919
objects in that arc are estimated

213
00:07:29,990 --> 00:07:27,520

they're all at about the same redshift

214
00:07:31,830 --> 00:07:30,000
of 6.2 and you use that number and the

215
00:07:33,830 --> 00:07:31,840
photo photometric information that you

216
00:07:35,670 --> 00:07:33,840
have to estimate everything else it's

217
00:07:37,029 --> 00:07:35,680
distance and then its size scale is

218
00:07:39,189 --> 00:07:37,039
related to that so there's just a

219
00:07:41,029 --> 00:07:39,199
tremendous amount of scientific

220
00:07:42,550 --> 00:07:41,039
information in these multicolor images

221
00:07:44,309 --> 00:07:42,560
in addition to just the beauty of

222
00:07:46,469 --> 00:07:44,319
looking at the galaxies that are in them

223
00:07:48,150 --> 00:07:46,479
oh yeah for sure and patty also like why

224
00:07:50,070 --> 00:07:48,160
is it important to be studying this star

225
00:07:51,350 --> 00:07:50,080
that is within the first billion years

226
00:07:53,110 --> 00:07:51,360
of the big bang

227
00:07:55,430 --> 00:07:53,120
so when we look around at our local

228
00:07:57,350 --> 00:07:55,440
universe or the stars in our own galaxy

229
00:07:59,990 --> 00:07:57,360
we get a picture of how the universe has

230
00:08:02,150 --> 00:08:00,000
evolved and one of the coolest stories

231
00:08:04,309 --> 00:08:02,160
about that is where matter came from

232
00:08:07,510 --> 00:08:04,319
where the heavy elements came from where

233
00:08:09,830 --> 00:08:07,520
the carbon calcium oxygen that makes up

234
00:08:12,070 --> 00:08:09,840
everything you know our bodies our bones

235
00:08:14,309 --> 00:08:12,080
our telescopes where did those elements

236
00:08:17,270 --> 00:08:14,319
come from and the answer is that they're

237
00:08:19,830 --> 00:08:17,280
fused in the centers in the cores of

238
00:08:22,309 --> 00:08:19,840

stars and massive stars in particular

239
00:08:24,150 --> 00:08:22,319
are very efficient at this they fuse

240
00:08:25,749 --> 00:08:24,160
lower elements like hydrogen and helium

241
00:08:27,589 --> 00:08:25,759
into heavier elements and then they

242
00:08:29,430 --> 00:08:27,599
explode in supernova explosions and they

243
00:08:31,110 --> 00:08:29,440
spew that material out into their local

244
00:08:32,630 --> 00:08:31,120
environment so the next generation of

245
00:08:34,230 --> 00:08:32,640
stars can pull that in as they're

246
00:08:36,310 --> 00:08:34,240
forming those are the kind of things

247
00:08:38,550 --> 00:08:36,320
that form rocky planets like the earth's

248
00:08:40,149 --> 00:08:38,560
where we've got like an iron core and

249
00:08:42,630 --> 00:08:40,159
all those elements in our atmospheres

250
00:08:45,670 --> 00:08:42,640
those were fused in earlier generations

251
00:08:47,990 --> 00:08:45,680
of stars so arendelle is this single

252
00:08:50,070 --> 00:08:48,000
star the farthest yet that we've been

253
00:08:52,310 --> 00:08:50,080
able to observe and it will allow us to

254
00:08:54,470 --> 00:08:52,320
see how that process started to be put

255
00:08:56,310 --> 00:08:54,480
together in the very earliest days when

256
00:08:58,710 --> 00:08:56,320
did those very early heavy elements

257
00:09:00,550 --> 00:08:58,720
start to be infused into the material

258
00:09:02,630 --> 00:09:00,560
and it's just a window that's opening up

259
00:09:04,710 --> 00:09:02,640
onto you know the next big thing because

260
00:09:06,230 --> 00:09:04,720
that light is pushed so far into the red

261
00:09:07,750 --> 00:09:06,240
that we need a telescope that can go

262
00:09:10,150 --> 00:09:07,760
even further into the red than hubble

263
00:09:12,630 --> 00:09:10,160

can to really uncover the cool things

264
00:09:14,790 --> 00:09:12,640
yeah and speaking of i think

265
00:09:16,150 --> 00:09:14,800
another fantastic part about all of this

266
00:09:17,750 --> 00:09:16,160
is that there's already approved

267
00:09:19,190 --> 00:09:17,760
observations to look at arendelle with

268
00:09:21,269 --> 00:09:19,200
the recently launched james webb space

269
00:09:22,790 --> 00:09:21,279
telescope which is a super powerful

270
00:09:24,470 --> 00:09:22,800
infrared space telescope that just

271
00:09:26,150 --> 00:09:24,480
launched in december we're so excited

272
00:09:28,230 --> 00:09:26,160
for it to begin science operations this

273
00:09:29,110 --> 00:09:28,240
summer and jane could you kind of tell

274
00:09:30,470 --> 00:09:29,120
us how

275
00:09:32,790 --> 00:09:30,480
uh webb might bring this hubble

276
00:09:35,190 --> 00:09:32,800
discovery even farther sure so i learned

277
00:09:37,750 --> 00:09:35,200
about this this lens star

278
00:09:39,110 --> 00:09:37,760
when the the discoverers came to me said

279
00:09:40,230 --> 00:09:39,120
so do you want to be we're trying to

280
00:09:41,829 --> 00:09:40,240
figure out how to plan some web

281
00:09:44,150 --> 00:09:41,839
observations are you in i'm like oh i'm

282
00:09:46,790 --> 00:09:44,160
totally in that's cool so what we worked

283
00:09:49,190 --> 00:09:46,800
out was a set of observations with near

284
00:09:51,269 --> 00:09:49,200
cam which is the the image the near fred

285
00:09:53,670 --> 00:09:51,279
imager to get

286
00:09:56,310 --> 00:09:53,680
colors in all of those filters that are

287
00:09:59,110 --> 00:09:56,320
too red for hubble to do well right or

288
00:10:01,590 --> 00:09:59,120

to do it all right and so if so

289
00:10:03,590 --> 00:10:01,600
web will pick up where hubble left off

290
00:10:06,550 --> 00:10:03,600
getting redder filters so we'll have

291
00:10:08,470 --> 00:10:06,560
very crisp gorgeous images we've already

292
00:10:10,790 --> 00:10:08,480
proven with webb that we can take

293
00:10:12,550 --> 00:10:10,800
gorgeous images it's very as a very very

294
00:10:15,030 --> 00:10:12,560
sharp telescope and now we're getting

295
00:10:16,630 --> 00:10:15,040
the science instruments ready to go the

296
00:10:19,110 --> 00:10:16,640
second science instrument that we will

297
00:10:21,269 --> 00:10:19,120
target for this uh for this galaxy and

298
00:10:23,829 --> 00:10:21,279
star is near spec the near fred

299
00:10:26,949 --> 00:10:23,839
spectrograph and so we'll be taking

300
00:10:29,110 --> 00:10:26,959
spectra of not only the the lens galaxy

301
00:10:32,310 --> 00:10:29,120
the sunrise arc but also the star

302
00:10:34,550 --> 00:10:32,320
arendelle and so the near spec has a lot

303
00:10:37,430 --> 00:10:34,560
of cool bells and whistles one of them

304
00:10:39,590 --> 00:10:37,440
is it has this micro shutter array

305
00:10:42,150 --> 00:10:39,600
that has a quarter of a million doors

306
00:10:44,470 --> 00:10:42,160
that can open and close magnetically and

307
00:10:46,069 --> 00:10:44,480
so we will open up doors

308
00:10:48,470 --> 00:10:46,079
we'll close most of them so we don't get

309
00:10:50,949 --> 00:10:48,480
the the brightness of the sky in the way

310
00:10:53,509 --> 00:10:50,959
and then we'll just open some doors for

311
00:10:56,069 --> 00:10:53,519
the lens galaxy and for arendelle the

312
00:10:58,310 --> 00:10:56,079
star and we'll be getting spectra right

313
00:10:59,910 --> 00:10:58,320

with a little prism to tell us about

314
00:11:02,069 --> 00:10:59,920
what's inside of those get what's inside

315
00:11:04,470 --> 00:11:02,079
that galaxy what is the temperature of

316
00:11:06,389 --> 00:11:04,480
that star how bright is it really

317
00:11:08,069 --> 00:11:06,399
how as patty was talking about how many

318
00:11:09,829 --> 00:11:08,079
out what how

319
00:11:12,069 --> 00:11:09,839
how much of the heavier elements that

320
00:11:13,829 --> 00:11:12,079
were made in stars are in this galaxy

321
00:11:16,069 --> 00:11:13,839
versus just the boring hydrogen and

322
00:11:18,470 --> 00:11:16,079
helium that's made in the big bang okay

323
00:11:20,150 --> 00:11:18,480
gotcha and so more broadly speaking why

324
00:11:21,829 --> 00:11:20,160
is it important that both hubble and web

325
00:11:22,790 --> 00:11:21,839
are going to be operating at the same

326
00:11:25,110 --> 00:11:22,800
time

327
00:11:27,110 --> 00:11:25,120
sure so hubble and webb are really

328
00:11:28,470 --> 00:11:27,120
complementary they're they're not really

329
00:11:30,790 --> 00:11:28,480
in competition

330
00:11:32,310 --> 00:11:30,800
when we built web we knew full well

331
00:11:33,829 --> 00:11:32,320
there was a hubble up there doing great

332
00:11:36,470 --> 00:11:33,839
stuff and we didn't try to replicate

333
00:11:38,790 --> 00:11:36,480
that functionality so it's really like

334
00:11:41,269 --> 00:11:38,800
players in a band like you know your

335
00:11:42,630 --> 00:11:41,279
drummer and your keyboardist are doing

336
00:11:45,509 --> 00:11:42,640
different things

337
00:11:48,389 --> 00:11:45,519
and so you you select them for different

338
00:11:50,790 --> 00:11:48,399

skills so web is really designed to do

339
00:11:52,870 --> 00:11:50,800
the things that hubble can't it has much

340
00:11:54,470 --> 00:11:52,880
greater spectroscopic capabilities than

341
00:11:56,470 --> 00:11:54,480
hubble so we can really see what the

342
00:11:58,230 --> 00:11:56,480
universe is made of which is great

343
00:12:00,230 --> 00:11:58,240
because that's that's part of what i

344
00:12:01,750 --> 00:12:00,240
what my research is i love spectroscopy

345
00:12:03,829 --> 00:12:01,760
what's stuff made of

346
00:12:05,430 --> 00:12:03,839
um and then the other part is that we're

347
00:12:07,829 --> 00:12:05,440
operating in the infrared with web so

348
00:12:08,949 --> 00:12:07,839
we're looking the bluest light that webb

349
00:12:12,389 --> 00:12:08,959
can see

350
00:12:14,470 --> 00:12:12,399
is like a dusky red like like red wine

351
00:12:16,949 --> 00:12:14,480
and then it just gets redder from there

352
00:12:19,350 --> 00:12:16,959
right so whereas hubble can see

353
00:12:21,670 --> 00:12:19,360
um into the near infrared and then it

354
00:12:23,910 --> 00:12:21,680
can see into pretty hard into the

355
00:12:25,110 --> 00:12:23,920
ultraviolet like bluer than cats or bees

356
00:12:26,790 --> 00:12:25,120
can see

357
00:12:27,990 --> 00:12:26,800
okay yeah it's going to be really great

358
00:12:30,629 --> 00:12:28,000
i'm very excited for them both to be

359
00:12:32,389 --> 00:12:30,639
working together up there and uh back to

360
00:12:34,230 --> 00:12:32,399
hubble patty could you just sort of tell

361
00:12:36,230 --> 00:12:34,240
us how hubble's doing these days how

362
00:12:38,389 --> 00:12:36,240
long we can expect it to last sure

363
00:12:40,949 --> 00:12:38,399

absolutely so hubble is actually doing

364
00:12:43,190 --> 00:12:40,959
great and it was launched in 1990 so

365
00:12:45,269 --> 00:12:43,200
it's coming up on its 32nd birthday in

366
00:12:47,590 --> 00:12:45,279
space that is a long time for an

367
00:12:50,230 --> 00:12:47,600
observatory to be in space i mean it's

368
00:12:52,150 --> 00:12:50,240
in a low earth orbit and its orbit was

369
00:12:54,629 --> 00:12:52,160
chosen so that it could be a rendezvous

370
00:12:56,870 --> 00:12:54,639
with the space shuttle and astronauts

371
00:12:58,710 --> 00:12:56,880
could actually grab it and bring it back

372
00:13:00,230 --> 00:12:58,720
into the bay there and service it what

373
00:13:02,550 --> 00:13:00,240
servicing meant was that it could

374
00:13:05,110 --> 00:13:02,560
refurbish the instruments refurbish the

375
00:13:07,030 --> 00:13:05,120
computer the power systems and this was

376
00:13:09,030 --> 00:13:07,040
done five times during the lifetime of

377
00:13:10,790 --> 00:13:09,040
hubble during the last servicing mission

378
00:13:12,629 --> 00:13:10,800
the astronauts worked very hard to leave

379
00:13:15,110 --> 00:13:12,639
the telescope at the peak of its

380
00:13:17,110 --> 00:13:15,120
capabilities and ever since then there's

381
00:13:19,110 --> 00:13:17,120
been a team of engineers and scientists

382
00:13:21,750 --> 00:13:19,120
working together on the ground to extend

383
00:13:23,670 --> 00:13:21,760
the lifetime as much as possible

384
00:13:26,069 --> 00:13:23,680
so we're expecting hubble to continue

385
00:13:27,829 --> 00:13:26,079
into the next decade so we can squeeze

386
00:13:28,790 --> 00:13:27,839
as much great science out of hubble as

387
00:13:31,030 --> 00:13:28,800
possible

388
00:13:32,550 --> 00:13:31,040

that's fantastic thank you guys all

389
00:13:33,990 --> 00:13:32,560
right so bear with me for a second we've

390
00:13:35,910 --> 00:13:34,000
been getting some questions from social

391
00:13:39,910 --> 00:13:35,920
media so let's see if there's anything

392
00:13:41,110 --> 00:13:39,920
we can talk about here um okay so

393
00:13:42,710 --> 00:13:41,120
we did talk about this a little bit

394
00:13:44,389 --> 00:13:42,720
early but maybe patty if you want to go

395
00:13:46,310 --> 00:13:44,399
into this a little bit more someone on

396
00:13:48,949 --> 00:13:46,320
youtube is just curious more knowing

397
00:13:51,590 --> 00:13:48,959
about how we can tell this is a star

398
00:13:52,389 --> 00:13:51,600
rather than you know a galaxy basically

399
00:13:55,990 --> 00:13:52,399
or

400
00:13:57,829 --> 00:13:56,000
either one i can take that one okay so

401
00:14:00,389 --> 00:13:57,839
the main constraint that it has to be

402
00:14:02,629 --> 00:14:00,399
really sm so the main constraint is that

403
00:14:05,110 --> 00:14:02,639
it's really small and really bright

404
00:14:07,030 --> 00:14:05,120
and so the size constraint comes mostly

405
00:14:09,670 --> 00:14:07,040
from the fact that in the images it

406
00:14:12,470 --> 00:14:09,680
looks like a dot it's round it isn't

407
00:14:14,310 --> 00:14:12,480
stretched and if it had any significant

408
00:14:16,470 --> 00:14:14,320
size like bigger than the size of our

409
00:14:19,350 --> 00:14:16,480
solar system then given the really high

410
00:14:21,590 --> 00:14:19,360
magnification we would see it stretched

411
00:14:24,069 --> 00:14:21,600
but we don't we see it as a dot and so

412
00:14:26,470 --> 00:14:24,079
that places a really strict limit on the

413
00:14:28,069 --> 00:14:26,480

size in the paper we give it in terms of

414
00:14:29,910 --> 00:14:28,079
but it you know it's got a

415
00:14:32,310 --> 00:14:29,920
they're all about the size of the solar

416
00:14:35,030 --> 00:14:32,320
system so it's got to be smaller than

417
00:14:36,629 --> 00:14:35,040
like out to pluto right so that's one

418
00:14:39,670 --> 00:14:36,639
constraint it's got to be something that

419
00:14:41,670 --> 00:14:39,680
fits in a small box okay and given that

420
00:14:42,790 --> 00:14:41,680
really high magnification something like

421
00:14:44,470 --> 00:14:42,800
thousands

422
00:14:46,949 --> 00:14:44,480
um and it's whether it's one thousand or

423
00:14:48,150 --> 00:14:46,959
ten thousand the we we showed a bunch of

424
00:14:50,310 --> 00:14:48,160
different models to show that it's

425
00:14:51,430 --> 00:14:50,320
somewhere in that range okay so you have

426
00:14:53,030 --> 00:14:51,440
something that's

427
00:14:55,910 --> 00:14:53,040
given its brightness magnified by

428
00:14:57,590 --> 00:14:55,920
factors of a thousand well that's like a

429
00:14:58,949 --> 00:14:57,600
million times the mass of the sun a

430
00:15:00,790 --> 00:14:58,959
million times the luminosity the

431
00:15:04,150 --> 00:15:00,800
brightness of the sun okay

432
00:15:05,350 --> 00:15:04,160
so all right what's what is out there

433
00:15:07,750 --> 00:15:05,360
that is

434
00:15:09,910 --> 00:15:07,760
bright as a million suns and fits in our

435
00:15:11,189 --> 00:15:09,920
solar system well that's really very

436
00:15:13,829 --> 00:15:11,199
massive stars

437
00:15:14,870 --> 00:15:13,839
or binaries could be binary or it could

438
00:15:16,069 --> 00:15:14,880

be

439
00:15:18,389 --> 00:15:16,079
some

440
00:15:20,389 --> 00:15:18,399
accreting black hole but we also know it

441
00:15:22,310 --> 00:15:20,399
hasn't changed in brightness so we have

442
00:15:24,870 --> 00:15:22,320
observations hubble has observed this

443
00:15:26,470 --> 00:15:24,880
this star multiple times in part to look

444
00:15:27,590 --> 00:15:26,480
for supernova we're going to look for

445
00:15:32,150 --> 00:15:27,600
lens

446
00:15:34,389 --> 00:15:32,160
multiple epochs we don't see any sign

447
00:15:35,670 --> 00:15:34,399
that has changed brightness so one of

448
00:15:37,749 --> 00:15:35,680
the characteristic features of

449
00:15:39,509 --> 00:15:37,759
recreating black holes is that they go

450
00:15:40,870 --> 00:15:39,519
up and down in brightness and they

451
00:15:43,829 --> 00:15:40,880
change and so

452
00:15:46,310 --> 00:15:43,839
so we think the most likely explanation

453
00:15:47,829 --> 00:15:46,320
in the paper is that this really is a

454
00:15:50,230 --> 00:15:47,839
massive star

455
00:15:51,910 --> 00:15:50,240
yeah okay make sense thank you awesome

456
00:15:53,509 --> 00:15:51,920
well thank you all so much for sending

457
00:15:54,949 --> 00:15:53,519
in these questions on social media i

458
00:15:56,150 --> 00:15:54,959
think we are unfortunately running out

459
00:15:57,910 --> 00:15:56,160
of time for today though so we're going

460
00:15:59,189 --> 00:15:57,920
to have to wrap things up but thank you

461
00:16:00,629 --> 00:15:59,199
all for tuning in to learn more about

462
00:16:02,710 --> 00:16:00,639
hubble's discovery of the farthest

463
00:16:04,230 --> 00:16:02,720

individual star ever seen this is a

464
00:16:06,550 --> 00:16:04,240
really cool story so if you want to find

465
00:16:08,230 --> 00:16:06,560
out more be sure to check out nasa.gov

466
00:16:10,150 --> 00:16:08,240
hubble and as always you can keep up

467
00:16:12,629 --> 00:16:10,160
with hubble on social media at nasa

468
00:16:14,230 --> 00:16:12,639
hubble on facebook twitter and instagram

469
00:16:15,990 --> 00:16:14,240
thank you all so much for joining us