

1  
00:00:01,760 --> 00:00:05,910  
hello everybody and welcome to our

2  
00:00:03,658 --> 00:00:08,388  
latest Hubble hangout this is a place

3  
00:00:05,910 --> 00:00:10,589  
where you can be on the bleeding edge of

4  
00:00:08,388 --> 00:00:12,869  
science it's being done with the Hubble

5  
00:00:10,589 --> 00:00:14,009  
Space Telescope my name is Tony Darnell

6  
00:00:12,869 --> 00:00:16,980  
and I work at Space Telescope Science

7  
00:00:14,009 --> 00:00:18,719  
Institute with me to facilitate our

8  
00:00:16,980 --> 00:00:20,250  
discussion today is my colleague dr.

9  
00:00:18,719 --> 00:00:23,729  
Carol Christian from the Space Telescope

10  
00:00:20,250 --> 00:00:26,609  
Science Institute and Scott Lewis from

11  
00:00:23,730 --> 00:00:28,768  
space fan news and no the cosmos comm so

12  
00:00:26,609 --> 00:00:32,039  
these guys are going to help be discuss

13  
00:00:28,768 --> 00:00:34,170  
a very exciting topic today which is the

14  
00:00:32,039 --> 00:00:37,109  
frontier field survey we're gonna get an

15  
00:00:34,170 --> 00:00:39,750  
update on one of the largest programs

16  
00:00:37,109 --> 00:00:41,878  
ever to use the Hubble Space Telescope

17  
00:00:39,750 --> 00:00:43,799  
very ambitious project we've done

18  
00:00:41,878 --> 00:00:47,009  
hangouts on this before and I will make

19  
00:00:43,799 --> 00:00:48,538  
sure that we give you guys a good update

20  
00:00:47,009 --> 00:00:49,679  
as well as a sort a little bit of

21  
00:00:48,539 --> 00:00:51,570  
background on some of the things we've

22  
00:00:49,679 --> 00:00:54,238  
done if you've not heard of it before

23  
00:00:51,570 --> 00:00:55,738  
so before I guess or with the

24  
00:00:54,238 --> 00:00:59,218  
introductions let me say that we are

25  
00:00:55,738 --> 00:01:02,218  
monitoring the Q&A app on on YouTube and

26  
00:00:59,219 --> 00:01:04,290  
G+ as well as the G+ event event page

27  
00:01:02,219 --> 00:01:06,299  
from which this is being broadcast and

28  
00:01:04,290 --> 00:01:09,810  
I'm also looking at Twitter with the

29

00:01:06,299 --> 00:01:12,479  
hashtag Hubble hangout so plz interact

30  
00:01:09,810 --> 00:01:14,549  
with us ask us questions comments this

31  
00:01:12,478 --> 00:01:16,469  
is the time to do it because very

32  
00:01:14,549 --> 00:01:18,900  
nowhere else will you get this much

33  
00:01:16,469 --> 00:01:21,079  
up-to-date access to people working

34  
00:01:18,900 --> 00:01:24,180  
directly with the Hubble Space Telescope

35  
00:01:21,079 --> 00:01:25,650  
so let's go ahead and get started let me

36  
00:01:24,180 --> 00:01:26,909  
let me introduce the team members we

37  
00:01:25,650 --> 00:01:29,700  
have here with us today starting with

38  
00:01:26,909 --> 00:01:31,259  
dr. Jennifer lot she's the principal

39  
00:01:29,700 --> 00:01:34,920  
investigator of the frontier fields

40  
00:01:31,259 --> 00:01:36,509  
survey and she will be giving us some

41  
00:01:34,920 --> 00:01:37,140  
updates as well as telling us how things

42  
00:01:36,509 --> 00:01:39,209  
were going

43  
00:01:37,140 --> 00:01:40,709

also with us dr. dan Koh you remember

44

00:01:39,209 --> 00:01:42,239

him he's been in several hangouts with

45

00:01:40,709 --> 00:01:45,298

us he's also an astronomer at Space

46

00:01:42,239 --> 00:01:47,368

Telescope Science Institute and he is

47

00:01:45,299 --> 00:01:49,470

going to also give us good insight into

48

00:01:47,368 --> 00:01:58,680

what's going on and for the first time I

49

00:01:49,469 --> 00:02:00,180

have dr. Lewis I'm losing it blue bolt

50

00:01:58,680 --> 00:02:04,079

bulger right that's your last name

51

00:02:00,180 --> 00:02:06,030

Stroller sorry lou Strowger you didn't

52

00:02:04,078 --> 00:02:07,679

have it up and I drew a blank it's also

53

00:02:06,030 --> 00:02:09,118

for the first time and I'm we're gonna

54

00:02:07,680 --> 00:02:11,400

learn about his role on the project as

55

00:02:09,118 --> 00:02:13,469

well as some of his research interests

56

00:02:11,400 --> 00:02:16,980

as well dr. ray Lucas also

57

00:02:13,469 --> 00:02:20,520

a astronomer at the Institute working on

58  
00:02:16,979 --> 00:02:23,789  
the team dr. Norman Grogan also with us

59  
00:02:20,520 --> 00:02:27,450  
for the first time so we got three

60  
00:02:23,789 --> 00:02:30,780  
newbies and I just saw Anton Kokomo join

61  
00:02:27,449 --> 00:02:34,289  
hello Anton welcome good to see you

62  
00:02:30,780 --> 00:02:34,949  
again and so let's go ahead and get

63  
00:02:34,289 --> 00:02:36,810  
started

64  
00:02:34,949 --> 00:02:37,799  
we as I said will be monitoring all

65  
00:02:36,810 --> 00:02:39,599  
those different channels for the

66  
00:02:37,800 --> 00:02:41,250  
questions and comments but let's start

67  
00:02:39,599 --> 00:02:44,840  
with you Jim why don't you give us a

68  
00:02:41,250 --> 00:02:47,129  
very brief introduction into the

69  
00:02:44,840 --> 00:02:48,840  
frontier fields initiative that's what

70  
00:02:47,129 --> 00:02:50,849  
what the survey is trying to accomplish

71  
00:02:48,840 --> 00:02:52,770  
and I also want to mention before you

72  
00:02:50,849 --> 00:02:56,489  
get started that I have put a link in

73  
00:02:52,770 --> 00:02:58,650  
the description box of the event page on

74  
00:02:56,490 --> 00:03:01,530  
Google+ to our first hangout so you

75  
00:02:58,650 --> 00:03:03,480  
could go back watch a lot of what we've

76  
00:03:01,530 --> 00:03:05,909  
rd back the one we had in October where

77  
00:03:03,479 --> 00:03:07,289  
we over and and gave a background an

78  
00:03:05,909 --> 00:03:09,479  
overview of the whole survey when it

79  
00:03:07,289 --> 00:03:12,209  
just got started so Jennifer want to

80  
00:03:09,479 --> 00:03:15,439  
give us a brief overview okay sure I'll

81  
00:03:12,210 --> 00:03:21,120  
try to bring everybody up to speed so

82  
00:03:15,439 --> 00:03:25,439  
we're now about I don't know six months

83  
00:03:21,120 --> 00:03:28,170  
into observing this new program called

84  
00:03:25,439 --> 00:03:31,199  
the frontier fields and the aim of this

85  
00:03:28,169 --> 00:03:35,159  
program basically is to peer deeper into

86

00:03:31,199 --> 00:03:37,079  
the universe than we ever have before so

87  
00:03:35,159 --> 00:03:39,359  
I think probably many of your listeners

88  
00:03:37,080 --> 00:03:42,570  
have heard of the Hubble Ultra Deep

89  
00:03:39,360 --> 00:03:45,180  
Field a new version of that actually

90  
00:03:42,569 --> 00:03:47,639  
came out quite recently last week was

91  
00:03:45,180 --> 00:03:49,469  
made made the press there was an

92  
00:03:47,639 --> 00:03:52,589  
ultraviolet addition to the Ultra Deep

93  
00:03:49,469 --> 00:03:54,750  
Field so what the frontier fields is

94  
00:03:52,590 --> 00:03:56,849  
aiming to do is actually to try to peer

95  
00:03:54,750 --> 00:04:00,389  
deeper into the universe than the Ultra

96  
00:03:56,849 --> 00:04:04,169  
Deep Field and we're going to do that by

97  
00:04:00,389 --> 00:04:08,219  
using a trick from Einstein's theory of

98  
00:04:04,169 --> 00:04:11,939  
general relativity by using very massive

99  
00:04:08,219 --> 00:04:15,659  
clusters of galaxies as telescopes so

100  
00:04:11,939 --> 00:04:17,790

these objects can bend light and space

101

00:04:15,659 --> 00:04:21,149

and act like a telescope and magnify

102

00:04:17,790 --> 00:04:24,390

galaxies behind those clusters and so by

103

00:04:21,149 --> 00:04:26,609

peering very deeply at a very massive

104

00:04:24,389 --> 00:04:27,269

cluster of galaxies we should be able to

105

00:04:26,610 --> 00:04:29,389

see deeper

106

00:04:27,269 --> 00:04:31,918

to the universe than we would otherwise

107

00:04:29,389 --> 00:04:35,189

so the frontier fields is aiming to

108

00:04:31,918 --> 00:04:38,459

observe six of these strong lensing

109

00:04:35,189 --> 00:04:41,129

clusters or also getting parallel blank

110

00:04:38,459 --> 00:04:43,318

fields near to the cluster and we are

111

00:04:41,129 --> 00:04:44,939

almost done with our first cluster

112

00:04:43,319 --> 00:04:47,220

that's going to happen at the end of

113

00:04:44,939 --> 00:04:49,699

this month so we've had a few pretty

114

00:04:47,220 --> 00:04:53,099

images out there but we're really just



115  
00:04:49,699 --> 00:04:55,889  
as I said getting under way with this

116  
00:04:53,098 --> 00:04:58,378  
long-term project I have to say it's one

117  
00:04:55,889 --> 00:05:01,168  
of the most innovative ideas I've heard

118  
00:04:58,379 --> 00:05:03,000  
in a while using gravitational lensing

119  
00:05:01,168 --> 00:05:05,038  
to make the Hubble Space Telescope more

120  
00:05:03,000 --> 00:05:06,899  
powerful than it would otherwise be it's

121  
00:05:05,038 --> 00:05:08,939  
like adding a pair of that kind of like

122  
00:05:06,899 --> 00:05:10,948  
adding a Barlow lens to the Hubble right

123  
00:05:08,939 --> 00:05:13,469  
you can see just a little a little bit

124  
00:05:10,949 --> 00:05:16,050  
further back and into into this so you

125  
00:05:13,470 --> 00:05:17,759  
said you're almost done with the first

126  
00:05:16,050 --> 00:05:21,090  
field I thought we're we were done with

127  
00:05:17,759 --> 00:05:24,930  
with that one well what we're doing is

128  
00:05:21,089 --> 00:05:28,378  
for every cluster we're going to it back

129  
00:05:24,930 --> 00:05:30,509  
to it twice so Hubble has a number of

130  
00:05:28,379 --> 00:05:33,569  
cameras on it and we're going to we're

131  
00:05:30,509 --> 00:05:35,580  
turning on two cameras at once one is

132  
00:05:33,569 --> 00:05:38,490  
the infrared camera the Wide Field

133  
00:05:35,579 --> 00:05:40,408  
Camera 3 and the other is our trusty

134  
00:05:38,490 --> 00:05:43,889  
optical camera the advanced camera for

135  
00:05:40,408 --> 00:05:46,348  
surveys and while one camera is centered

136  
00:05:43,889 --> 00:05:50,430  
on the cluster the other camera will be

137  
00:05:46,348 --> 00:05:53,310  
on on a parallel field holding Hubble at

138  
00:05:50,430 --> 00:05:55,500  
a fixed angle as we collect a lot of

139  
00:05:53,310 --> 00:05:57,449  
data with those two cameras and then we

140  
00:05:55,500 --> 00:06:00,750  
have to come back and we have to let

141  
00:05:57,449 --> 00:06:02,218  
Hubble rotate around and so about six

142  
00:06:00,750 --> 00:06:05,728  
months later we come back to a field

143

00:06:02,218 --> 00:06:09,120  
switching the cameras so now we're back

144  
00:06:05,728 --> 00:06:12,240  
to a bell 27:44 and we're swap the

145  
00:06:09,120 --> 00:06:15,389  
cameras so now we have the advanced

146  
00:06:12,240 --> 00:06:18,329  
camera for surveys on the cluster the

147  
00:06:15,389 --> 00:06:20,579  
intrud cameras on the parallel field we

148  
00:06:18,329 --> 00:06:22,560  
got data yesterday we're gonna get data

149  
00:06:20,579 --> 00:06:24,658  
tomorrow we're getting data all through

150  
00:06:22,560 --> 00:06:28,800  
the end of this month and then we'll be

151  
00:06:24,658 --> 00:06:30,810  
done with a bell 27:44 so Carol I don't

152  
00:06:28,800 --> 00:06:32,340  
want to ask you real quick do you can

153  
00:06:30,810 --> 00:06:37,459  
you've been associated with Hubble

154  
00:06:32,339 --> 00:06:37,459  
forever this strikes me is probably the

155  
00:06:40,180 --> 00:07:10,689  
am I wrong what once I introduced

156  
00:07:07,759 --> 00:07:14,030  
Frank's hangout with M of the month so

157  
00:07:10,689 --> 00:07:17,750

it's so I tend to do that so anyway okay

158

00:07:14,029 --> 00:07:19,339

so can you remember I've I've always

159

00:07:17,750 --> 00:07:22,430

described the frontier fields as being

160

00:07:19,339 --> 00:07:25,399

one of the most ambitious individual

161

00:07:22,430 --> 00:07:26,870

efforts that have been done by those by

162

00:07:25,399 --> 00:07:28,038

the Hubble Space Telescope would you

163

00:07:26,870 --> 00:07:29,478

agree with that statement or is there

164

00:07:28,038 --> 00:07:33,649

something been has there been anything

165

00:07:29,478 --> 00:07:36,560

that's used this much Hubble time well I

166

00:07:33,649 --> 00:07:38,568

think what I would comment on is that

167

00:07:36,560 --> 00:07:41,598

Hubble has gone through a number of

168

00:07:38,569 --> 00:07:44,449

stages and in the early days everybody

169

00:07:41,598 --> 00:07:46,668

was scrambling and so the the way the

170

00:07:44,449 --> 00:07:49,520

time was allocated was to individual

171

00:07:46,668 --> 00:07:51,529

teams there were some what were called

172  
00:07:49,519 --> 00:07:54,769  
guaranteed time observers and they got

173  
00:07:51,529 --> 00:07:56,569  
larger chunks of time but in general

174  
00:07:54,769 --> 00:07:58,609  
we're trying to get everybody in the

175  
00:07:56,569 --> 00:08:00,889  
Astronomy community to get a piece of

176  
00:07:58,610 --> 00:08:03,710  
the action and that we had award-winning

177  
00:08:00,889 --> 00:08:05,990  
proposals then and then with the Hubble

178  
00:08:03,709 --> 00:08:08,120  
Deep Field that kind of changed things

179  
00:08:05,990 --> 00:08:09,740  
that changed the game a little bit there

180  
00:08:08,120 --> 00:08:11,899  
was more cooperation with other

181  
00:08:09,740 --> 00:08:14,329  
observatories the idea of doing these

182  
00:08:11,899 --> 00:08:16,519  
deep fields and immediately offering all

183  
00:08:14,329 --> 00:08:19,639  
the data to the community to do research

184  
00:08:16,519 --> 00:08:21,348  
on that's that's one of the things is

185  
00:08:19,639 --> 00:08:23,060  
that the team that you see here is

186  
00:08:21,348 --> 00:08:25,519  
working very hard and they have their

187  
00:08:23,060 --> 00:08:27,918  
own science research goals but they are

188  
00:08:25,519 --> 00:08:29,538  
as soon as this data is fully processed

189  
00:08:27,918 --> 00:08:31,370  
and they're confident the data has

190  
00:08:29,538 --> 00:08:34,458  
integrity it's offered to the entire

191  
00:08:31,370 --> 00:08:36,860  
science community to do research on so

192  
00:08:34,458 --> 00:08:39,679  
that see change took place over the last

193  
00:08:36,860 --> 00:08:42,860  
ten years of doing these and so we're I

194  
00:08:39,679 --> 00:08:46,578  
would say that we've been trying to do

195  
00:08:42,860 --> 00:08:48,709  
on behalf it's kind of an observatory on

196  
00:08:46,578 --> 00:08:51,528  
behalf of the community so that

197  
00:08:48,708 --> 00:08:53,929  
everybody in the community can

198  
00:08:51,528 --> 00:08:56,269  
fit from the observations but we still

199  
00:08:53,929 --> 00:08:58,399  
have the normal time allocation process

200

00:08:56,269 --> 00:09:00,589  
going on in parallel so people are still

201  
00:08:58,399 --> 00:09:02,809  
from individual teams applying for their

202  
00:09:00,589 --> 00:09:04,670  
own data and then we also have these

203  
00:09:02,809 --> 00:09:06,258  
things called Treasury programs which

204  
00:09:04,669 --> 00:09:08,509  
has a significant amount of data

205  
00:09:06,259 --> 00:09:10,789  
associated with them but this is sort of

206  
00:09:08,509 --> 00:09:13,909  
interesting because frontier fields is

207  
00:09:10,789 --> 00:09:16,039  
on behalf of the community conducted by

208  
00:09:13,909 --> 00:09:18,019  
the observatory so I think that's a

209  
00:09:16,039 --> 00:09:20,539  
little bit so we have now lots of

210  
00:09:18,019 --> 00:09:22,490  
flavors of kinds of programs done by

211  
00:09:20,539 --> 00:09:24,828  
Hubble Space Telescope and the fact that

212  
00:09:22,490 --> 00:09:28,180  
this looks so far back in time and gives

213  
00:09:24,828 --> 00:09:31,638  
us a little glimpse of what JWST may see

214  
00:09:28,179 --> 00:09:33,799

after it's launched in 2018 is really

215

00:09:31,639 --> 00:09:35,659

exciting right and we're gonna get to

216

00:09:33,799 --> 00:09:37,789

the schedule here in just a little bit

217

00:09:35,659 --> 00:09:38,990

about where we are and the observing

218

00:09:37,789 --> 00:09:41,480

program but it sounds like what you're

219

00:09:38,990 --> 00:09:43,039

saying is the nature of the way Hubble

220

00:09:41,480 --> 00:09:45,170

is being used now is there starting to

221

00:09:43,039 --> 00:09:47,838

change and it got it started with the

222

00:09:45,169 --> 00:09:49,549

holder of the Hubble Deep Field and and

223

00:09:47,839 --> 00:09:52,220

also we're realistic we know this

224

00:09:49,549 --> 00:09:54,620

telescope won't last forever what we

225

00:09:52,220 --> 00:09:56,300

pretend like it would oh but we know it

226

00:09:54,620 --> 00:09:57,948

won't and so we're really in the phase

227

00:09:56,299 --> 00:10:02,328

of thinking about what is it that we

228

00:09:57,948 --> 00:10:06,258

have to do with HST you know before 2020



229  
00:10:02,328 --> 00:10:08,088  
or 2022 when it may not be operating in

230  
00:10:06,259 --> 00:10:10,220  
an optimal fashion we've got a beautiful

231  
00:10:08,089 --> 00:10:13,490  
observatory right now let's use it to

232  
00:10:10,220 --> 00:10:16,610  
its best advantage awesome ok well Dan

233  
00:10:13,490 --> 00:10:19,250  
so what as Dan Koh I want to ask you

234  
00:10:16,610 --> 00:10:21,500  
briefly about something that you know

235  
00:10:19,250 --> 00:10:23,230  
Jennifer alluded to when she was

236  
00:10:21,500 --> 00:10:26,179  
describing you know how the

237  
00:10:23,230 --> 00:10:28,699  
gravitational lensing what it will do a

238  
00:10:26,179 --> 00:10:31,578  
lot of that gravitational lensing when

239  
00:10:28,698 --> 00:10:33,289  
we look at the galaxy clusters that you

240  
00:10:31,578 --> 00:10:36,318  
guys have selected which I want to talk

241  
00:10:33,289 --> 00:10:38,028  
about too in just a minute but the when

242  
00:10:36,318 --> 00:10:40,099  
you look at those galaxy clusters the

243  
00:10:38,028 --> 00:10:43,578  
lensing that's happening there a lot of

244  
00:10:40,100 --> 00:10:47,000  
it is being affected by the dark matter

245  
00:10:43,578 --> 00:10:48,019  
that is up and around these galaxies

246  
00:10:47,000 --> 00:10:49,339  
right and I asked you this because

247  
00:10:48,019 --> 00:10:50,480  
you're my Dark Matter guy whenever I

248  
00:10:49,339 --> 00:10:53,389  
have a dark amount of question I always

249  
00:10:50,480 --> 00:10:54,980  
come to you first so I so do a little

250  
00:10:53,389 --> 00:10:56,480  
bit what how does it how does dark what

251  
00:10:54,980 --> 00:10:58,819  
does the role Dark Matter plays in some

252  
00:10:56,480 --> 00:11:01,039  
of this lensing that you're observing so

253  
00:10:58,818 --> 00:11:03,049  
dark matter is most of the stuff in the

254  
00:11:01,039 --> 00:11:05,208  
universe and in these galaxies clusters

255  
00:11:03,049 --> 00:11:07,338  
there's probably a hundred times as much

256  
00:11:05,208 --> 00:11:09,258  
dark matter is there is of the stuff

257

00:11:07,339 --> 00:11:12,230  
that we can see the galaxies themselves

258  
00:11:09,259 --> 00:11:14,209  
the stars that have burned brightly so

259  
00:11:12,230 --> 00:11:16,249  
there's there's there's so much mass

260  
00:11:14,208 --> 00:11:18,438  
there and we can measure how much mass

261  
00:11:16,249 --> 00:11:20,749  
is there by this gravitational lensing

262  
00:11:18,438 --> 00:11:22,838  
effect and so I brought my handy

263  
00:11:20,749 --> 00:11:25,040  
gravitational lens here this is a

264  
00:11:22,839 --> 00:11:26,600  
plastic lens and I've shown this on

265  
00:11:25,039 --> 00:11:28,219  
these these hangouts before you bet you

266  
00:11:26,600 --> 00:11:30,319  
may have seen it before but basically

267  
00:11:28,220 --> 00:11:32,869  
it's it's ground to have a shape that's

268  
00:11:30,318 --> 00:11:35,599  
that's similar to exactly similar to a

269  
00:11:32,869 --> 00:11:38,778  
black hole okay before you start we star

270  
00:11:35,600 --> 00:11:41,089  
Scott would you put up one of the fields

271  
00:11:38,778 --> 00:11:42,828

one of the fields that it doesn't matter

272

00:11:41,089 --> 00:11:44,929

which one one of the frontier fields

273

00:11:42,828 --> 00:11:48,229

with a per image because you let's take

274

00:11:44,928 --> 00:11:49,818

a look at that that what the the Hubble

275

00:11:48,230 --> 00:11:51,230

is actually taking a picture of him then

276

00:11:49,818 --> 00:11:55,639

we'll go to Dan's demo to kind of give

277

00:11:51,230 --> 00:11:58,188

it a little bit of more of knowledge

278

00:11:55,639 --> 00:12:00,169

there okay so your so you see one of the

279

00:11:58,188 --> 00:12:03,948

fields on the right is the galaxy

280

00:12:00,169 --> 00:12:06,049

cluster that is you can see all of these

281

00:12:03,948 --> 00:12:09,169

kind of elongated shapes that are kind

282

00:12:06,049 --> 00:12:11,298

of in the center of this galaxy some of

283

00:12:09,169 --> 00:12:14,928

the some of these galaxies are actually

284

00:12:11,298 --> 00:12:17,028

a little bit distorted this one's not

285

00:12:14,928 --> 00:12:18,649

there's not have the most biggest

286  
00:12:17,028 --> 00:12:20,328  
examples of what I'm talking about but

287  
00:12:18,649 --> 00:12:22,428  
you kind of get a sense of some of these

288  
00:12:20,328 --> 00:12:24,198  
galaxies are squished some of them are a

289  
00:12:22,428 --> 00:12:29,208  
little bit stretched out and that's due

290  
00:12:24,198 --> 00:12:30,258  
to the changing or the bending of the

291  
00:12:29,208 --> 00:12:33,318  
light as it goes through the

292  
00:12:30,259 --> 00:12:36,409  
gravitational wells of the of the of the

293  
00:12:33,318 --> 00:12:38,868  
galaxy cluster so with this in mind Dan

294  
00:12:36,409 --> 00:12:41,688  
go ahead alright so we have light coming

295  
00:12:38,869 --> 00:12:44,959  
from a distant galaxy right a cluster

296  
00:12:41,688 --> 00:12:47,269  
okay I'll let you take it yeah so so

297  
00:12:44,958 --> 00:12:51,109  
this is this is the most distant galaxy

298  
00:12:47,269 --> 00:12:52,759  
we know yet so this was found in a

299  
00:12:51,110 --> 00:12:55,009  
previous program it's exactly

300  
00:12:52,759 --> 00:12:57,289  
gravitationally lends itself and it's

301  
00:12:55,009 --> 00:12:59,209  
still pretty small but I have it here on

302  
00:12:57,289 --> 00:13:01,099  
my phone and and when what happens is

303  
00:12:59,208 --> 00:13:02,958  
when you pass a gravitational lens in

304  
00:13:01,100 --> 00:13:05,360  
front of a distant galaxy it gets

305  
00:13:02,958 --> 00:13:06,649  
magnified here let me bring up myself a

306  
00:13:05,360 --> 00:13:09,350  
bit bigger ik and I can see what I'm

307  
00:13:06,649 --> 00:13:10,759  
doing here so bring this this lens in

308  
00:13:09,350 --> 00:13:12,769  
front of it and it magnifies that

309  
00:13:10,759 --> 00:13:15,019  
distant galaxy so it makes it bigger we

310  
00:13:12,769 --> 00:13:16,850  
can see it better it also makes makes

311  
00:13:15,019 --> 00:13:19,049  
different arcs that you see in these

312  
00:13:16,850 --> 00:13:22,259  
images and it even makes multiple image

313  
00:13:19,049 --> 00:13:24,839  
and we see all of these same effects in

314

00:13:22,259 --> 00:13:28,289  
these in these actual Hubble images and

315  
00:13:24,840 --> 00:13:30,899  
this is how we we see that the distant

316  
00:13:28,289 --> 00:13:32,699  
galaxies better but we can also map out

317  
00:13:30,899 --> 00:13:34,169  
the dark matter that's in this galaxy

318  
00:13:32,700 --> 00:13:36,120  
cluster so most of the mass that's in

319  
00:13:34,169 --> 00:13:37,439  
this galaxy cluster is stuff that we

320  
00:13:36,120 --> 00:13:39,840  
don't know what it is yet it's dark

321  
00:13:37,440 --> 00:13:42,090  
matter we can't see it but by measuring

322  
00:13:39,840 --> 00:13:44,820  
these deflections of the light we can

323  
00:13:42,090 --> 00:13:46,889  
tell how much mass is there to bet in

324  
00:13:44,820 --> 00:13:48,810  
space and time and in that amount to

325  
00:13:46,889 --> 00:13:51,750  
deflect the light around it and to tell

326  
00:13:48,809 --> 00:13:53,519  
us how powerful that lens it's so so put

327  
00:13:51,750 --> 00:13:57,029  
that back up just a so the analogy here

328  
00:13:53,519 --> 00:13:58,559

is look at the pink and the yellow parts

329

00:13:57,029 --> 00:13:59,579

of the light on Dan's phone there that's

330

00:13:58,559 --> 00:14:01,229

the net that's the light don't worry

331

00:13:59,580 --> 00:14:03,780

about the reflections on the wineglasses

332

00:14:01,230 --> 00:14:07,200

right and but that's what's being in the

333

00:14:03,779 --> 00:14:09,059

the wineglass bottom is the analogy of

334

00:14:07,200 --> 00:14:11,400

what I see

335

00:14:09,059 --> 00:14:13,199

cluster lensing and that's the actual

336

00:14:11,399 --> 00:14:15,240

lens now I want to get to the lens

337

00:14:13,200 --> 00:14:16,950

models that are being used to figure

338

00:14:15,240 --> 00:14:19,019

this out later and we'll go back to this

339

00:14:16,950 --> 00:14:20,550

wine glass in just a second but that's

340

00:14:19,019 --> 00:14:22,740

what you want to pay attention to and

341

00:14:20,549 --> 00:14:25,529

that to me is one of the most easiest

342

00:14:22,740 --> 00:14:27,389

ways to see what the heck is going on in



343  
00:14:25,529 --> 00:14:28,500  
in gravitational lensing so thank you

344  
00:14:27,389 --> 00:14:31,500  
very much Dan now you didn't ask my

345  
00:14:28,500 --> 00:14:34,080  
question though how is dark matter

346  
00:14:31,500 --> 00:14:37,379  
playing the dominant role yes wincing

347  
00:14:34,080 --> 00:14:39,180  
absolutely under times more Dark Matter

348  
00:14:37,379 --> 00:14:41,009  
than that stuff that we can see and if

349  
00:14:39,179 --> 00:14:42,750  
it wasn't for the dark matter that these

350  
00:14:41,009 --> 00:14:45,179  
magnification effects would be much

351  
00:14:42,750 --> 00:14:46,889  
weaker and these these cosmic telescopes

352  
00:14:45,179 --> 00:14:50,159  
wouldn't magnify the distant galaxies

353  
00:14:46,889 --> 00:14:53,069  
nearly as much okay okay so that's a

354  
00:14:50,159 --> 00:14:55,259  
brief intro into what frontier fields is

355  
00:14:53,070 --> 00:14:57,780  
doing and why they're - and when done

356  
00:14:55,259 --> 00:15:00,149  
and how they're doing in and what the

357  
00:14:57,779 --> 00:15:02,100  
what they're looking at we didn't really

358  
00:15:00,149 --> 00:15:03,480  
talk about the parallel fields right now

359  
00:15:02,100 --> 00:15:05,610  
but maybe we'll get we'll get a chance

360  
00:15:03,480 --> 00:15:07,399  
to do that but one of the questions the

361  
00:15:05,610 --> 00:15:10,340  
frontier fields is trying to answer is

362  
00:15:07,399 --> 00:15:12,480  
is the Hubble ultra-deep field

363  
00:15:10,340 --> 00:15:14,820  
ubiquitous I mean if we look in other

364  
00:15:12,480 --> 00:15:16,350  
areas of the sky what will we see will

365  
00:15:14,820 --> 00:15:18,270  
we see nothing or will we see more

366  
00:15:16,350 --> 00:15:19,980  
galaxies like we did in the Ultra Deep

367  
00:15:18,269 --> 00:15:21,509  
Field than if we did what will they look

368  
00:15:19,980 --> 00:15:23,190  
like will they be distributed more or

369  
00:15:21,509 --> 00:15:24,779  
less the same so these are really

370  
00:15:23,190 --> 00:15:27,230  
important questions that ultimately go

371

00:15:24,779 --> 00:15:29,669  
into our place in the universe and so

372  
00:15:27,230 --> 00:15:32,269  
that by looking at all that these just

373  
00:15:29,669 --> 00:15:33,649  
six different areas of the sky

374  
00:15:32,269 --> 00:15:36,350  
they're hoping to help answer that

375  
00:15:33,649 --> 00:15:39,049  
question now I want to ask I'm not sure

376  
00:15:36,350 --> 00:15:43,759  
to who maybe Jennifer why did you pick

377  
00:15:39,049 --> 00:15:47,949  
the six clusters you did oh well that

378  
00:15:43,759 --> 00:15:51,289  
was a very difficult task actually so

379  
00:15:47,950 --> 00:15:53,839  
this idea was originally conceived by a

380  
00:15:51,289 --> 00:15:56,360  
science working group and that working

381  
00:15:53,839 --> 00:15:58,820  
group you know pulled a bunch of experts

382  
00:15:56,360 --> 00:16:00,649  
and pulled together a list of like 20 or

383  
00:15:58,820 --> 00:16:03,680  
30 clusters that they thought might be

384  
00:16:00,649 --> 00:16:06,799  
good candidates that would be very

385  
00:16:03,679 --> 00:16:09,559

strong lenders and then they gave us a

386

00:16:06,799 --> 00:16:14,179

long list of criteria one of which being

387

00:16:09,559 --> 00:16:16,789

you know you had to be able to you know

388

00:16:14,179 --> 00:16:19,489

have a high probability of finding very

389

00:16:16,789 --> 00:16:22,969

distant galaxies that would be very

390

00:16:19,490 --> 00:16:25,580

strongly lensed the galaxy cluster had

391

00:16:22,970 --> 00:16:27,830

to fit within our cut our camera right

392

00:16:25,580 --> 00:16:29,959

so it could be too far away it couldn't

393

00:16:27,830 --> 00:16:31,550

be too close it had to sort of be there

394

00:16:29,958 --> 00:16:35,208

just the right distance to fit within

395

00:16:31,549 --> 00:16:38,778

within the camera and it also needed to

396

00:16:35,208 --> 00:16:41,809

be in a really dark piece of sky right

397

00:16:38,778 --> 00:16:44,179

so that actually posed kind of a problem

398

00:16:41,809 --> 00:16:49,069

by not sort of out of the plane of the

399

00:16:44,179 --> 00:16:51,259

galaxy so we live in a galaxy and if

400  
00:16:49,070 --> 00:16:54,260  
you've ever seen the Milky Way you're

401  
00:16:51,259 --> 00:16:56,778  
seeing you know a lot of stars and

402  
00:16:54,259 --> 00:16:58,819  
actually a lot of dust that's associated

403  
00:16:56,778 --> 00:17:00,950  
with our galaxy and that makes are

404  
00:16:58,820 --> 00:17:03,500  
really really hard to see distant faint

405  
00:17:00,950 --> 00:17:06,620  
galaxies that are not you know part of

406  
00:17:03,500 --> 00:17:10,220  
our Milky not part of the Milky Way and

407  
00:17:06,619 --> 00:17:12,198  
so we wanted to avoid all of that junk

408  
00:17:10,220 --> 00:17:15,049  
that's in our galaxy when we were

409  
00:17:12,199 --> 00:17:17,150  
looking at distant distant clusters so

410  
00:17:15,049 --> 00:17:20,240  
we had to throw out a bunch of clusters

411  
00:17:17,150 --> 00:17:23,120  
because of that we also had to throw out

412  
00:17:20,240 --> 00:17:25,039  
clusters that were too close to the

413  
00:17:23,119 --> 00:17:26,779  
plane of our solar system because

414  
00:17:25,039 --> 00:17:30,319  
they're scattered light so diet coal

415  
00:17:26,779 --> 00:17:33,470  
it-- that would also make it difficult

416  
00:17:30,319 --> 00:17:35,450  
to see really really faint objects and

417  
00:17:33,470 --> 00:17:38,870  
then we had some other criteria we

418  
00:17:35,450 --> 00:17:41,950  
wanted it these clusters to be easily

419  
00:17:38,869 --> 00:17:45,168  
followed up by facilities on the ground

420  
00:17:41,950 --> 00:17:47,989  
so in particular there

421  
00:17:45,169 --> 00:17:51,259  
a telescope or actually a whole set of

422  
00:17:47,989 --> 00:17:51,679  
telescopes in the deserts of Chile

423  
00:17:51,259 --> 00:17:55,700  
called

424  
00:17:51,679 --> 00:17:58,070  
Alma which is a millimeter telescope and

425  
00:17:55,700 --> 00:18:02,119  
we thought that that telescope would be

426  
00:17:58,069 --> 00:18:04,489  
really good and powerful and perhaps be

427  
00:18:02,118 --> 00:18:07,579  
able to follow up any very faint distant

428

00:18:04,489 --> 00:18:08,808  
galaxies that we found with Hubble and

429  
00:18:07,579 --> 00:18:11,239  
then of course the other great

430  
00:18:08,808 --> 00:18:14,928  
telescopes on the ground are in Hawaii

431  
00:18:11,239 --> 00:18:16,460  
on Mauna Kea and we wanted it to be

432  
00:18:14,929 --> 00:18:18,499  
observable from Mauna Kea

433  
00:18:16,460 --> 00:18:20,808  
so when you add all those you know

434  
00:18:18,499 --> 00:18:24,798  
selection criteria you actually end up

435  
00:18:20,808 --> 00:18:27,079  
with a very small list of good places in

436  
00:18:24,798 --> 00:18:28,788  
the sky and a small list of clusters

437  
00:18:27,079 --> 00:18:31,608  
well I'll say I mean it must be hard

438  
00:18:28,788 --> 00:18:33,710  
enough just to find somebody who can get

439  
00:18:31,608 --> 00:18:35,749  
the alignment right I mean that alone

440  
00:18:33,710 --> 00:18:37,278  
you know Swit seem to be a real real big

441  
00:18:35,749 --> 00:18:39,259  
filter in terms of what you can observe

442  
00:18:37,278 --> 00:18:40,278

but I guess the ground Observatory part

443

00:18:39,259 --> 00:18:41,839  
of it also makes it even more

444

00:18:40,278 --> 00:18:47,298  
restrictive because you've got to do it

445

00:18:41,839 --> 00:18:50,839  
where they can see - I want I jump in

446

00:18:47,298 --> 00:18:52,489  
and just add this is Norman Norman also

447

00:18:50,839 --> 00:18:54,888  
helped a lot with this process by all

448

00:18:52,489 --> 00:18:56,749  
means go ahead that even even once we

449

00:18:54,888 --> 00:18:58,819  
had the most desirable candidates

450

00:18:56,749 --> 00:19:01,579  
selected we ran into trouble that this

451

00:18:58,819 --> 00:19:04,608  
is such a large program that certain

452

00:19:01,579 --> 00:19:06,288  
targets could not be observed in tandem

453

00:19:04,608 --> 00:19:09,528  
just because Hubble did not have enough

454

00:19:06,288 --> 00:19:12,009  
time of the day to point at those

455

00:19:09,528 --> 00:19:14,329  
targets simultaneously so even beyond

456

00:19:12,009 --> 00:19:16,489  
scientific desirability we had an issue



457  
00:19:14,329 --> 00:19:18,108  
with schedule ability and we had

458  
00:19:16,489 --> 00:19:20,659  
something of a jigsaw puzzle to solve

459  
00:19:18,108 --> 00:19:23,358  
where each season is it where we were

460  
00:19:20,659 --> 00:19:27,139  
doing a target and couldn't overlap as

461  
00:19:23,358 --> 00:19:30,769  
we can only do so much at one time cool

462  
00:19:27,138 --> 00:19:32,959  
so okay so I want to get to a little bit

463  
00:19:30,769 --> 00:19:33,919  
of where we are now so and then I want

464  
00:19:32,960 --> 00:19:36,379  
to get to some of the some of the

465  
00:19:33,919 --> 00:19:38,869  
science that Ray and Lois Lee or lured

466  
00:19:36,378 --> 00:19:40,908  
are involved in but Jennifer can you

467  
00:19:38,868 --> 00:19:42,888  
give us a quick update where are we now

468  
00:19:40,909 --> 00:19:47,389  
where's the I mean the project started

469  
00:19:42,888 --> 00:19:50,329  
back in October yes observing in October

470  
00:19:47,388 --> 00:19:53,209  
so as I said we're aiming to do six

471  
00:19:50,329 --> 00:19:56,509  
clusters we want to do two clusters a

472  
00:19:53,210 --> 00:19:58,519  
year and we have to go and look at each

473  
00:19:56,509 --> 00:20:01,910  
cluster every

474  
00:19:58,519 --> 00:20:03,829  
twice so come back after six months so

475  
00:20:01,910 --> 00:20:06,679  
we started in October with the first

476  
00:20:03,829 --> 00:20:11,019  
observations of a bell 2740 so I think

477  
00:20:06,679 --> 00:20:11,019  
it Norman is that the really high tech

478  
00:20:14,170 --> 00:20:25,808  
the schedule yeah I like this Norman can

479  
00:20:17,990 --> 00:20:29,329  
you zoom in enhance so we went to a bell

480  
00:20:25,808 --> 00:20:31,730  
27:44 got some data then we switched

481  
00:20:29,329 --> 00:20:34,009  
over to the second cluster max oh four

482  
00:20:31,730 --> 00:20:38,179  
one six got some data and now we're back

483  
00:20:34,009 --> 00:20:39,829  
at a Bell 27:44 and as I said I think

484  
00:20:38,179 --> 00:20:42,679  
we'll be done by the end of the month

485

00:20:39,829 --> 00:20:44,329  
with that our very first you know field

486  
00:20:42,679 --> 00:20:47,420  
for which we've collected all the data

487  
00:20:44,329 --> 00:20:49,669  
with both cameras on both the parallel

488  
00:20:47,420 --> 00:20:58,610  
and cluster fields this isn't quite oh I

489  
00:20:49,670 --> 00:21:00,529  
saw that going well this one has overlap

490  
00:20:58,609 --> 00:21:01,428  
with Spitzer observations so that's

491  
00:21:00,529 --> 00:21:03,379  
right

492  
00:21:01,429 --> 00:21:07,519  
that you're also using the Spitzer Space

493  
00:21:03,380 --> 00:21:09,559  
Telescope to gather observations to that

494  
00:21:07,519 --> 00:21:10,940  
is not on this schedule which is what

495  
00:21:09,558 --> 00:21:16,819  
Scott is showing which is from our

496  
00:21:10,940 --> 00:21:18,850  
webpage which is the Green is what has

497  
00:21:16,819 --> 00:21:22,970  
why you explained it to us

498  
00:21:18,849 --> 00:21:25,789  
maybe norm can explain this Norman well

499  
00:21:22,970 --> 00:21:30,250

so I think this is a bit of that a

500

00:21:25,789 --> 00:21:32,808

jigsaw puzzle I was describing which is

501

00:21:30,250 --> 00:21:35,029

block block my face but we come back

502

00:21:32,808 --> 00:21:40,519

twice with every target so so where you

503

00:21:35,029 --> 00:21:42,470

see when you figure on the calendar

504

00:21:40,519 --> 00:21:44,089

we're learning that target and all the

505

00:21:42,470 --> 00:21:46,130

target names are over here on the side

506

00:21:44,089 --> 00:21:47,569

at some point I'll dredge up the actual

507

00:21:46,130 --> 00:21:50,330

electronic version hopefully by the end

508

00:21:47,569 --> 00:21:54,230

of the call no this is way more fun and

509

00:21:50,329 --> 00:21:56,659

so there's a blanket between the colored

510

00:21:54,230 --> 00:21:59,360

bands where and and there were you know

511

00:21:56,660 --> 00:22:02,720

all analyzing data doing Google Hangouts

512

00:21:59,359 --> 00:22:05,178

that sort of thing but you can see for

513

00:22:02,720 --> 00:22:07,850

most of the next or the current year in

514  
00:22:05,179 --> 00:22:09,919  
the next two years we plan to be doing

515  
00:22:07,849 --> 00:22:11,519  
these observations so we're going to be

516  
00:22:09,919 --> 00:22:14,430  
quite busy

517  
00:22:11,519 --> 00:22:16,309  
and as I mentioned earlier we needed to

518  
00:22:14,430 --> 00:22:19,610  
pick targets that in some sense were

519  
00:22:16,309 --> 00:22:22,289  
spring fall targets paired off with

520  
00:22:19,609 --> 00:22:24,539  
winter summer targets so that we don't

521  
00:22:22,289 --> 00:22:27,539  
have much overlap of Hubbell trying to

522  
00:22:24,539 --> 00:22:29,180  
do any two different fields at once

523  
00:22:27,539 --> 00:22:31,500  
because that would just be too many

524  
00:22:29,180 --> 00:22:34,740  
orbits of Hubbell to try to get done in

525  
00:22:31,500 --> 00:22:36,690  
that amount of time so on the far right

526  
00:22:34,740 --> 00:22:39,539  
or the far left I should say are the is

527  
00:22:36,690 --> 00:22:41,970  
the individual I'll put Scott's up here

528  
00:22:39,539 --> 00:22:46,349  
so you can put your to rest

529  
00:22:41,970 --> 00:22:48,450  
so the on the far far left is the galaxy

530  
00:22:46,349 --> 00:22:49,949  
cluster and and then throughout other

531  
00:22:48,450 --> 00:22:53,130  
dates for when everything is going to

532  
00:22:49,950 --> 00:22:55,860  
get observed it's right now a bell 27:44

533  
00:22:53,130 --> 00:23:00,270  
has been your starting your second pass

534  
00:22:55,859 --> 00:23:03,389  
on that one and what's the other one

535  
00:23:00,269 --> 00:23:04,920  
max oh four sixteen is that how I say

536  
00:23:03,390 --> 00:23:09,420  
that Jo four sixteen is that how you

537  
00:23:04,920 --> 00:23:10,650  
guys Branson oh that one is complete is

538  
00:23:09,420 --> 00:23:13,350  
that right is that what your blog said

539  
00:23:10,650 --> 00:23:15,000  
first oh no we're coming back to it in

540  
00:23:13,349 --> 00:23:17,730  
August oh you come back to us right

541  
00:23:15,000 --> 00:23:19,079  
that's right okay so the blog the blog

542

00:23:17,730 --> 00:23:20,819  
post that I read said that you were

543  
00:23:19,079 --> 00:23:22,109  
finished with the first the first part

544  
00:23:20,819 --> 00:23:24,359  
of it that's right

545  
00:23:22,109 --> 00:23:26,279  
advanced camera for surveys for the main

546  
00:23:24,359 --> 00:23:29,279  
field and the wide field camera for the

547  
00:23:26,279 --> 00:23:32,819  
the parallel fields and and looking at

548  
00:23:29,279 --> 00:23:35,490  
this schedule okay remember that all the

549  
00:23:32,819 --> 00:23:37,799  
other observations have been that Hubble

550  
00:23:35,490 --> 00:23:41,430  
is doing has to fit in a schedule like

551  
00:23:37,799 --> 00:23:43,200  
this so imagine every one of the

552  
00:23:41,430 --> 00:23:45,600  
observations that is being done by all

553  
00:23:43,200 --> 00:23:47,519  
the community fold it into a calendar

554  
00:23:45,599 --> 00:23:50,429  
like this and that's what scheduling is

555  
00:23:47,519 --> 00:23:51,389  
like yeah clearly find us all the Hubble

556  
00:23:50,430 --> 00:23:55,410

time which you know would have been

557

00:23:51,390 --> 00:24:01,860

lovely but Fields gets the highest

558

00:23:55,410 --> 00:24:03,930

priority obvious we've tried to make our

559

00:24:01,859 --> 00:24:05,490

program friendly to other observing

560

00:24:03,930 --> 00:24:07,440

that's going on that's that's why these

561

00:24:05,490 --> 00:24:10,289

bands of color here as wide as they are

562

00:24:07,440 --> 00:24:12,090

we try to allow for other people to get

563

00:24:10,289 --> 00:24:14,039

their work done without impinging on the

564

00:24:12,089 --> 00:24:18,000

schedule too severely we've had a few

565

00:24:14,039 --> 00:24:20,250

interesting schedule issues so anything

566

00:24:18,000 --> 00:24:23,339

you care to share just uh just work they

567

00:24:20,250 --> 00:24:24,380

just worked out okay um well I could I

568

00:24:23,339 --> 00:24:27,048

can explain

569

00:24:24,380 --> 00:24:30,860

issue that we came up with that actually

570

00:24:27,048 --> 00:24:36,230

the the people ray and Anton actually



571  
00:24:30,859 --> 00:24:39,199  
helped us solve quite quickly so during

572  
00:24:36,230 --> 00:24:41,419  
our last observing epoch which was max

573  
00:24:39,200 --> 00:24:44,210  
oh four one six

574  
00:24:41,419 --> 00:24:47,090  
we had infrared observations of the

575  
00:24:44,210 --> 00:24:49,009  
parallel field and there's a unique

576  
00:24:47,089 --> 00:24:51,678  
characteristic for infrared cameras and

577  
00:24:49,009 --> 00:24:54,288  
that sometimes if you go and observe

578  
00:24:51,679 --> 00:24:56,659  
something extremely bright it takes a

579  
00:24:54,288 --> 00:24:59,089  
while it can leave kind of a light and

580  
00:24:56,659 --> 00:25:01,880  
echo in the camera something that we

581  
00:24:59,089 --> 00:25:06,740  
call persistence and we ended up

582  
00:25:01,880 --> 00:25:09,350  
catching persistence in one of our a set

583  
00:25:06,740 --> 00:25:11,359  
of our observations for the frontier

584  
00:25:09,349 --> 00:25:13,609  
fields and it turns out actually that

585  
00:25:11,359 --> 00:25:15,769  
was coming from a planet or from an

586  
00:25:13,609 --> 00:25:18,288  
exoplanet observation that happened

587  
00:25:15,769 --> 00:25:20,480  
about ten hours before before our

588  
00:25:18,288 --> 00:25:22,548  
observations okay wait wait wait so you

589  
00:25:20,480 --> 00:25:24,740  
have to explain this to me a persistence

590  
00:25:22,548 --> 00:25:27,048  
means you were getting up observations

591  
00:25:24,740 --> 00:25:29,120  
from a previous you were still getting

592  
00:25:27,048 --> 00:25:30,139  
that's right signals from a previous

593  
00:25:29,119 --> 00:25:33,199  
Hubble observation

594  
00:25:30,140 --> 00:25:36,140  
yeah so that that that was looking at an

595  
00:25:33,200 --> 00:25:38,179  
incredibly bright star and spreading the

596  
00:25:36,140 --> 00:25:40,580  
light out of That star over most of the

597  
00:25:38,179 --> 00:25:43,820  
infrared camera and they were looking

598  
00:25:40,579 --> 00:25:46,879  
for very faint variations in the

599

00:25:43,819 --> 00:25:49,250  
brightness of That star due to a planet

600  
00:25:46,880 --> 00:25:50,720  
going around that star you like sure

601  
00:25:49,250 --> 00:25:52,548  
yeah so they were kind of doing the

602  
00:25:50,720 --> 00:25:54,319  
exact opposite of what we're doing right

603  
00:25:52,548 --> 00:25:56,298  
we're looking for very tiny little faint

604  
00:25:54,319 --> 00:25:58,849  
dots and they're looking at really

605  
00:25:56,298 --> 00:26:00,679  
really bright stars you can annoy Hubble

606  
00:25:58,849 --> 00:26:02,629  
you keep doing this right right so they

607  
00:26:00,679 --> 00:26:05,509  
were getting their observations shortly

608  
00:26:02,630 --> 00:26:08,630  
before ours and there was a signal left

609  
00:26:05,509 --> 00:26:11,240  
over and in the camera but because we

610  
00:26:08,630 --> 00:26:14,000  
have a crack team our team is looking at

611  
00:26:11,240 --> 00:26:16,400  
the data as soon as it comes off the

612  
00:26:14,000 --> 00:26:19,548  
camera like like you know within within

613  
00:26:16,400 --> 00:26:21,350

hours array and an amped honor are

614

00:26:19,548 --> 00:26:22,879  
working on that and Ray is one of the

615

00:26:21,349 --> 00:26:25,849  
people that does our data quality

616

00:26:22,880 --> 00:26:29,240  
inspections and caught it quite quickly

617

00:26:25,849 --> 00:26:30,740  
and you know this is a problem for us

618

00:26:29,240 --> 00:26:33,798  
but it's not just a problem for us it's

619

00:26:30,740 --> 00:26:35,839  
a problem for other Hubble users who

620

00:26:33,798 --> 00:26:38,269  
have observations after these and so

621

00:26:35,839 --> 00:26:40,308  
because of that we were able to

622

00:26:38,269 --> 00:26:42,829  
to change the schedule and change the

623

00:26:40,308 --> 00:26:44,959  
way that those observations are now

624

00:26:42,829 --> 00:26:46,368  
planned oh good well I want to get to

625

00:26:44,959 --> 00:26:48,859  
some of the surprises you guys have run

626

00:26:46,368 --> 00:26:50,269  
across so far but would you so ray you

627

00:26:48,858 --> 00:26:54,528  
want comment on that what was that like

628  
00:26:50,269 --> 00:26:55,759  
give the you know this while you're at

629  
00:26:54,528 --> 00:26:57,169  
it won't you go and explain to us what

630  
00:26:55,759 --> 00:26:59,108  
your what you're doing on the project is

631  
00:26:57,169 --> 00:27:02,690  
about one of the roles that you have

632  
00:26:59,108 --> 00:27:05,829  
well in deference to Carol and other

633  
00:27:02,690 --> 00:27:18,019  
folks I may be the oldest on here

634  
00:27:05,829 --> 00:27:20,108  
forever I actually got into this deep

635  
00:27:18,019 --> 00:27:26,569  
fields business

636  
00:27:20,108 --> 00:27:29,088  
welcome Carol fields business way back

637  
00:27:26,569 --> 00:27:33,229  
in the early 90s when I was working with

638  
00:27:29,088 --> 00:27:36,229  
Alan Dressler's programs to observe

639  
00:27:33,229 --> 00:27:37,700  
medium distance galaxies clusters these

640  
00:27:36,229 --> 00:27:40,308  
weren't particularly known for having

641  
00:27:37,700 --> 00:27:43,159  
lenses and arcs and and that sort of

642  
00:27:40,308 --> 00:27:47,569  
thing as any prominent part of them but

643  
00:27:43,159 --> 00:27:49,639  
I worked on that with him as his

644  
00:27:47,569 --> 00:27:54,168  
Institute contact here in a number of

645  
00:27:49,638 --> 00:27:57,888  
ways and then leading that helped

646  
00:27:54,169 --> 00:28:02,089  
inspire the original Hubble Deep Field

647  
00:27:57,888 --> 00:28:05,028  
and so I was asked to help with some of

648  
00:28:02,088 --> 00:28:07,069  
that started out in a very informal way

649  
00:28:05,028 --> 00:28:09,469  
we were all just sort of deciding or

650  
00:28:07,069 --> 00:28:11,538  
talking about what could we do and

651  
00:28:09,469 --> 00:28:14,028  
various other things happened it grew

652  
00:28:11,538 --> 00:28:17,538  
into the project that we all know it

653  
00:28:14,028 --> 00:28:21,858  
turned into but I was part of that and

654  
00:28:17,538 --> 00:28:24,229  
then the Hubble Deep Field south that

655  
00:28:21,858 --> 00:28:25,638  
you were gonna get those get any real

656

00:28:24,229 --> 00:28:28,940  
native back then wasn't it but wasn't

657  
00:28:25,638 --> 00:28:31,728  
that kind of a risky it was viewed that

658  
00:28:28,940 --> 00:28:34,459  
way by people a lot back then there were

659  
00:28:31,729 --> 00:28:37,879  
a lot of guff but there were a number of

660  
00:28:34,459 --> 00:28:40,999  
people actually who you know for better

661  
00:28:37,878 --> 00:28:43,038  
or worse from their own perspective were

662  
00:28:40,999 --> 00:28:46,578  
asked if they might be interested in

663  
00:28:43,038 --> 00:28:47,989  
helping do we do this or that and you

664  
00:28:46,578 --> 00:28:50,148  
know there were a number of people who

665  
00:28:47,989 --> 00:28:50,460  
for their own reasons and you know they

666  
00:28:50,148 --> 00:28:53,009  
had

667  
00:28:50,460 --> 00:28:55,500  
priorities but they you know felt you

668  
00:28:53,009 --> 00:28:57,660  
know I really might sink a lot of my

669  
00:28:55,500 --> 00:28:59,130  
time into this when I've got other

670  
00:28:57,660 --> 00:29:02,009

things that I need to do with my career

671

00:28:59,130 --> 00:29:04,770

that I know are more certain and you

672

00:29:02,009 --> 00:29:08,460

know they didn't do it and you know it's

673

00:29:04,769 --> 00:29:10,109

I I I don't think people judge me my

674

00:29:08,460 --> 00:29:11,940

career right now then well but I don't

675

00:29:10,109 --> 00:29:14,369

think those people should be faulted for

676

00:29:11,940 --> 00:29:16,830

it really because you know they no one

677

00:29:14,369 --> 00:29:19,079

ever knows for sure how things will turn

678

00:29:16,829 --> 00:29:20,759

out and you know they had definite

679

00:29:19,079 --> 00:29:23,039

things that they wanted to work on that

680

00:29:20,759 --> 00:29:26,250

they could clearly see they had plenty

681

00:29:23,039 --> 00:29:32,009

to do with so I think it's sort of a

682

00:29:26,250 --> 00:29:34,859

combination of okay I can I can see some

683

00:29:32,009 --> 00:29:37,230

time or interest enough in myself to

684

00:29:34,859 --> 00:29:38,879

want to try this and enough of a sense



685  
00:29:37,230 --> 00:29:41,370  
of you know being part of something

686  
00:29:38,880 --> 00:29:45,180  
that's risky but could turn out to be

687  
00:29:41,369 --> 00:29:46,709  
historic and you know you you just do it

688  
00:29:45,180 --> 00:29:50,039  
and that's a decision that everyone has

689  
00:29:46,710 --> 00:29:53,970  
to make for themselves as I said I got

690  
00:29:50,039 --> 00:29:56,220  
involved in it because I was being asked

691  
00:29:53,970 --> 00:29:58,769  
you know can we do this kind of thing

692  
00:29:56,220 --> 00:30:04,650  
even is it feasible with the telescope

693  
00:29:58,769 --> 00:30:06,859  
and that role sort of propagated into

694  
00:30:04,650 --> 00:30:10,259  
several other programs that we worked on

695  
00:30:06,859 --> 00:30:11,789  
as I said after the original Hubble Deep

696  
00:30:10,259 --> 00:30:14,369  
Field I worked on the Hubble Deep Field

697  
00:30:11,789 --> 00:30:21,869  
south and then the Hubble Ultra Deep

698  
00:30:14,369 --> 00:30:23,849  
Field and and for some very large geo

699  
00:30:21,869 --> 00:30:25,469  
programs guest observer or general

700  
00:30:23,849 --> 00:30:31,039  
observer programs that go through the

701  
00:30:25,470 --> 00:30:34,470  
peer review unlike these programs do I

702  
00:30:31,039 --> 00:30:37,019  
you know I was in the role of one called

703  
00:30:34,470 --> 00:30:39,690  
Goods at first of trying to figure out

704  
00:30:37,019 --> 00:30:41,609  
if we could do it at all and then

705  
00:30:39,690 --> 00:30:44,340  
thankfully Norman came along and ever

706  
00:30:41,609 --> 00:30:46,619  
since has been taking over that kind of

707  
00:30:44,339 --> 00:30:48,709  
stuff in great detail and I'm very

708  
00:30:46,619 --> 00:30:51,449  
grateful for Norman

709  
00:30:48,710 --> 00:30:54,720  
because he's very good at it and it's

710  
00:30:51,450 --> 00:30:56,700  
very hard work it involves a lot of

711  
00:30:54,720 --> 00:31:01,110  
iteration back and forth finding all

712  
00:30:56,700 --> 00:31:04,430  
kinds of problems as he mentioned you

713

00:31:01,109 --> 00:31:07,829  
know things like target visibility times

714  
00:31:04,430 --> 00:31:09,900  
guidestar lack of guide stars all of

715  
00:31:07,829 --> 00:31:11,759  
these operational issues like that that

716  
00:31:09,900 --> 00:31:14,930  
have to be factored in to actually make

717  
00:31:11,759 --> 00:31:17,430  
the observations and as far as my own

718  
00:31:14,930 --> 00:31:23,400  
part in this I mean I originally got

719  
00:31:17,430 --> 00:31:26,400  
involved in this at the early level or

720  
00:31:23,400 --> 00:31:28,680  
early time sort of talking about things

721  
00:31:26,400 --> 00:31:31,200  
like general advice historical

722  
00:31:28,680 --> 00:31:33,120  
precedents things that we've done with

723  
00:31:31,200 --> 00:31:40,440  
the original Hubble Deep Field and the

724  
00:31:33,119 --> 00:31:43,019  
other early observations more as more is

725  
00:31:40,440 --> 00:31:45,000  
just sort of oh yes I remember we did

726  
00:31:43,019 --> 00:31:47,069  
this back then this was a good idea or

727  
00:31:45,000 --> 00:31:51,210

that maybe that didn't turn out so well

728

00:31:47,069 --> 00:31:53,490

or that kind of thing so I was just a

729

00:31:51,210 --> 00:31:57,029

little bit of institutional memory in

730

00:31:53,490 --> 00:32:02,970

that sense talking about program designs

731

00:31:57,029 --> 00:32:04,589

development testing policies believe it

732

00:32:02,970 --> 00:32:07,440

or not there are policies for us

733

00:32:04,589 --> 00:32:10,199

involved with this here if you actually

734

00:32:07,440 --> 00:32:12,900

have your fingers in the data you know

735

00:32:10,200 --> 00:32:19,880

in the pixels in any way you can't

736

00:32:12,900 --> 00:32:23,490

really be immediately engaged in science

737

00:32:19,880 --> 00:32:26,550

right away that's because of you know

738

00:32:23,490 --> 00:32:29,099

you don't want to let's have the

739

00:32:26,549 --> 00:32:32,460

situation where people in the Institute

740

00:32:29,099 --> 00:32:36,079

have an earlier advantage over there but

741

00:32:32,460 --> 00:32:39,029

that's I mean in this case we've got the

742  
00:32:36,079 --> 00:32:40,740  
data are available to everybody all the

743  
00:32:39,029 --> 00:32:49,859  
time it's like your frontier fields

744  
00:32:40,740 --> 00:32:55,559  
later available to everyone no ray your

745  
00:32:49,859 --> 00:32:56,939  
audio is all right well that's let's see

746  
00:32:55,559 --> 00:32:58,919  
let's hope it works itself out a little

747  
00:32:56,940 --> 00:33:01,590  
bit so let me know yeah let's go a

748  
00:32:58,920 --> 00:33:03,630  
little bit to the let's go a little bit

749  
00:33:01,589 --> 00:33:06,000  
to the to where we are now the fields

750  
00:33:03,630 --> 00:33:08,940  
that we have now we have two fields so

751  
00:33:06,000 --> 00:33:10,859  
far that we've imaged ooh I'd like to

752  
00:33:08,940 --> 00:33:11,789  
get you in on this discussion so why

753  
00:33:10,859 --> 00:33:13,019  
don't you tell us a little bit about

754  
00:33:11,789 --> 00:33:15,269  
what you're doing on the project but

755  
00:33:13,019 --> 00:33:15,970  
what can you tell us about where we're

756  
00:33:15,269 --> 00:33:17,529  
at now

757  
00:33:15,970 --> 00:33:20,829  
on with with the frontier field

758  
00:33:17,529 --> 00:33:23,349  
observations so I think Jen gave a

759  
00:33:20,829 --> 00:33:25,679  
little bit of a progress report on the

760  
00:33:23,349 --> 00:33:30,309  
the field the frontier fields progress

761  
00:33:25,680 --> 00:33:32,759  
I'm a part of a sort of a piggyback or

762  
00:33:30,309 --> 00:33:35,440  
a satellite project to look for

763  
00:33:32,759 --> 00:33:37,720  
supernovae in these fields and try to

764  
00:33:35,440 --> 00:33:42,430  
analyze them to tell us something about

765  
00:33:37,720 --> 00:33:48,039  
you know the environments of the early

766  
00:33:42,430 --> 00:33:50,019  
universe our project has as looked at

767  
00:33:48,039 --> 00:33:52,450  
each one of each frame of the frontier

768  
00:33:50,019 --> 00:33:54,339  
fields as they come in and difference

769  
00:33:52,450 --> 00:33:56,799  
those frames to look for these you know

770

00:33:54,339 --> 00:33:59,559  
various to subtracted one from the other

771  
00:33:56,799 --> 00:34:01,809  
and what's left behind is stuff that's

772  
00:33:59,559 --> 00:34:03,279  
different something is changing okay

773  
00:34:01,809 --> 00:34:04,750  
anything that goes bump in the night

774  
00:34:03,279 --> 00:34:09,849  
anything that changes in brightness we

775  
00:34:04,750 --> 00:34:12,099  
pick up and our plan is to analyze each

776  
00:34:09,849 --> 00:34:14,860  
one look for potential supernovae

777  
00:34:12,099 --> 00:34:15,789  
identify those supernovae and see if we

778  
00:34:14,860 --> 00:34:18,760  
can't learn something about their

779  
00:34:15,789 --> 00:34:21,670  
universe from them yet yes we've been

780  
00:34:18,760 --> 00:34:25,510  
very successful we've found 13 so far 13

781  
00:34:21,670 --> 00:34:26,860  
supernovae yeah yeah it's a it's a

782  
00:34:25,510 --> 00:34:29,920  
little bit larger than we expected but

783  
00:34:26,860 --> 00:34:32,140  
that's a to come are you expecting I

784  
00:34:29,920 --> 00:34:33,820

don't remember it these things are

785

00:34:32,139 --> 00:34:35,559

actually pretty broad if you think of

786

00:34:33,820 --> 00:34:38,320

like you'd be happy if you caught two or

787

00:34:35,559 --> 00:34:39,789

three right yeah well it's not but it's

788

00:34:38,320 --> 00:34:41,380

it's something like on the order of a

789

00:34:39,789 --> 00:34:45,550

handful and now we're you know we're

790

00:34:41,380 --> 00:34:47,619

doing quite quite well and it depends

791

00:34:45,550 --> 00:34:50,260

also on what type of supernovae you're

792

00:34:47,619 --> 00:34:53,349

looking for whether or not it's related

793

00:34:50,260 --> 00:34:55,480

to very massive stars or the more

794

00:34:53,349 --> 00:34:57,789

coveted you know type 1a supernovae

795

00:34:55,480 --> 00:35:01,570

which we used to determine the distances

796

00:34:57,789 --> 00:35:04,840

to galaxies precisely and measure dark

797

00:35:01,570 --> 00:35:06,580

energy from so this project is a little

798

00:35:04,840 --> 00:35:08,710

different from our usual dark energy



799

00:35:06,579 --> 00:35:10,420  
mission where we're looking more to

800

00:35:08,710 --> 00:35:11,829  
understand the supernovae in the

801

00:35:10,420 --> 00:35:16,030  
environments themselves so we've been

802

00:35:11,829 --> 00:35:19,929  
trying we have a dark energy mission no

803

00:35:16,030 --> 00:35:23,200  
uh so a with these deep fields that have

804

00:35:19,929 --> 00:35:25,868  
been going on for 15 plus years

805

00:35:23,199 --> 00:35:29,169  
Lee since goods let's say ten years

806

00:35:25,869 --> 00:35:33,550  
we've had a component or we've built in

807

00:35:29,170 --> 00:35:35,349  
a component to those two the the way in

808

00:35:33,550 --> 00:35:37,570  
which those fields were accumulated to

809

00:35:35,349 --> 00:35:41,769  
allow us to search for distant

810

00:35:37,570 --> 00:35:46,329  
supernovae within them the mission then

811

00:35:41,769 --> 00:35:49,630  
was to try and find as many type 1a

812

00:35:46,329 --> 00:35:51,220  
supernovae as we could and determine if

813  
00:35:49,630 --> 00:35:54,460  
the universe was indeed not only

814  
00:35:51,219 --> 00:35:57,189  
accelerating at relatively recent epochs

815  
00:35:54,460 --> 00:36:01,240  
in the past but also decelerating at

816  
00:35:57,190 --> 00:36:03,119  
even further epochs or even really that

817  
00:36:01,239 --> 00:36:06,159  
deceleration aren't you guys you brought

818  
00:36:03,119 --> 00:36:15,550  
we found it we were very happy we found

819  
00:36:06,159 --> 00:36:20,858  
it it's a big fat medallion for four for

820  
00:36:15,550 --> 00:36:23,710  
that and I didn't wear it today but but

821  
00:36:20,858 --> 00:36:27,219  
yeah no it's we were very happy we found

822  
00:36:23,710 --> 00:36:31,720  
it and so since then the mission has

823  
00:36:27,219 --> 00:36:34,500  
been changing evolving to further

824  
00:36:31,719 --> 00:36:37,358  
refining the measure of dark energy

825  
00:36:34,500 --> 00:36:40,239  
which we still do to this day but also

826  
00:36:37,358 --> 00:36:43,029  
taking on other projects weird the great

827

00:36:40,239 --> 00:36:45,608  
thing about these fields is the lensing

828  
00:36:43,030 --> 00:36:46,900  
and the lensing allows us to probe even

829  
00:36:45,608 --> 00:36:49,480  
earlier in the universe and we have

830  
00:36:46,900 --> 00:36:51,010  
before and we can do some really

831  
00:36:49,480 --> 00:36:54,639  
interesting things like that like say

832  
00:36:51,010 --> 00:36:57,670  
what the rate of occurrence of events

833  
00:36:54,639 --> 00:37:01,779  
are like in the very early universe we

834  
00:36:57,670 --> 00:37:04,180  
could say you know if we can see similar

835  
00:37:01,780 --> 00:37:07,240  
the most the earliest supernovae from

836  
00:37:04,179 --> 00:37:09,818  
the you know prime primordial superstars

837  
00:37:07,239 --> 00:37:11,679  
excuse me the first stars if we could

838  
00:37:09,818 --> 00:37:12,849  
see supernovae from the first stars that

839  
00:37:11,679 --> 00:37:15,460  
might be very important and very

840  
00:37:12,849 --> 00:37:17,289  
interesting so the Lansing's the lensing

841  
00:37:15,460 --> 00:37:19,240

allows us to see this through the

842

00:37:17,289 --> 00:37:21,699  
magnification that we get but blue

843

00:37:19,239 --> 00:37:24,459  
aren't there the supernovae especially

844

00:37:21,699 --> 00:37:26,710  
the type 1a is also really useful for

845

00:37:24,460 --> 00:37:30,280  
testing how well we understand the

846

00:37:26,710 --> 00:37:32,050  
lensing yeah because you know what the

847

00:37:30,280 --> 00:37:34,900  
distance is you know how bright that

848

00:37:32,050 --> 00:37:36,880  
supernova is supposed to be and so you

849

00:37:34,900 --> 00:37:40,030  
can see if your prediction

850

00:37:36,880 --> 00:37:42,369  
of the magnification due to the cluster

851

00:37:40,030 --> 00:37:45,970  
is right or not that's right so we can

852

00:37:42,369 --> 00:37:48,489  
actually turn the the test around and we

853

00:37:45,969 --> 00:37:50,799  
could use the precise the precision of

854

00:37:48,489 --> 00:37:53,679  
the supernovae to tell us something

855

00:37:50,800 --> 00:37:57,100  
about the accuracy of the magnification

856  
00:37:53,679 --> 00:37:59,739  
maps and in fact we have a really new

857  
00:37:57,099 --> 00:38:02,259  
candidate which we just found in the

858  
00:37:59,739 --> 00:38:06,039  
last few weeks that is indeed a very

859  
00:38:02,260 --> 00:38:09,550  
precise type 1a supernova it's in a

860  
00:38:06,039 --> 00:38:13,239  
really unique environment but it's more

861  
00:38:09,550 --> 00:38:15,880  
or less unobscured doesn't have

862  
00:38:13,239 --> 00:38:18,159  
extinction to it and it's a very ideal

863  
00:38:15,880 --> 00:38:20,470  
object for measuring distances in

864  
00:38:18,159 --> 00:38:23,170  
measuring precisely luminosities and we

865  
00:38:20,469 --> 00:38:28,029  
can use that to test the lens model at

866  
00:38:23,170 --> 00:38:29,800  
that in this is in a a bell 27:44 okay

867  
00:38:28,030 --> 00:38:32,170  
so I didn't see that let me see if I can

868  
00:38:29,800 --> 00:38:34,630  
rephrase this in a way that might be a

869  
00:38:32,170 --> 00:38:35,800  
little more understandable to some

870  
00:38:34,630 --> 00:38:37,210  
people because I want to make sure this

871  
00:38:35,800 --> 00:38:40,180  
is an important point you're making so

872  
00:38:37,210 --> 00:38:42,340  
type 1a supernovae are are a supernova

873  
00:38:40,179 --> 00:38:44,589  
that we they're very special kind we

874  
00:38:42,340 --> 00:38:45,910  
then they we know they're special

875  
00:38:44,590 --> 00:38:47,620  
because we know their intrinsic

876  
00:38:45,909 --> 00:38:49,629  
brightness we know how bright they

877  
00:38:47,619 --> 00:38:50,799  
really are as if they would be right

878  
00:38:49,630 --> 00:38:51,849  
next to us we don't want them to be

879  
00:38:50,800 --> 00:38:54,310  
right next to us but if they were

880  
00:38:51,849 --> 00:38:56,170  
knowing how bright something is

881  
00:38:54,309 --> 00:38:58,420  
intrinsically and then measuring its

882  
00:38:56,170 --> 00:38:59,980  
brightness from wherever it is we get

883  
00:38:58,420 --> 00:39:01,659  
some sense of how far away it is that's

884

00:38:59,980 --> 00:39:03,490  
why there's such good yard sticks but

885  
00:39:01,659 --> 00:39:06,009  
what lewis saying is they also can use

886  
00:39:03,489 --> 00:39:08,229  
those to tell them something about the

887  
00:39:06,010 --> 00:39:11,020  
way in which the lens that that light is

888  
00:39:08,230 --> 00:39:12,880  
traveling through is being modelled and

889  
00:39:11,019 --> 00:39:15,820  
how well they're doing at it am i right

890  
00:39:12,880 --> 00:39:18,970  
so sorry i don't know are doing a good

891  
00:39:15,820 --> 00:39:20,590  
job with your model then you would see a

892  
00:39:18,969 --> 00:39:22,000  
brightness that you observe with the

893  
00:39:20,590 --> 00:39:23,530  
frontier fields if you're doing a bad

894  
00:39:22,000 --> 00:39:24,460  
job with your model then frontier fields

895  
00:39:23,530 --> 00:39:27,460  
are going to show you something

896  
00:39:24,460 --> 00:39:29,409  
different because you're wrong your

897  
00:39:27,460 --> 00:39:31,929  
model isn't acting right on the on the

898  
00:39:29,409 --> 00:39:33,339

and and now that we're on the subject of

899

00:39:31,929 --> 00:39:36,009

models we should probably bring that up

900

00:39:33,340 --> 00:39:39,160

now models are these things that you

901

00:39:36,010 --> 00:39:41,260

invent mathematically that explain what

902

00:39:39,159 --> 00:39:42,819

is happening to the light as it travels

903

00:39:41,260 --> 00:39:44,080

through the galaxy cluster in other

904

00:39:42,820 --> 00:39:47,170

words you get these squished out

905

00:39:44,079 --> 00:39:49,929

galaxies are all weird and snaky looking

906

00:39:47,170 --> 00:39:53,170

and in weird shapes it's being

907

00:39:49,929 --> 00:39:55,539

done - by the actual gravitational lens

908

00:39:53,170 --> 00:39:58,119

you're trying to mathematically describe

909

00:39:55,539 --> 00:40:01,329

that you've got some right who wants to

910

00:39:58,119 --> 00:40:03,280

talk about the models Dan yeah yeah okay

911

00:40:01,329 --> 00:40:04,960

Dan you wanna talk about the models yeah

912

00:40:03,280 --> 00:40:06,700

we I'm gonna get you in on this in just



913  
00:40:04,960 --> 00:40:08,260  
a minute don't worry I know I gotta get

914  
00:40:06,699 --> 00:40:10,210  
you in on cuz I will talk about data

915  
00:40:08,260 --> 00:40:11,740  
there's all this dark matter in the

916  
00:40:10,210 --> 00:40:13,539  
cluster like we talked about but we

917  
00:40:11,739 --> 00:40:15,279  
don't know exactly where it is and and

918  
00:40:13,539 --> 00:40:17,318  
just like you said Tony we we observe

919  
00:40:15,280 --> 00:40:19,660  
this lensing and and based on the

920  
00:40:17,318 --> 00:40:22,989  
lensing we we can map it out in some

921  
00:40:19,659 --> 00:40:26,078  
detail but but not perfectly and so we

922  
00:40:22,989 --> 00:40:29,049  
actually had five different teams from

923  
00:40:26,079 --> 00:40:31,000  
the community all submit their models so

924  
00:40:29,050 --> 00:40:33,910  
that everybody could could use them so

925  
00:40:31,000 --> 00:40:35,619  
these are all public favorite models and

926  
00:40:33,909 --> 00:40:38,230  
they all said use mine use mine right

927  
00:40:35,619 --> 00:40:40,030  
they all have different ways of modeling

928  
00:40:38,230 --> 00:40:41,380  
and describing exactly how the dark

929  
00:40:40,030 --> 00:40:43,150  
matter is distributed and you know

930  
00:40:41,380 --> 00:40:45,490  
there's it's constrained to some degree

931  
00:40:43,150 --> 00:40:46,990  
by the lensing but not exactly and so

932  
00:40:45,489 --> 00:40:48,729  
they all submitted these models and and

933  
00:40:46,989 --> 00:40:50,439  
these are teams that had you know kind

934  
00:40:48,730 --> 00:40:52,389  
of had friendly competition before and

935  
00:40:50,440 --> 00:40:53,950  
they'd be you know propose their models

936  
00:40:52,389 --> 00:40:55,929  
and they tried to one-up each other and

937  
00:40:53,949 --> 00:40:57,639  
you know and in this case they all work

938  
00:40:55,929 --> 00:41:00,279  
together so we brought them all together

939  
00:40:57,639 --> 00:41:02,710  
they did you know they shared all the

940  
00:41:00,280 --> 00:41:05,500  
best available lensing data that they

941

00:41:02,710 --> 00:41:06,849  
had and they you know they then they

942  
00:41:05,500 --> 00:41:08,260  
went off and they worked separately and

943  
00:41:06,849 --> 00:41:09,880  
they made these models they you know but

944  
00:41:08,260 --> 00:41:11,799  
they kind of cooperated and and so now

945  
00:41:09,880 --> 00:41:15,190  
this is all available and so for any

946  
00:41:11,798 --> 00:41:17,829  
galaxy that you see being lens by one of

947  
00:41:15,190 --> 00:41:21,670  
these frontier fields clusters or any

948  
00:41:17,829 --> 00:41:24,099  
supernova you can you can go to a

949  
00:41:21,670 --> 00:41:25,690  
webpage and you can you can figure out

950  
00:41:24,099 --> 00:41:26,890  
what are the different magnification

951  
00:41:25,690 --> 00:41:29,230  
estimates from all these different

952  
00:41:26,889 --> 00:41:31,659  
models how much do the models say that

953  
00:41:29,230 --> 00:41:32,798  
this galaxy is being magnified and it'll

954  
00:41:31,659 --> 00:41:35,500  
give you this this whole range of

955  
00:41:32,798 --> 00:41:37,030

predictions that then you can in the

956

00:41:35,500 --> 00:41:39,338

case of a supernova you can then predict

957

00:41:37,030 --> 00:41:42,130

you can then compare against what you

958

00:41:39,338 --> 00:41:44,739

actually know the magnification is so

959

00:41:42,130 --> 00:41:48,119

here Scott's got one up he went to the

960

00:41:44,739 --> 00:41:50,798

mast and pulled this up yeah that's

961

00:41:48,119 --> 00:41:55,329

right so so what we're looking at here

962

00:41:50,798 --> 00:41:57,608

is actually so the a magnification of a

963

00:41:55,329 --> 00:41:59,680

distant galaxy also depends on how far

964

00:41:57,608 --> 00:42:00,900

away that galaxy is so what we're

965

00:41:59,679 --> 00:42:02,828

looking at here is we're looking at

966

00:42:00,900 --> 00:42:03,500

magnifications for three different

967

00:42:02,829 --> 00:42:05,490

distance

968

00:42:03,500 --> 00:42:06,690

and if that's what you're seeing in a

969

00:42:05,489 --> 00:42:09,000

different color so it's a little bit

970  
00:42:06,690 --> 00:42:11,190  
confusing but basically a weight so this

971  
00:42:09,000 --> 00:42:13,170  
is this is the mathematical model right

972  
00:42:11,190 --> 00:42:15,630  
right the colors are different

973  
00:42:13,170 --> 00:42:17,940  
magnifications blue is maybe different

974  
00:42:15,630 --> 00:42:19,650  
magnifications in red right well so blue

975  
00:42:17,940 --> 00:42:21,809  
is for a galaxy that's a certain

976  
00:42:19,650 --> 00:42:24,150  
distance away and in green is for a

977  
00:42:21,809 --> 00:42:27,150  
galaxy that's more distant and then red

978  
00:42:24,150 --> 00:42:28,829  
is for some of the most distant galaxies

979  
00:42:27,150 --> 00:42:30,750  
we used we've we've yet discovered red

980  
00:42:28,829 --> 00:42:32,849  
is for those galaxies so if that's what

981  
00:42:30,750 --> 00:42:34,349  
you're interested in most like me you

982  
00:42:32,849 --> 00:42:36,150  
would be looking at the at the red and

983  
00:42:34,349 --> 00:42:38,460  
this image here and so what you're

984  
00:42:36,150 --> 00:42:40,050  
looking at here those words it's bright

985  
00:42:38,460 --> 00:42:43,889  
red is where the magnification is

986  
00:42:40,050 --> 00:42:45,900  
highest how many's models doing how done

987  
00:42:43,889 --> 00:42:55,469  
are they there I'd say they're doing

988  
00:42:45,900 --> 00:42:57,630  
well so so I would say they're not so

989  
00:42:55,469 --> 00:42:59,939  
our our first supernova that we had a

990  
00:42:57,630 --> 00:43:01,680  
chance to do this with is what I

991  
00:42:59,940 --> 00:43:03,119  
mentioned last week so we're still

992  
00:43:01,679 --> 00:43:05,969  
looking at the data but the plenary

993  
00:43:03,119 --> 00:43:08,819  
results are kind of interesting we've we

994  
00:43:05,969 --> 00:43:12,659  
think the lens models predict something

995  
00:43:08,820 --> 00:43:14,400  
like a factor of 10 magnification so the

996  
00:43:12,659 --> 00:43:17,279  
object should be ten times brighter than

997  
00:43:14,400 --> 00:43:20,970  
you would expect for it for its distance

998

00:43:17,280 --> 00:43:23,010  
or its epic what we observe is something

999  
00:43:20,969 --> 00:43:25,379  
more like just a 30% increase in

1000  
00:43:23,010 --> 00:43:27,930  
brightness so maybe this is a hole in

1001  
00:43:25,380 --> 00:43:29,160  
the lens model or maybe it's saying that

1002  
00:43:27,929 --> 00:43:31,019  
there's a problem with the lens model

1003  
00:43:29,159 --> 00:43:32,549  
yeah that is interesting and I mean

1004  
00:43:31,019 --> 00:43:33,690  
because didn't you all just have a press

1005  
00:43:32,550 --> 00:43:45,080  
release saying that this worked really

1006  
00:43:33,690 --> 00:43:45,079  
well for supernovas yeah leading edge

1007  
00:43:50,119 --> 00:43:54,389  
sorry last time it seemed to work well

1008  
00:43:52,320 --> 00:43:56,430  
and you know there are there are a range

1009  
00:43:54,389 --> 00:43:58,019  
of predictions so I mean that they all

1010  
00:43:56,429 --> 00:44:01,619  
well anyway well you know we'll have

1011  
00:43:58,019 --> 00:44:03,090  
time to so we've got we've got some

1012  
00:44:01,619 --> 00:44:04,380

we've got a lot of comments and stuff at

1013

00:44:03,090 --> 00:44:06,090

Anton let me get you in on this

1014

00:44:04,380 --> 00:44:07,349

discussion welcome by the way it's good

1015

00:44:06,090 --> 00:44:10,110

to see you again I haven't seen you

1016

00:44:07,349 --> 00:44:12,269

since AS thank you Tony well we've been

1017

00:44:10,110 --> 00:44:14,220

kind of busy yeah I guess so the cider

1018

00:44:12,269 --> 00:44:17,699

coming in and so we've been doing all

1019

00:44:14,219 --> 00:44:19,558

this new combination of data

1020

00:44:17,699 --> 00:44:21,480

thank you for having me on so you're

1021

00:44:19,559 --> 00:44:23,220

doing the you're doing the pipelining

1022

00:44:21,480 --> 00:44:26,190

calibrations and things like that has

1023

00:44:23,219 --> 00:44:28,169

there been any any any surprises any

1024

00:44:26,190 --> 00:44:30,960

things that that you have come across

1025

00:44:28,170 --> 00:44:32,579

that you didn't expect yeah sure so let

1026

00:44:30,960 --> 00:44:34,019

me answer so you've asked a few times



1027  
00:44:32,579 --> 00:44:35,460  
what's the status of our current

1028  
00:44:34,019 --> 00:44:38,190  
observing I can give a quick update on

1029  
00:44:35,460 --> 00:44:41,309  
that maybe add a few more details to

1030  
00:44:38,190 --> 00:44:44,550  
what Jen was saying below yes so we've

1031  
00:44:41,309 --> 00:44:47,819  
now basically finished almost finished

1032  
00:44:44,550 --> 00:44:49,349  
our first cluster we are about let's say

1033  
00:44:47,818 --> 00:44:50,849  
two-thirds or three-quarters of the way

1034  
00:44:49,349 --> 00:44:53,760  
through our second epoch we have these

1035  
00:44:50,849 --> 00:44:55,769  
two e box on the clusters and when we're

1036  
00:44:53,760 --> 00:44:57,930  
done that means we have complete

1037  
00:44:55,769 --> 00:45:00,690  
coverage in both cameras on the cluster

1038  
00:44:57,929 --> 00:45:02,068  
and also on this parallel field so what

1039  
00:45:00,690 --> 00:45:04,559  
we're doing is we're basically looking

1040  
00:45:02,068 --> 00:45:06,269  
at the data as it comes in so I've got

1041  
00:45:04,559 --> 00:45:08,390  
this team of folks helping me I've got a

1042  
00:45:06,269 --> 00:45:11,880  
I've got about a half dozen other people

1043  
00:45:08,389 --> 00:45:13,799  
all looking at images as I come in and I

1044  
00:45:11,880 --> 00:45:15,720  
can actually share with you what we do

1045  
00:45:13,800 --> 00:45:18,240  
is basically we look live almost at the

1046  
00:45:15,719 --> 00:45:20,699  
exposures sort of after within a couple

1047  
00:45:18,239 --> 00:45:22,259  
of hours after Hubble takes it the

1048  
00:45:20,699 --> 00:45:23,879  
images come down and we can look at them

1049  
00:45:22,260 --> 00:45:25,980  
and we can inspect them very quickly and

1050  
00:45:23,880 --> 00:45:27,690  
have a really quick turnaround so I can

1051  
00:45:25,980 --> 00:45:29,190  
in fact share with you all if I can

1052  
00:45:27,690 --> 00:45:31,858  
figure out how to do the screen sharing

1053  
00:45:29,190 --> 00:45:33,838  
yeah all right yeah it's the latest data

1054  
00:45:31,858 --> 00:45:36,088  
that came in last night let me see this

1055

00:45:33,838 --> 00:45:38,250  
it's a green arrow that arrow and the

1056  
00:45:36,088 --> 00:45:39,630  
green screen there and you see that yeah

1057  
00:45:38,250 --> 00:45:41,309  
it comes up and then there's a button

1058  
00:45:39,630 --> 00:45:43,200  
that says Start screen share but it's

1059  
00:45:41,309 --> 00:45:55,079  
grey for me I can't click it so I don't

1060  
00:45:43,199 --> 00:45:57,899  
know Oh cute okay I've seen that so I'm

1061  
00:45:55,079 --> 00:46:00,450  
gonna screen share this window and this

1062  
00:45:57,900 --> 00:46:04,440  
is the most recent observations that

1063  
00:46:00,449 --> 00:46:06,629  
came in nice oh wow bring that up so

1064  
00:46:04,440 --> 00:46:09,480  
that came in over night kind of

1065  
00:46:06,630 --> 00:46:11,970  
yesterday evening and Hubble just took

1066  
00:46:09,480 --> 00:46:15,510  
that basically not even a day ago kind

1067  
00:46:11,969 --> 00:46:17,399  
of within 12 hours ago maybe and this is

1068  
00:46:15,510 --> 00:46:21,599  
the images pretty much as we see them

1069  
00:46:17,400 --> 00:46:24,210

coming in from the telescope or they are

1070

00:46:21,599 --> 00:46:26,760

the same filter they all the same filter

1071

00:46:24,210 --> 00:46:29,490

are so these are different exposures so

1072

00:46:26,760 --> 00:46:30,480

each each orbit basically we take four

1073

00:46:29,489 --> 00:46:33,118

exposures in the

1074

00:46:30,480 --> 00:46:34,650

given filter and the difference between

1075

00:46:33,119 --> 00:46:37,079

the ones on the left and ones on the

1076

00:46:34,650 --> 00:46:39,358

right in this case we apply a special

1077

00:46:37,079 --> 00:46:41,519

background scar subtraction these are

1078

00:46:39,358 --> 00:46:43,909

really quality checks ideally they

1079

00:46:41,519 --> 00:46:46,199

should look the same and luckily they do

1080

00:46:43,909 --> 00:46:47,368

look different than any way then there's

1081

00:46:46,199 --> 00:46:48,919

been too something wrong with it well

1082

00:46:47,369 --> 00:46:50,460

what about what about Lou and his

1083

00:46:48,920 --> 00:46:51,329

subtractions what would you be

1084  
00:46:50,460 --> 00:46:53,909  
subtracting Lou

1085  
00:46:51,329 --> 00:46:56,670  
you'd be doing another another O'War bit

1086  
00:46:53,909 --> 00:46:58,649  
later or what that's correct so we would

1087  
00:46:56,670 --> 00:47:00,809  
be looking at let's say the very first

1088  
00:46:58,650 --> 00:47:04,460  
visit relative to this in this visit

1089  
00:47:00,809 --> 00:47:07,409  
okay yeah and so what Lou would be doing

1090  
00:47:04,460 --> 00:47:09,900  
would be when you subtract these images

1091  
00:47:07,409 --> 00:47:11,670  
you'd see very little difference it'd be

1092  
00:47:09,900 --> 00:47:13,500  
maybe a few specks that are different

1093  
00:47:11,670 --> 00:47:17,250  
and some of them would be bad big sores

1094  
00:47:13,500 --> 00:47:18,869  
or things are change in the detector in

1095  
00:47:17,250 --> 00:47:21,389  
just a very small fraction of those

1096  
00:47:18,869 --> 00:47:24,119  
would actually be the supernovae this is

1097  
00:47:21,389 --> 00:47:26,339  
exactly the kind of thing that we can

1098  
00:47:24,119 --> 00:47:28,470  
sort of look at when we do these checks

1099  
00:47:26,340 --> 00:47:33,858  
I'm how to turn off the screen show this

1100  
00:47:28,469 --> 00:47:33,858  
one you're off you did we're back to

1101  
00:47:34,489 --> 00:47:39,659  
interject a comment I think antenna is

1102  
00:47:37,108 --> 00:47:41,389  
kind of underselling calibration yeah I

1103  
00:47:39,659 --> 00:47:44,489  
think so too

1104  
00:47:41,389 --> 00:47:47,608  
and I've watched Anton as you know

1105  
00:47:44,489 --> 00:47:51,029  
outreach observer with the rest of the

1106  
00:47:47,608 --> 00:47:53,639  
team poring over these observations and

1107  
00:47:51,030 --> 00:47:55,320  
picking over every little nuance and so

1108  
00:47:53,639 --> 00:47:57,000  
calibration pipeline maybe you can talk

1109  
00:47:55,320 --> 00:47:59,970  
a little bit about what a calibration

1110  
00:47:57,000 --> 00:48:04,320  
pipeline is because it's not like taking

1111  
00:47:59,969 --> 00:48:06,659  
a cell phone picture yeah let's say a

1112

00:48:04,320 --> 00:48:08,430  
few words about it these pictures you

1113  
00:48:06,659 --> 00:48:10,139  
see they've actually been through

1114  
00:48:08,429 --> 00:48:12,629  
calibration already so they look a

1115  
00:48:10,139 --> 00:48:14,519  
little bit prettier than the actual raw

1116  
00:48:12,630 --> 00:48:16,320  
images we get from the telescope which

1117  
00:48:14,519 --> 00:48:20,699  
look real nasty by the way folks they do

1118  
00:48:16,320 --> 00:48:22,380  
not they look pretty ugly because the

1119  
00:48:20,699 --> 00:48:24,839  
detectors are not perfect and so you get

1120  
00:48:22,380 --> 00:48:26,570  
all kinds of junk on them in fact you

1121  
00:48:24,840 --> 00:48:29,010  
can see yourself if you take a picture

1122  
00:48:26,570 --> 00:48:31,680  
some cell phones will do this on some

1123  
00:48:29,010 --> 00:48:32,970  
cameras to take like a long exposure at

1124  
00:48:31,679 --> 00:48:36,690  
night if you're taking a picture of

1125  
00:48:32,969 --> 00:48:38,608  
somebody in the evening yeah take maybe

1126  
00:48:36,690 --> 00:48:40,590

a few seconds for the shadow to open and

1127

00:48:38,608 --> 00:48:42,869

close and when you look at their picture

1128

00:48:40,590 --> 00:48:43,619

you'll see the little bright spots all

1129

00:48:42,869 --> 00:48:46,318

over the image

1130

00:48:43,619 --> 00:48:47,700

and we deal with much the same thing we

1131

00:48:46,318 --> 00:48:49,739

deal with these little random bright

1132

00:48:47,699 --> 00:48:51,689

spots that mean different exposures and

1133

00:48:49,739 --> 00:48:53,579

so that's one aspect of the calibration

1134

00:48:51,690 --> 00:48:55,528

is making sure that the things in the

1135

00:48:53,579 --> 00:48:57,690

detector are actually removed before we

1136

00:48:55,528 --> 00:48:59,548

can make a clean image so yes if we

1137

00:48:57,690 --> 00:49:01,559

spend our time checking these images and

1138

00:48:59,548 --> 00:49:03,838

also running all the software pipelines

1139

00:49:01,559 --> 00:49:05,339

to clean them up and so what you see in

1140

00:49:03,838 --> 00:49:08,190

the end when we make these pretty color



1141  
00:49:05,338 --> 00:49:09,808  
pictures it's basically a version of

1142  
00:49:08,190 --> 00:49:11,579  
that for each different filter each

1143  
00:49:09,809 --> 00:49:13,109  
different color are you have to first

1144  
00:49:11,579 --> 00:49:14,940  
clean them up and stack them and make

1145  
00:49:13,108 --> 00:49:17,038  
them deeper and once you've done that

1146  
00:49:14,940 --> 00:49:19,019  
that takes a few weeks to do then we can

1147  
00:49:17,039 --> 00:49:21,420  
serve them out and let the rest of the

1148  
00:49:19,018 --> 00:49:34,738  
community use them but yeah that's what

1149  
00:49:21,420 --> 00:49:37,170  
keeps us busy and the cage of these go

1150  
00:49:34,739 --> 00:49:39,088  
across the field with Hubble and so we

1151  
00:49:37,170 --> 00:49:41,940  
see these bright streaks on the images

1152  
00:49:39,088 --> 00:49:44,219  
sometimes and folks like ray do a heroic

1153  
00:49:41,940 --> 00:49:45,568  
job of identifying these images and

1154  
00:49:44,219 --> 00:49:47,818  
actually masking them out because

1155  
00:49:45,568 --> 00:49:50,338  
otherwise the whole image would be criss

1156  
00:49:47,818 --> 00:49:53,009  
crossed by other satellites and you

1157  
00:49:50,338 --> 00:49:54,778  
wouldn't have to see like it's really

1158  
00:49:53,009 --> 00:49:57,298  
crowded up there now it's not like the

1159  
00:49:54,778 --> 00:49:59,639  
old days everybody's up there now yeah I

1160  
00:49:57,298 --> 00:50:01,199  
worry about that real estate and the I2

1161  
00:49:59,639 --> 00:50:04,618  
pointers are gonna get crowded too it

1162  
00:50:01,199 --> 00:50:05,968  
looks like it as well so ray I guess I

1163  
00:50:04,619 --> 00:50:08,309  
think you're back now I wanted to get

1164  
00:50:05,969 --> 00:50:10,108  
you just a few more thoughts I I want to

1165  
00:50:08,309 --> 00:50:11,400  
get to a lot of comments and stuff that

1166  
00:50:10,108 --> 00:50:12,509  
we have to but you didn't get you have

1167  
00:50:11,400 --> 00:50:14,460  
to finish your thought and I just wanted

1168  
00:50:12,509 --> 00:50:17,278  
to know if you had anything else you

1169

00:50:14,460 --> 00:50:19,469  
would like to add well you were talking

1170  
00:50:17,278 --> 00:50:22,710  
about maybe in several different areas

1171  
00:50:19,469 --> 00:50:24,838  
you were talking about models and I

1172  
00:50:22,710 --> 00:50:28,739  
think one of the most fascinating things

1173  
00:50:24,838 --> 00:50:30,659  
to me and it's something that people try

1174  
00:50:28,739 --> 00:50:33,960  
to model but it depends on the accuracy

1175  
00:50:30,659 --> 00:50:36,989  
of what is known there and how how good

1176  
00:50:33,960 --> 00:50:40,409  
a quality it is people will sometimes

1177  
00:50:36,989 --> 00:50:42,960  
try to look at distant galaxies that are

1178  
00:50:40,409 --> 00:50:46,759  
lensed by the foreground clusters and

1179  
00:50:42,960 --> 00:50:52,829  
they'll try to essentially D project

1180  
00:50:46,759 --> 00:50:57,028  
those galaxies as observed into what

1181  
00:50:52,829 --> 00:50:59,329  
they really have in the way of shape

1182  
00:50:57,028 --> 00:51:01,918  
and I think that's a fascinating process

1183  
00:50:59,329 --> 00:51:04,048

always I guess I'd obviously it depends

1184

00:51:01,918 --> 00:51:05,129

on how good your model is yes and

1185

00:51:04,048 --> 00:51:08,728

there's always a lot of room for

1186

00:51:05,130 --> 00:51:12,150

skepticism I imagine Lu's not gonna be

1187

00:51:08,728 --> 00:51:13,948

impressed probably but I do think it's

1188

00:51:12,150 --> 00:51:15,778

one of the most fascinating things about

1189

00:51:13,949 --> 00:51:17,959

this I've always been interested in

1190

00:51:15,778 --> 00:51:20,429

galaxies biologies in a lot of the

1191

00:51:17,958 --> 00:51:23,879

survey projects that I've been part of

1192

00:51:20,429 --> 00:51:26,189

and and so I think this is this is a

1193

00:51:23,880 --> 00:51:29,999

really fascinating aspect of it not only

1194

00:51:26,188 --> 00:51:34,768

the bringing and divisibility of the

1195

00:51:29,998 --> 00:51:37,259

most distant objects but also trying to

1196

00:51:34,768 --> 00:51:40,318

see where possible you know the the

1197

00:51:37,259 --> 00:51:43,139

structure of some more distant galaxies

1198  
00:51:40,318 --> 00:51:47,208  
of course the main point here I think is

1199  
00:51:43,139 --> 00:51:50,518  
is really finding those sort of you know

1200  
00:51:47,208 --> 00:51:54,418  
earliest galaxies if we can but but this

1201  
00:51:50,518 --> 00:51:56,488  
is just sort of a an interesting not

1202  
00:51:54,418 --> 00:51:58,889  
quite diversion but it's it's a separate

1203  
00:51:56,489 --> 00:52:01,409  
topic but fascinating

1204  
00:51:58,889 --> 00:52:03,389  
I don't know Scott can bring up the

1205  
00:52:01,409 --> 00:52:07,289  
image that I sent him earlier there's a

1206  
00:52:03,389 --> 00:52:09,719  
really good example of an object that's

1207  
00:52:07,289 --> 00:52:12,059  
that's not the most distant thing in the

1208  
00:52:09,719 --> 00:52:15,358  
universe but is extremely highly

1209  
00:52:12,059 --> 00:52:18,778  
magnified by our cluster max oh four one

1210  
00:52:15,358 --> 00:52:20,909  
six and actually there's just beautiful

1211  
00:52:18,778 --> 00:52:22,739  
things all over that image can we have

1212  
00:52:20,909 --> 00:52:29,459  
it up now yeah if you zoom in towards

1213  
00:52:22,739 --> 00:52:31,469  
the center let me even more yeah that's

1214  
00:52:29,458 --> 00:52:36,899  
right it's that kind of blue fuzzy thing

1215  
00:52:31,469 --> 00:52:39,958  
yeah look at all of them Wow yeah so so

1216  
00:52:36,900 --> 00:52:41,579  
the the reddish orangish galaxies are

1217  
00:52:39,958 --> 00:52:44,308  
the cluster galaxies those are the

1218  
00:52:41,579 --> 00:52:46,769  
things that are doing interesting and

1219  
00:52:44,309 --> 00:52:49,289  
the things that are those blue are key

1220  
00:52:46,768 --> 00:52:51,508  
things are the background galaxies which

1221  
00:52:49,289 --> 00:52:54,059  
are not you know those are probably not

1222  
00:52:51,509 --> 00:52:56,519  
the most distant things but but they're

1223  
00:52:54,059 --> 00:52:58,859  
really you know highly magnified and

1224  
00:52:56,518 --> 00:53:01,108  
then if you look you know close to that

1225  
00:52:58,858 --> 00:53:03,978  
bright central galaxy there's something

1226

00:53:01,108 --> 00:53:07,768  
that's kind of fuzzy and blue and red

1227  
00:53:03,978 --> 00:53:10,269  
and that is a galaxy that's magnified by

1228  
00:53:07,768 --> 00:53:12,639  
like a factor of 20

1229  
00:53:10,269 --> 00:53:15,400  
so we're just seeing that object isn't

1230  
00:53:12,639 --> 00:53:17,829  
up Jupiter yeah it's not it's a it's a

1231  
00:53:15,400 --> 00:53:20,590  
galaxy that's just been magnified much

1232  
00:53:17,829 --> 00:53:21,909  
much much more than you could you know

1233  
00:53:20,590 --> 00:53:24,220  
it's at a much higher spatial resolution

1234  
00:53:21,909 --> 00:53:27,519  
than anything that Hubble would normally

1235  
00:53:24,219 --> 00:53:31,299  
see that's just a beautiful image this

1236  
00:53:27,519 --> 00:53:34,750  
is a great example of what also with the

1237  
00:53:31,300 --> 00:53:37,000  
wineglass demonstration and again also

1238  
00:53:34,750 --> 00:53:38,739  
there's the distortion aspect even

1239  
00:53:37,000 --> 00:53:42,070  
though something's highly magnified it

1240  
00:53:38,739 --> 00:53:43,659

may be distorted quite a bit and that's

1241  
00:53:42,070 --> 00:53:46,930  
part of what I was talking about by D

1242  
00:53:43,659 --> 00:53:48,969  
projection of you know trying to apply

1243  
00:53:46,929 --> 00:53:51,159  
the distortion correction if you will

1244  
00:53:48,969 --> 00:53:53,589  
for the gravitational distortion

1245  
00:53:51,159 --> 00:53:55,329  
correction there there are also other

1246  
00:53:53,590 --> 00:53:57,250  
distortion corrections and the images

1247  
00:53:55,329 --> 00:54:00,069  
but that that we have to do but that's a

1248  
00:53:57,250 --> 00:54:06,369  
different matter so what's that bright I

1249  
00:54:00,070 --> 00:54:09,340  
am the red and blue points are stars the

1250  
00:54:06,369 --> 00:54:09,759  
little ring of green dots yeah look at

1251  
00:54:09,340 --> 00:54:12,850  
that

1252  
00:54:09,760 --> 00:54:14,770  
that's a multiple-- image thing that's

1253  
00:54:12,849 --> 00:54:17,230  
it's being imaged not only by the

1254  
00:54:14,769 --> 00:54:21,159  
cluster but by that red those smaller



1255  
00:54:17,230 --> 00:54:23,469  
red galaxies there you can scroll all

1256  
00:54:21,159 --> 00:54:26,679  
over this image and see examples like

1257  
00:54:23,469 --> 00:54:28,419  
that actually if you go the other way

1258  
00:54:26,679 --> 00:54:30,849  
towards the bottom there's some cool

1259  
00:54:28,420 --> 00:54:34,599  
things of is this available for people

1260  
00:54:30,849 --> 00:54:36,279  
or is this something that it's not but

1261  
00:54:34,599 --> 00:54:39,730  
we can make it of it we should put it on

1262  
00:54:36,280 --> 00:54:41,519  
our blog yeah so actually yeah right in

1263  
00:54:39,730 --> 00:54:44,710  
the corner there I don't know if you see

1264  
00:54:41,519 --> 00:54:48,429  
there's a there's a galaxy that's lensed

1265  
00:54:44,710 --> 00:54:51,010  
and it's being warped by that edge on

1266  
00:54:48,429 --> 00:54:52,929  
red galaxy there I mean it's just you

1267  
00:54:51,010 --> 00:54:56,950  
know I can look at how this is got a lot

1268  
00:54:52,929 --> 00:54:58,269  
look at all of them there's a lot so you

1269  
00:54:56,949 --> 00:55:00,429  
got to use do you have to use different

1270  
00:54:58,269 --> 00:55:02,940  
models for different galaxies or how do

1271  
00:55:00,429 --> 00:55:05,679  
you how do you do is it are the models

1272  
00:55:02,940 --> 00:55:08,289  
working only for certain clusters I mean

1273  
00:55:05,679 --> 00:55:10,239  
how do you apply the models maybe that's

1274  
00:55:08,289 --> 00:55:12,460  
a really hard question yeah I don't know

1275  
00:55:10,239 --> 00:55:13,629  
Dan can answer that one well the one

1276  
00:55:12,460 --> 00:55:15,940  
thing I wanted to point out I mean each

1277  
00:55:13,630 --> 00:55:18,160  
one of these lens galaxies that you see

1278  
00:55:15,940 --> 00:55:19,570  
there is another piece to them it's

1279  
00:55:18,159 --> 00:55:21,549  
another piece of the puzzle of where the

1280  
00:55:19,570 --> 00:55:23,769  
dark matter is and we see so many more

1281  
00:55:21,550 --> 00:55:27,340  
of these in these really deep images

1282  
00:55:23,769 --> 00:55:29,050  
we did before so the models of the

1283

00:55:27,340 --> 00:55:29,850  
magnifications are just getting better

1284  
00:55:29,050 --> 00:55:32,740  
and better

1285  
00:55:29,849 --> 00:55:34,118  
did you say what cluster this was this

1286  
00:55:32,739 --> 00:55:36,819  
is Mac so for 16

1287  
00:55:34,119 --> 00:55:39,100  
right this is Mac so for 16 this is our

1288  
00:55:36,820 --> 00:55:41,110  
very deep optical image of this so

1289  
00:55:39,099 --> 00:55:42,849  
actually any very distant galaxies are

1290  
00:55:41,110 --> 00:55:44,230  
not even visible because they're only

1291  
00:55:42,849 --> 00:55:45,489  
apparent in the infrared

1292  
00:55:44,230 --> 00:55:46,900  
that's right they'd show up in the

1293  
00:55:45,489 --> 00:55:50,559  
infrared okay I'll be getting the

1294  
00:55:46,900 --> 00:55:53,079  
infrared data in sort of August okay

1295  
00:55:50,559 --> 00:55:54,880  
great well guys we're gonna we're gonna

1296  
00:55:53,079 --> 00:55:57,340  
keep having more frontier fields

1297  
00:55:54,880 --> 00:55:59,680

hangouts but I really want to get to

1298

00:55:57,340 --> 00:56:02,559

some some questions but before too much

1299

00:55:59,679 --> 00:56:04,000

time passes and and going along with the

1300

00:56:02,559 --> 00:56:05,829

different galaxies at different

1301

00:56:04,000 --> 00:56:07,750

distances kind of thing I have something

1302

00:56:05,829 --> 00:56:10,389

here from Adam synergy who says I think

1303

00:56:07,750 --> 00:56:13,300

the deepest image is so far have

1304

00:56:10,389 --> 00:56:18,099

revealed galaxies at around  $Z$  equals 7.8

1305

00:56:13,300 --> 00:56:20,110

so how deep can HST go now briefly say

1306

00:56:18,099 --> 00:56:24,849

us in as few words as possible what  $Z$

1307

00:56:20,110 --> 00:56:31,180

means and then maybe I don't know mother

1308

00:56:24,849 --> 00:56:33,250

who's that - was  $Z$  is called is redshift

1309

00:56:31,179 --> 00:56:35,469

we talk about it as below and it's just

1310

00:56:33,250 --> 00:56:37,000

a number it's it's a number and in what

1311

00:56:35,469 --> 00:56:39,789

it describes is how much the universe

1312  
00:56:37,000 --> 00:56:42,699  
has stretched over the 13 billion year

1313  
00:56:39,789 --> 00:56:45,099  
history of our universe so if it's if

1314  
00:56:42,699 --> 00:56:48,219  
it's a Z of of 1 that means the universe

1315  
00:56:45,099 --> 00:56:49,989  
was half its size back then if the Z of

1316  
00:56:48,219 --> 00:56:51,459  
2 it means the universe was a third of

1317  
00:56:49,989 --> 00:56:53,618  
its size back can we see it and it's

1318  
00:56:51,460 --> 00:56:55,269  
been stretched by that factor and as the

1319  
00:56:53,619 --> 00:56:57,070  
universe has stretched have stretched

1320  
00:56:55,269 --> 00:56:59,019  
the light along with it and to redder

1321  
00:56:57,070 --> 00:57:01,660  
and redder wavelengths and if it's far

1322  
00:56:59,019 --> 00:57:02,858  
enough away you see the galaxies all the

1323  
00:57:01,659 --> 00:57:04,599  
way in the infrared and that's why we

1324  
00:57:02,858 --> 00:57:06,730  
need to look in the infrared to see the

1325  
00:57:04,599 --> 00:57:08,858  
most distant galaxies so the question

1326  
00:57:06,730 --> 00:57:13,119  
was that we we see galaxies out to

1327  
00:57:08,858 --> 00:57:15,969  
redshift of of 7.8 I think so there's

1328  
00:57:13,119 --> 00:57:18,550  
there's confirmed galaxies or you've

1329  
00:57:15,969 --> 00:57:20,108  
obtained a spectra and so you can tell

1330  
00:57:18,550 --> 00:57:23,500  
that the galaxy is definitely out too

1331  
00:57:20,108 --> 00:57:24,190  
much of 7.5 or 7.6 those have been

1332  
00:57:23,500 --> 00:57:26,320  
confirmed

1333  
00:57:24,190 --> 00:57:28,329  
then further out you have what are

1334  
00:57:26,320 --> 00:57:30,430  
candidates all the way up to the

1335  
00:57:28,329 --> 00:57:32,049  
redshift 11 and that was the one that I

1336  
00:57:30,429 --> 00:57:33,789  
was I was showing on my on my phone

1337  
00:57:32,050 --> 00:57:35,769  
earlier that's right damn we had a

1338  
00:57:33,789 --> 00:57:37,659  
hangout about that a while right

1339  
00:57:35,769 --> 00:57:41,199  
okay so Craig land

1340

00:57:37,659 --> 00:57:45,338  
is saying poor doctor lots relegated to

1341  
00:57:41,199 --> 00:57:48,929  
the stsci dungeon venue how long does

1342  
00:57:45,338 --> 00:57:48,929  
one have to work there to be allowed

1343  
00:58:11,730 --> 00:58:18,068  
okay so so here's one from Nava Vermeer

1344  
00:58:16,030 --> 00:58:22,839  
who goes is it possible that the first

1345  
00:58:18,068 --> 00:58:25,420  
AG ends black holes also suck in Dark

1346  
00:58:22,838 --> 00:58:27,009  
Matter that's a good question and we're

1347  
00:58:25,420 --> 00:58:29,409  
the seeds for the supermassive black

1348  
00:58:27,010 --> 00:58:34,180  
holes we observe today question well

1349  
00:58:29,409 --> 00:58:37,269  
that's a good one for Anton or Norman it

1350  
00:58:34,179 --> 00:58:40,750  
turns out black holes actually are dark

1351  
00:58:37,269 --> 00:58:43,239  
matter you know in a way one candidate

1352  
00:58:40,750 --> 00:58:46,568  
for dark matter at one point was lots of

1353  
00:58:43,239 --> 00:58:48,729  
small mini or micro black holes because

1354  
00:58:46,568 --> 00:58:50,440

they dark you don't see them and they

1355

00:58:48,730 --> 00:58:52,990

can basically just act as gravitational

1356

00:58:50,440 --> 00:58:55,210

lenses I think that's now been largely

1357

00:58:52,989 --> 00:58:57,669

ruled out black holes are obviously not

1358

00:58:55,210 --> 00:59:00,039

a candidate for the Dark Matter we see

1359

00:58:57,670 --> 00:59:03,150

around galaxies it's more likely to be

1360

00:59:00,039 --> 00:59:06,490

very small particles but the black holes

1361

00:59:03,150 --> 00:59:10,000

certainly can still suck in anything

1362

00:59:06,489 --> 00:59:13,899

that that feels gravity and that has

1363

00:59:10,000 --> 00:59:15,760

math I think the main thing about the

1364

00:59:13,900 --> 00:59:18,309

black holes is even if they were to suck

1365

00:59:15,760 --> 00:59:20,200

in dark matter or we wouldn't actually

1366

00:59:18,309 --> 00:59:23,680

see it dark matter tends not to interact

1367

00:59:20,199 --> 00:59:25,538

with other with normal matter and so the

1368

00:59:23,679 --> 00:59:28,538

way we see black holes is when they suck



1369  
00:59:25,539 --> 00:59:32,079  
in normal gas like hydrogen and helium

1370  
00:59:28,539 --> 00:59:33,490  
and so forth that gas heats up and heats

1371  
00:59:32,079 --> 00:59:35,289  
up a lot actually heats up to about a

1372  
00:59:33,489 --> 00:59:37,538  
million degrees as it's being sucked in

1373  
00:59:35,289 --> 00:59:39,539  
by the black mold and so when there's

1374  
00:59:37,539 --> 00:59:41,890  
gas heats up it gives off a lot of

1375  
00:59:39,539 --> 00:59:44,200  
high-energy radiation gives off things

1376  
00:59:41,889 --> 00:59:46,480  
like x-rays and ultraviolet and so forth

1377  
00:59:44,199 --> 00:59:47,980  
just before it ever gets into the black

1378  
00:59:46,480 --> 00:59:49,929  
hole it forms a sort of a disk around

1379  
00:59:47,980 --> 00:59:51,250  
the black hole and gives off all this

1380  
00:59:49,929 --> 00:59:52,809  
x-rays and

1381  
00:59:51,250 --> 00:59:54,219  
what we see that's actually why we can

1382  
00:59:52,809 --> 00:59:56,289  
see black holes that we don't actually

1383  
00:59:54,219 --> 00:59:57,879  
see the black holes what we see is the

1384  
00:59:56,289 --> 00:59:59,769  
gas that's around them that's lighting

1385  
00:59:57,880 --> 01:00:02,590  
up and it's giving off all these x-rays

1386  
00:59:59,769 --> 01:00:04,480  
and it's an interesting question

1387  
01:00:02,590 --> 01:00:07,630  
these frontier fields classes are not

1388  
01:00:04,480 --> 01:00:09,670  
actually I would say the best place to

1389  
01:00:07,630 --> 01:00:12,400  
see early black holes because they tend

1390  
01:00:09,670 --> 01:00:14,409  
to be so rare and the frontier fields is

1391  
01:00:12,400 --> 01:00:16,900  
like a very narrow pencil beam looking

1392  
01:00:14,409 --> 01:00:18,819  
back into the early universe narrow or

1393  
01:00:16,900 --> 01:00:22,000  
even than the ultra deep field and the

1394  
01:00:18,820 --> 01:00:23,950  
other big surveys so if there are early

1395  
01:00:22,000 --> 01:00:25,360  
black holes but if we're very lucky we

1396  
01:00:23,949 --> 01:00:27,969  
might see them with the frontier field

1397

01:00:25,360 --> 01:00:29,260  
but our better chance is to look at some

1398  
01:00:27,969 --> 01:00:31,899  
of the other big surveys we've been

1399  
01:00:29,260 --> 01:00:34,840  
doing like the cosmos survey and goods

1400  
01:00:31,900 --> 01:00:37,990  
and our candles because they spread out

1401  
01:00:34,840 --> 01:00:40,180  
more and so we tend to we tend to need a

1402  
01:00:37,989 --> 01:00:41,859  
big survey to find even just a few and

1403  
01:00:40,179 --> 01:00:43,839  
if Anton can I just can I just stop you

1404  
01:00:41,860 --> 01:00:46,420  
brief interruption here Jennifer

1405  
01:00:43,840 --> 01:00:47,769  
Jen Jen has to go she's got other

1406  
01:00:46,420 --> 01:00:50,889  
commitments I just wanted to break in

1407  
01:00:47,769 --> 01:00:56,739  
real fast as a janitor for being here

1408  
01:00:50,889 --> 01:01:02,619  
and your legacy she has to do so you may

1409  
01:00:56,739 --> 01:01:04,209  
thank you for attending and we're back

1410  
01:01:02,619 --> 01:01:06,339  
we're gonna be back for more updates on

1411  
01:01:04,210 --> 01:01:08,710

this okay right you'll join us again

1412

01:01:06,340 --> 01:01:10,360

great yep sounds good

1413

01:01:08,710 --> 01:01:14,139

all right thank you Thank You Jan bye

1414

01:01:10,360 --> 01:01:21,430

bye okay Anton I'm sorry I'm done I have

1415

01:01:14,139 --> 01:01:22,779

to go alright so I guess yeah I guess so

1416

01:01:21,429 --> 01:01:24,250

I guess we are at the end of our time

1417

01:01:22,780 --> 01:01:26,500

when we should we should just probably

1418

01:01:24,250 --> 01:01:28,150

cut it here I'm afraid you have one

1419

01:01:26,500 --> 01:01:32,019

question that I really wanted answered

1420

01:01:28,150 --> 01:01:34,119

okay from YouTube and I cannot pronounce

1421

01:01:32,019 --> 01:01:38,440

his name so I'm just gonna share this up

1422

01:01:34,119 --> 01:01:41,589

on the window here there we go

1423

01:01:38,440 --> 01:01:43,090

is it purposes frontier fields is to

1424

01:01:41,590 --> 01:01:45,220

check whether the galaxies are

1425

01:01:43,090 --> 01:01:48,280

distributed and the ultra-deep field

1426  
01:01:45,219 --> 01:01:49,899  
around the sky is it better to just do

1427  
01:01:48,280 --> 01:01:53,170  
another ultra deep field at different

1428  
01:01:49,900 --> 01:01:56,670  
locations instead of deep fields around

1429  
01:01:53,170 --> 01:01:59,050  
new clusters or having it close to these

1430  
01:01:56,670 --> 01:02:01,869  
gravitational lens areas is that going

1431  
01:01:59,050 --> 01:02:05,220  
to affect the the deep fields that we

1432  
01:02:01,869 --> 01:02:05,219  
get out of it to compare to the original

1433  
01:02:05,480 --> 01:02:09,960  
nobody we're doing both so we're doing

1434  
01:02:08,250 --> 01:02:12,150  
more of the deep fields and we're also

1435  
01:02:09,960 --> 01:02:13,920  
doing the lensing alongside of it so

1436  
01:02:12,150 --> 01:02:15,360  
we're observing even because right even

1437  
01:02:13,920 --> 01:02:17,130  
talked much about the parallel field

1438  
01:02:15,360 --> 01:02:22,320  
we're doing as well with these but

1439  
01:02:17,130 --> 01:02:24,000  
that's it is a tooth in there's a quick

1440  
01:02:22,320 --> 01:02:25,860  
answer to it that the parallel fields

1441  
01:02:24,000 --> 01:02:28,230  
are far enough away from the main

1442  
01:02:25,860 --> 01:02:30,780  
cluster that basically they are like

1443  
01:02:28,230 --> 01:02:32,639  
another ultra deep field there's a bit

1444  
01:02:30,780 --> 01:02:35,130  
of weak lensing so from the cluster but

1445  
01:02:32,639 --> 01:02:36,809  
not very much and so each parallel field

1446  
01:02:35,130 --> 01:02:39,390  
is basically like ultra deep field so

1447  
01:02:36,809 --> 01:02:41,070  
yes so we're basically getting six more

1448  
01:02:39,389 --> 01:02:42,629  
ultra deep field they're not quite as

1449  
01:02:41,070 --> 01:02:44,910  
deep as the original but they within

1450  
01:02:42,630 --> 01:02:46,440  
half a magnitude you know and in

1451  
01:02:44,909 --> 01:02:47,819  
addition we're getting this cluster so

1452  
01:02:46,440 --> 01:02:51,450  
we're getting a two-for-one basically

1453  
01:02:47,820 --> 01:02:53,910  
yeah official dynamo parlance what he's

1454

01:02:51,449 --> 01:02:56,250  
talking about is cosmic variance and you

1455  
01:02:53,909 --> 01:02:57,599  
know that's exactly what we're doing by

1456  
01:02:56,250 --> 01:02:59,460  
getting all these different parallel

1457  
01:02:57,599 --> 01:03:02,309  
fields around different places in the

1458  
01:02:59,460 --> 01:03:05,340  
sky you know see how they're all normal

1459  
01:03:02,309 --> 01:03:06,900  
each one is compared to the rest that's

1460  
01:03:05,340 --> 01:03:16,800  
right only view your elephant through a

1461  
01:03:06,900 --> 01:03:19,309  
straw you kind of want to so what

1462  
01:03:16,800 --> 01:03:22,050  
they're talking about is imagine in the

1463  
01:03:19,309 --> 01:03:24,420  
field of view of the Hubble are two

1464  
01:03:22,050 --> 01:03:25,289  
cameras each looking in the same well

1465  
01:03:24,420 --> 01:03:27,750  
they're each looking in slightly

1466  
01:03:25,289 --> 01:03:28,980  
different areas of the image plane and

1467  
01:03:27,750 --> 01:03:32,250  
they're able to image at the exact same

1468  
01:03:28,980 --> 01:03:34,199

time not only the cluster but the area

1469

01:03:32,250 --> 01:03:35,400

just adjacent to it in another camera

1470

01:03:34,199 --> 01:03:37,949

and as Jen was saying at the beginning

1471

01:03:35,400 --> 01:03:41,039

they come back to it and they rotate and

1472

01:03:37,949 --> 01:03:42,239

they use different cameras each time to

1473

01:03:41,039 --> 01:03:45,329

look at those things so that's what

1474

01:03:42,239 --> 01:03:47,399

that's the wavelength coverage yeah and

1475

01:03:45,329 --> 01:03:49,710

it's you think it's using the Hubble I

1476

01:03:47,400 --> 01:03:51,690

think in a pretty efficient way so guys

1477

01:03:49,710 --> 01:03:55,260

also as always it's great to talk

1478

01:03:51,690 --> 01:03:57,450

frontier fields Ultra Deep fields far

1479

01:03:55,260 --> 01:03:58,860

away things Dark Matter thank you so

1480

01:03:57,449 --> 01:04:00,319

much for joining us and giving us an

1481

01:03:58,860 --> 01:04:04,050

update you guys are doing great work

1482

01:04:00,320 --> 01:04:06,030

we're gonna look to get another oh well



1483  
01:04:04,050 --> 01:04:07,769  
can somebody come in just real fat Anton

1484  
01:04:06,030 --> 01:04:09,330  
I know you got to go so feel free if

1485  
01:04:07,769 --> 01:04:11,429  
you've got to go just you know go ahead

1486  
01:04:09,329 --> 01:04:14,909  
I just want to take a couple more

1487  
01:04:11,429 --> 01:04:16,769  
minutes and ask you know is there this

1488  
01:04:14,909 --> 01:04:18,089  
was scheduled for three years this

1489  
01:04:16,769 --> 01:04:22,230  
survey is it look like you

1490  
01:04:18,090 --> 01:04:24,630  
going to take that third year or not a

1491  
01:04:22,230 --> 01:04:27,539  
good question we've got a decision point

1492  
01:04:24,630 --> 01:04:29,760  
later this year actually about November

1493  
01:04:27,539 --> 01:04:31,380  
or so as to whether or not to do the

1494  
01:04:29,760 --> 01:04:33,800  
final two clusters we're certainly

1495  
01:04:31,380 --> 01:04:36,300  
committed to doing the first form and

1496  
01:04:33,800 --> 01:04:39,330  
why wouldn't lighter on this year yeah

1497  
01:04:36,300 --> 01:04:41,789  
why wouldn't we if Hubble keeps going if

1498  
01:04:39,329 --> 01:04:43,860  
the community supports it if it's

1499  
01:04:41,789 --> 01:04:46,019  
interesting science it coming out then

1500  
01:04:43,860 --> 01:04:47,820  
sure it's it's actually it provides a

1501  
01:04:46,019 --> 01:04:50,369  
good motivation to do the last two I

1502  
01:04:47,820 --> 01:04:52,980  
think basically want to have to see

1503  
01:04:50,369 --> 01:04:55,230  
people like Lou find supernovae or see

1504  
01:04:52,980 --> 01:04:58,530  
people like Dan find audit of galaxies

1505  
01:04:55,230 --> 01:05:00,360  
they keep doing that good stuff then

1506  
01:04:58,530 --> 01:05:02,519  
that provides a good incentive for us to

1507  
01:05:00,360 --> 01:05:03,690  
do the final two clusters and same for

1508  
01:05:02,519 --> 01:05:05,039  
the rest of the community - we're

1509  
01:05:03,690 --> 01:05:08,400  
throwing this wide open for the whole

1510  
01:05:05,039 --> 01:05:10,409  
community to to go and find things with

1511

01:05:08,400 --> 01:05:12,720  
actually one thing it wasn't mentioned

1512  
01:05:10,409 --> 01:05:14,929  
we've got about almost what well over a

1513  
01:05:12,719 --> 01:05:17,069  
dozen almost approaching 20 different

1514  
01:05:14,929 --> 01:05:18,509  
scientific papers from different teams

1515  
01:05:17,070 --> 01:05:20,400  
in the community already that have been

1516  
01:05:18,510 --> 01:05:21,600  
submitted but are using the frontier

1517  
01:05:20,400 --> 01:05:22,920  
fuels to do different kinds of

1518  
01:05:21,599 --> 01:05:27,360  
discoveries so we're throwing it out

1519  
01:05:22,920 --> 01:05:29,700  
there is actually using using these data

1520  
01:05:27,360 --> 01:05:31,019  
so yeah I think if the community keeps

1521  
01:05:29,699 --> 01:05:33,359  
using it and keeps finding interesting

1522  
01:05:31,019 --> 01:05:36,059  
signs that would be a very strong case

1523  
01:05:33,360 --> 01:05:37,680  
for us to do the fun or two clusters yes

1524  
01:05:36,059 --> 01:05:39,119  
yeah so whilst I see you're being so

1525  
01:05:37,679 --> 01:05:40,829

polite if you still got the community

1526

01:05:39,119 --> 01:05:42,389

support and everybody is you're still

1527

01:05:40,829 --> 01:05:44,369

getting good results everybody's you

1528

01:05:42,389 --> 01:05:47,549

know still thinks you should still be

1529

01:05:44,369 --> 01:05:49,710

doing it then you will I think it's not

1530

01:05:47,550 --> 01:05:52,530

just being polite I mean we really have

1531

01:05:49,710 --> 01:05:54,780

to you know undergo the assessment of

1532

01:05:52,530 --> 01:05:58,130

the community you have to prove that

1533

01:05:54,780 --> 01:05:58,130

what you're doing is worth the time I

1534

01:05:58,429 --> 01:06:02,940

want to comment that we've been talking

1535

01:06:00,599 --> 01:06:05,190

about the time allocation process which

1536

01:06:02,940 --> 01:06:07,670

is going on right now and each proposal

1537

01:06:05,190 --> 01:06:10,440

has maybe ten people that look at it

1538

01:06:07,670 --> 01:06:13,559

that's right your fields team has the

1539

01:06:10,440 --> 01:06:16,230

entire community looking at them right

1540  
01:06:13,559 --> 01:06:18,809  
so it's not just opinions and let me

1541  
01:06:16,230 --> 01:06:20,400  
tell you astronomers I know me if you

1542  
01:06:18,809 --> 01:06:22,710  
have ten astronomers in the room you

1543  
01:06:20,400 --> 01:06:24,570  
have a hundred ideas so you know

1544  
01:06:22,710 --> 01:06:28,980  
thousands of astronomers all looking at

1545  
01:06:24,570 --> 01:06:30,780  
the thousands of opinions of whether

1546  
01:06:28,980 --> 01:06:33,559  
this is worthwhile and so you try to get

1547  
01:06:30,780 --> 01:06:33,560  
the consensus

1548  
01:06:35,858 --> 01:06:42,019  
it's a good thing because community is

1549  
01:06:39,230 --> 01:06:43,579  
behind the project which means that they

1550  
01:06:42,019 --> 01:06:45,829  
understand they have a vested interest

1551  
01:06:43,579 --> 01:06:47,839  
in it so there's there's a good flip

1552  
01:06:45,829 --> 01:06:50,119  
side it's right one thing that I would

1553  
01:06:47,838 --> 01:06:52,429  
add is that at least at the onset of the

1554  
01:06:50,119 --> 01:06:54,140  
project we were hoping that citizen

1555  
01:06:52,429 --> 01:06:55,489  
science might be an aspect of this and

1556  
01:06:54,139 --> 01:06:57,650  
we haven't really been exploiting that

1557  
01:06:55,489 --> 01:06:59,029  
too much but when we say community we're

1558  
01:06:57,650 --> 01:07:01,130  
thinking of not just astronomers from

1559  
01:06:59,030 --> 01:07:03,320  
the of the public as well helping out

1560  
01:07:01,130 --> 01:07:05,660  
with the effort we will that's in that's

1561  
01:07:03,320 --> 01:07:08,030  
in progress as you as you complete the

1562  
01:07:05,659 --> 01:07:08,929  
observations on the first - yeah he

1563  
01:07:08,030 --> 01:07:10,430  
brings up a good point

1564  
01:07:08,929 --> 01:07:11,899  
all of these data are available on the

1565  
01:07:10,429 --> 01:07:14,358  
archive you could just log in and get

1566  
01:07:11,900 --> 01:07:17,480  
them yourselves and and Carol and I will

1567  
01:07:14,358 --> 01:07:19,639  
be talking a lot more about the time

1568

01:07:17,480 --> 01:07:20,990  
allocation process of Hubble and not

1569  
01:07:19,639 --> 01:07:24,559  
next week's hangout but the one after

1570  
01:07:20,989 --> 01:07:27,469  
and the or no maybe it's two Hangouts

1571  
01:07:24,559 --> 01:07:30,170  
from now and then there's the the issue

1572  
01:07:27,469 --> 01:07:32,868  
of other collaborators for frontier

1573  
01:07:30,170 --> 01:07:35,269  
fields Carol I want to organize another

1574  
01:07:32,869 --> 01:07:36,650  
hangout to discuss with them some of the

1575  
01:07:35,269 --> 01:07:39,050  
ways in which they're using frontier

1576  
01:07:36,650 --> 01:07:41,900  
fields data so that's all coming down

1577  
01:07:39,050 --> 01:07:44,210  
the pipeline so stay tuned guys thank

1578  
01:07:41,900 --> 01:07:46,099  
you all for joining us and Ray it was

1579  
01:07:44,210 --> 01:07:48,199  
great to have you thank you Norman

1580  
01:07:46,099 --> 01:07:50,210  
Anton as always it's great to have you

1581  
01:07:48,199 --> 01:07:51,919  
and Dan your rock star thank you I

1582  
01:07:50,210 --> 01:07:53,960

thought of dark matter questions for you

1583

01:07:51,920 --> 01:07:55,909

at some point we should get another

1584

01:07:53,960 --> 01:07:57,409

hangout with you because I want about

1585

01:07:55,909 --> 01:07:58,818

some other things I've learned and we'll

1586

01:07:57,409 --> 01:08:00,828

talk more about the results coming out

1587

01:07:58,818 --> 01:08:02,779

of this program it's exactly absolutely

1588

01:08:00,829 --> 01:08:04,450

we got a lot more hangouts got a lot

1589

01:08:02,780 --> 01:08:07,670

more to learn from frontier fields so

1590

01:08:04,449 --> 01:08:09,348

and Carol Scott thank you as always for

1591

01:08:07,670 --> 01:08:10,690

for helping me and for doing this with

1592

01:08:09,349 --> 01:08:13,250

me it's so much fun to have you here

1593

01:08:10,690 --> 01:08:15,740

absolutely I wanted to add also the

1594

01:08:13,250 --> 01:08:18,380

Thayer life there are a lot of other

1595

01:08:15,739 --> 01:08:20,479

people also involved and then the

1596

01:08:18,380 --> 01:08:22,460

relatively few numbers that you've seen



1597  
01:08:20,479 --> 01:08:24,349  
here there are a lot of people doing

1598  
01:08:22,460 --> 01:08:25,969  
this as well that's right there's a

1599  
01:08:24,350 --> 01:08:27,350  
collaboration and we're gonna we're

1600  
01:08:25,969 --> 01:08:28,850  
gonna keep trying but we're gonna keep

1601  
01:08:27,350 --> 01:08:30,440  
coming back and giving you more of a

1602  
01:08:28,850 --> 01:08:32,569  
sense of different aspects of this

1603  
01:08:30,439 --> 01:08:34,189  
program as well so this is our third

1604  
01:08:32,569 --> 01:08:35,719  
frontier fields hangout we certainly

1605  
01:08:34,189 --> 01:08:38,179  
won't be our last so you'll learn a lot

1606  
01:08:35,719 --> 01:08:39,770  
more about the different parts of it so

1607  
01:08:38,180 --> 01:08:41,810  
guys I hope you like this hub we'll hang

1608  
01:08:39,770 --> 01:08:44,630  
out the next one we're having next week

1609  
01:08:41,810 --> 01:08:45,500  
speaking of ultra-deep fields they've

1610  
01:08:44,630 --> 01:08:47,630  
added to it

1611  
01:08:45,500 --> 01:08:50,960  
they've added another wavelength to the

1612  
01:08:47,630 --> 01:08:52,640  
ultra-deep field of the UV ultraviolet

1613  
01:08:50,960 --> 01:08:55,189  
so we're going to talk with the people

1614  
01:08:52,640 --> 01:08:57,680  
who made that image and discuss more

1615  
01:08:55,189 --> 01:08:59,389  
things very very far away and when you

1616  
01:08:57,680 --> 01:09:04,279  
stare at nothing what do you see with

1617  
01:08:59,390 --> 01:09:04,910  
the Hubble answer is quite a bit all

1618  
01:09:04,279 --> 01:09:06,830  
right folks

1619  
01:09:04,909 --> 01:09:08,269  
on behalf of Christian and Scott loads I

1620  
01:09:06,829 --> 01:09:13,088  
want to thank you all for watching and

1621  
01:09:08,270 --> 01:09:13,089  
as always keep looking up