

1
00:00:00,949 --> 00:00:05,099
hello everybody and welcome to our

2
00:00:02,939 --> 00:00:06,628
latest Hubble hang out my name is Tony

3
00:00:05,099 --> 00:00:08,699
Darnell I work at the Space Telescope

4
00:00:06,628 --> 00:00:10,529
Science Institute and today we've got a

5
00:00:08,699 --> 00:00:11,609
really interesting hangout planned for

6
00:00:10,529 --> 00:00:14,009
you today we're going to be talking

7
00:00:11,609 --> 00:00:15,649
about white dwarfs clattuc cataclysmic

8
00:00:14,009 --> 00:00:18,060
variables the Hubble Space Telescope

9
00:00:15,650 --> 00:00:22,829
amateur astronomers all kinds of really

10
00:00:18,059 --> 00:00:25,559
interesting topics today and so the

11
00:00:22,829 --> 00:00:26,698
basic premise of today is the

12
00:00:25,559 --> 00:00:28,739
astronomers using the Hubble Space

13
00:00:26,699 --> 00:00:31,618
Telescope wanted to try and answer the

14
00:00:28,739 --> 00:00:33,780
question can white dwarf stars grow in

15
00:00:31,618 --> 00:00:34,979
mass among other things they live one of

16
00:00:33,780 --> 00:00:36,859
the questions they were trying to answer

17
00:00:34,979 --> 00:00:40,319
and today we're going to explore that

18
00:00:36,859 --> 00:00:42,420
with me today tall weighs is my good

19
00:00:40,320 --> 00:00:43,770
friend and colleague dr. carol christian

20
00:00:42,420 --> 00:00:46,109
she's from the Space Telescope Science

21
00:00:43,770 --> 00:00:49,109
Institute also she knows about all

22
00:00:46,109 --> 00:00:50,759
things Hubble and she's going to be

23
00:00:49,109 --> 00:00:52,469
helping me with this discussion also is

24
00:00:50,759 --> 00:00:55,349
scott lewis from know the cosmos calm

25
00:00:52,469 --> 00:00:58,050
and he'll be he'll be on hand to help

26
00:00:55,350 --> 00:01:00,090
provide his unique perspective as well

27
00:00:58,049 --> 00:01:02,549
before I get to the introductions of our

28
00:01:00,090 --> 00:01:04,170
group today though I want to point out

29

00:01:02,549 --> 00:01:05,759
that we we hope you'll interact with us

30
00:01:04,170 --> 00:01:08,310
we hope you'll send questions already

31
00:01:05,760 --> 00:01:09,868
I'm encouraged by what I see in the Q

32
00:01:08,310 --> 00:01:12,240
and a half there's already a lot of

33
00:01:09,868 --> 00:01:13,829
things there for us to get to and we're

34
00:01:12,239 --> 00:01:15,000
going to promise we'll get to as many as

35
00:01:13,829 --> 00:01:16,890
we can throughout the course of the

36
00:01:15,000 --> 00:01:18,930
discussion but if you're wondering how

37
00:01:16,890 --> 00:01:20,430
you can interact one of them is the Q&A

38
00:01:18,930 --> 00:01:22,799
app you'll see that if you're watching

39
00:01:20,430 --> 00:01:25,110
this on youtube or on the Google+ event

40
00:01:22,799 --> 00:01:26,880
page I just type in a question or a

41
00:01:25,109 --> 00:01:30,328
comment and I will see it come up on our

42
00:01:26,879 --> 00:01:32,489
window pane also the YouTube comments

43
00:01:30,328 --> 00:01:36,379

feel free to leave a comment there you

44

00:01:32,489 --> 00:01:39,390

can tweet using the habit the hubble hat

45

00:01:36,379 --> 00:01:40,890

hubble hang out hashtag one day I'll get

46

00:01:39,390 --> 00:01:43,560

that without stumbling hey I'm

47

00:01:40,890 --> 00:01:45,599

monitoring that on as well as well as

48

00:01:43,560 --> 00:01:47,430

the Google+ event page so there's lots

49

00:01:45,599 --> 00:01:49,379

of ways for you to leave us comments

50

00:01:47,430 --> 00:01:50,820

Scott Carol and I are looking at all of

51

00:01:49,379 --> 00:01:54,259

those so we encourage you to ask us

52

00:01:50,819 --> 00:01:59,728

questions okay so today we have with us

53

00:01:54,259 --> 00:02:02,819

from the University of Warwick I we have

54

00:01:59,728 --> 00:02:05,069

dr. Boris ken sekine he was the p.i of

55

00:02:02,819 --> 00:02:06,239

the program and he will be giving us a

56

00:02:05,069 --> 00:02:07,878

background of some of the scientific

57

00:02:06,239 --> 00:02:09,750

motivations and what they were doing

58
00:02:07,879 --> 00:02:11,250
what they were trying to accomplish

59
00:02:09,750 --> 00:02:13,539
scientifically with the Hubble Space

60
00:02:11,250 --> 00:02:15,699
Telescope also dr. Norton

61
00:02:13,539 --> 00:02:17,078
in woburn also of the Space Telescope

62
00:02:15,699 --> 00:02:19,658
Science Institute he's a member of the

63
00:02:17,079 --> 00:02:21,640
cost team and the cosmic origins

64
00:02:19,658 --> 00:02:23,318
spectrograph team who was also

65
00:02:21,639 --> 00:02:28,509
responsible for various things on the

66
00:02:23,318 --> 00:02:30,458
project Alan well T is here didn't know

67
00:02:28,509 --> 00:02:34,120
he's on here I'm sorry Alan he did and

68
00:02:30,459 --> 00:02:37,900
we have got Gordon Meyer and hard oh ok

69
00:02:34,120 --> 00:02:39,219
Sonnen from the word who were too here's

70
00:02:37,900 --> 00:02:40,959
the way bourse describes him he's

71
00:02:39,219 --> 00:02:42,669
describes them as two of the most

72
00:02:40,959 --> 00:02:45,609
professional amateurs you can imagine

73
00:02:42,669 --> 00:02:47,229
from they operated remote telescopes and

74
00:02:45,609 --> 00:02:49,359
without them we would certainly have

75
00:02:47,229 --> 00:02:53,619
struggled to complete this HST program

76
00:02:49,359 --> 00:02:56,169
so welcome guys we also have Arnie

77
00:02:53,620 --> 00:02:58,239
Hendon from the American Association

78
00:02:56,169 --> 00:03:00,099
from variable star observers he was

79
00:02:58,239 --> 00:03:01,658
where he was good he was responsible for

80
00:03:00,098 --> 00:03:06,068
organizing some of the campaigns so

81
00:03:01,658 --> 00:03:08,739
welcome Arnie and um we also and I think

82
00:03:06,068 --> 00:03:10,418
that covers everybody so let's go ahead

83
00:03:08,739 --> 00:03:12,730
and get started and Boris I'd like to

84
00:03:10,419 --> 00:03:14,530
start with you as the p.i give us some

85
00:03:12,729 --> 00:03:16,328
background of what you were trying to

86

00:03:14,530 --> 00:03:20,049
accomplish with this you had been given

87
00:03:16,329 --> 00:03:21,790
a hundred and twenty-two Hubble orbits

88
00:03:20,049 --> 00:03:23,739
to accomplish what you wanted to

89
00:03:21,789 --> 00:03:24,900
accomplish so give us them give us a

90
00:03:23,739 --> 00:03:28,959
background what were you trying to do

91
00:03:24,900 --> 00:03:30,789
okay Tony so so I guess you've talked

92
00:03:28,959 --> 00:03:33,569
about type 1a supernovae and past

93
00:03:30,789 --> 00:03:35,828
hangouts which are the among the most

94
00:03:33,568 --> 00:03:38,228
powerful explosions in the universe and

95
00:03:35,829 --> 00:03:41,859
they have been used to discover dark

96
00:03:38,229 --> 00:03:45,430
energy and led to the nobel prize in

97
00:03:41,859 --> 00:03:47,799
physics in 2011 and one big problems

98
00:03:45,430 --> 00:03:49,959
that we still don't know exactly what

99
00:03:47,799 --> 00:03:52,359
kind of stars explode under what

100
00:03:49,959 --> 00:03:55,419

conditions to make a type 1a supernova

101

00:03:52,359 --> 00:03:57,939

now most most astronomers agree that

102

00:03:55,419 --> 00:04:00,219

it's probably why twelves that reach the

103

00:03:57,938 --> 00:04:01,598

so-called Chandrasekhar limit a maximum

104

00:04:00,219 --> 00:04:03,848

limit that they have and then they

105

00:04:01,598 --> 00:04:05,888

explode and that means these white

106

00:04:03,848 --> 00:04:08,709

wolves need in some way to grow in mass

107

00:04:05,889 --> 00:04:11,979

and so that was the key question we want

108

00:04:08,709 --> 00:04:15,400

to address in in one type of white walls

109

00:04:11,979 --> 00:04:16,810

in binary stars ok you just interrupt

110

00:04:15,400 --> 00:04:18,548

you very briefly for a moment here and

111

00:04:16,810 --> 00:04:20,408

say one important thing about type 1a

112

00:04:18,548 --> 00:04:22,259

supernovae that I want to make sure we

113

00:04:20,408 --> 00:04:24,908

mentioned and that is they are basically

114

00:04:22,259 --> 00:04:26,528

possible yard sticks they are very

115
00:04:24,908 --> 00:04:27,129
important for measuring how far away

116
00:04:26,528 --> 00:04:29,680
things are

117
00:04:27,129 --> 00:04:31,659
in the universe because they when they

118
00:04:29,680 --> 00:04:33,310
do explode they explode with an own

119
00:04:31,660 --> 00:04:35,110
intrinsic brightness and that is a

120
00:04:33,310 --> 00:04:37,780
brightness that they would be if they

121
00:04:35,110 --> 00:04:39,639
were right next to us and if we see how

122
00:04:37,779 --> 00:04:41,319
bright they are very far away and we

123
00:04:39,639 --> 00:04:42,699
know how the light falls off a distance

124
00:04:41,319 --> 00:04:45,279
we can figure out how far they are so

125
00:04:42,699 --> 00:04:47,829
that's why type 1a supernovae are so

126
00:04:45,279 --> 00:04:50,619
important and as for said we don't know

127
00:04:47,829 --> 00:04:52,180
exactly the kinds of stars that cause

128
00:04:50,620 --> 00:04:53,259
them which which I guess surprises me

129
00:04:52,180 --> 00:04:56,350
course I thought we did have a good

130
00:04:53,259 --> 00:04:57,939
handle on that well it depends on a

131
00:04:56,350 --> 00:04:59,830
fashion that you follow a bit at the

132
00:04:57,939 --> 00:05:01,870
moment probably most people would say

133
00:04:59,829 --> 00:05:05,189
that they believe it's it's merging

134
00:05:01,870 --> 00:05:08,079
double weight loss to weight lost it

135
00:05:05,189 --> 00:05:10,389
merge together and thence exceed the

136
00:05:08,079 --> 00:05:12,039
Chandrasekhar limit but there's still

137
00:05:10,389 --> 00:05:14,649
quite a number of problems with that

138
00:05:12,040 --> 00:05:16,480
model as well so we wanted to explore an

139
00:05:14,649 --> 00:05:20,109
alternative route that may need to type

140
00:05:16,480 --> 00:05:21,850
1a supernovae and so the system that we

141
00:05:20,110 --> 00:05:24,400
were interested are called cataclysmic

142
00:05:21,850 --> 00:05:28,030
variables and in those systems you have

143

00:05:24,399 --> 00:05:30,579
a white dwarf that is accreting material

144
00:05:28,029 --> 00:05:32,439
from a relatively low mass companion

145
00:05:30,579 --> 00:05:34,839
stuff so something like the Sun or even

146
00:05:32,439 --> 00:05:37,029
less massive than the Sun and I think

147
00:05:34,839 --> 00:05:41,939
you might have a diagram on that real

148
00:05:37,029 --> 00:05:44,439
quick to put up okay here we go go ahead

149
00:05:41,939 --> 00:05:47,199
so yeah guys are just showing what what

150
00:05:44,439 --> 00:05:48,519
Boris is talking about okay so any

151
00:05:47,199 --> 00:05:50,979
contact as maghreb you have a white

152
00:05:48,519 --> 00:05:53,529
dwarf that accretes material from that

153
00:05:50,980 --> 00:05:56,080
companion star and you form an accretion

154
00:05:53,529 --> 00:06:00,250
disk of mainly hydrogen that then flows

155
00:05:56,079 --> 00:06:02,620
on to the y-12 and probably 20-30 years

156
00:06:00,250 --> 00:06:05,079
ago astronomers have excluded these kind

157
00:06:02,620 --> 00:06:09,069

of systems as potential type 1a

158

00:06:05,079 --> 00:06:10,599

progenitors because they go periodically

159

00:06:09,069 --> 00:06:13,269

through a process which is called the

160

00:06:10,600 --> 00:06:16,300

classic in nova where the hydrogen that

161

00:06:13,269 --> 00:06:18,399

flows on the surface of the y-12 starts

162

00:06:16,300 --> 00:06:19,840

to burn and then eject all the material

163

00:06:18,399 --> 00:06:22,629

that has been accreted back into space

164

00:06:19,839 --> 00:06:25,689

so if that really is true these white

165

00:06:22,629 --> 00:06:27,909

dwarfs they couldn't grow in mass yet

166

00:06:25,689 --> 00:06:31,540

there are some some question marks to

167

00:06:27,910 --> 00:06:33,820

those problems and some recent studies

168

00:06:31,540 --> 00:06:36,310

suggested well the weight loss NC in

169

00:06:33,819 --> 00:06:38,228

catechism acabas are actually more

170

00:06:36,310 --> 00:06:41,199

massive than we expected them to be and

171

00:06:38,228 --> 00:06:43,599

so that's where we initiated the

172
00:06:41,199 --> 00:06:45,969
large HST program to measure accurately

173
00:06:43,600 --> 00:06:48,250
the masses of faulty cataclysmic

174
00:06:45,970 --> 00:06:51,220
variables to have a bigger statistical

175
00:06:48,250 --> 00:06:52,750
sample on the bigger group of stars for

176
00:06:51,220 --> 00:06:54,970
which we have accurate masses and can

177
00:06:52,750 --> 00:06:58,389
learn something about the the mass

178
00:06:54,970 --> 00:07:00,190
distribution of these white walls so can

179
00:06:58,389 --> 00:07:03,250
I this cow can I just ask a quick

180
00:07:00,189 --> 00:07:05,980
question here so if there's a

181
00:07:03,250 --> 00:07:08,319
distribution of masses of these objects

182
00:07:05,980 --> 00:07:10,990
called cataclysmic variables is it

183
00:07:08,319 --> 00:07:13,719
possible that some could be supernova

184
00:07:10,990 --> 00:07:17,889
and some could be knowable or you don't

185
00:07:13,720 --> 00:07:20,890
know yet we don't know yet probably if

186
00:07:17,889 --> 00:07:23,709
if any of them become supernova it's a

187
00:07:20,889 --> 00:07:26,289
very small fraction of that type I style

188
00:07:23,709 --> 00:07:32,319
probably probably only the heaviest one

189
00:07:26,290 --> 00:07:34,090
will ever get to that point okay so you

190
00:07:32,319 --> 00:07:36,969
are looking so you wanted to see if

191
00:07:34,089 --> 00:07:40,060
these if these white dwarfs were getting

192
00:07:36,970 --> 00:07:42,610
more massive and it looked looking at

193
00:07:40,060 --> 00:07:44,379
that diagram that Scott has there I can

194
00:07:42,610 --> 00:07:46,509
already see that there are some

195
00:07:44,379 --> 00:07:49,209
challenges to actually measuring the

196
00:07:46,509 --> 00:07:50,740
white dwarf itself you want to explain

197
00:07:49,209 --> 00:07:53,109
some of the some of the real problems

198
00:07:50,740 --> 00:07:57,009
with making this observation yeah sure

199
00:07:53,110 --> 00:07:58,660
so one problem is that in these in these

200

00:07:57,009 --> 00:08:01,779
cataclysmic variables if you observe

201
00:07:58,660 --> 00:08:03,450
them at optical wavelengths so from the

202
00:08:01,779 --> 00:08:06,099
ground with a conventional telescope

203
00:08:03,449 --> 00:08:09,490
what you see is mainly the accretion

204
00:08:06,100 --> 00:08:11,350
disk and the companion star and they're

205
00:08:09,490 --> 00:08:13,180
much brighter than the y-12 at optical

206
00:08:11,350 --> 00:08:15,010
wavelengths and so you can't actually

207
00:08:13,180 --> 00:08:17,560
learn much about the white dwarf let

208
00:08:15,009 --> 00:08:19,329
alone its mass and that means if you

209
00:08:17,560 --> 00:08:22,300
want to study the way 12 you need to

210
00:08:19,329 --> 00:08:24,759
move into the ultraviolet and obtain

211
00:08:22,300 --> 00:08:26,650
observations at wavelengths that are

212
00:08:24,759 --> 00:08:27,879
like much shorter than the light that

213
00:08:26,649 --> 00:08:29,229
can penetrate through the Earth's

214
00:08:27,879 --> 00:08:31,629

atmosphere and that's where Hubble comes

215

00:08:29,230 --> 00:08:33,849

into play because Hubble is currently

216

00:08:31,629 --> 00:08:37,240

the only instrument that can do which

217

00:08:33,849 --> 00:08:38,770

are valid observations so let's bring no

218

00:08:37,240 --> 00:08:40,240

one in on this so Nolan is this where

219

00:08:38,769 --> 00:08:43,329

you took it over is this where you were

220

00:08:40,240 --> 00:08:46,259

involved with the Cubs with the with the

221

00:08:43,330 --> 00:08:46,259

observations themselves

222

00:08:46,840 --> 00:08:53,540

that time is that very ominous yeah did

223

00:08:49,909 --> 00:08:56,839

I do that sorry it's great a cab is now

224

00:08:53,539 --> 00:09:01,490

no variable right there yeah I'm

225

00:08:56,840 --> 00:09:04,009

introduction so well yes partially I

226

00:09:01,490 --> 00:09:05,840

should I guess say deference to a

227

00:09:04,009 --> 00:09:11,200

colleague who since left and gone back

228

00:09:05,840 --> 00:09:14,389

to Italy Ilana musang she really was the

229
00:09:11,200 --> 00:09:18,350
staff contact for this program initially

230
00:09:14,389 --> 00:09:19,789
and did I would say most of the work but

231
00:09:18,350 --> 00:09:24,490
she's gone on to a different position

232
00:09:19,789 --> 00:09:24,490
now and so I picked it up after she left

233
00:09:25,120 --> 00:09:31,090
the so we heard about ultraviolet and

234
00:09:27,860 --> 00:09:33,230
Hubble and the Hubble is the only

235
00:09:31,090 --> 00:09:36,680
observatory have that can do this kind

236
00:09:33,230 --> 00:09:38,930
of work that Boris want to do and so we

237
00:09:36,679 --> 00:09:41,289
have some spectrographs one of which you

238
00:09:38,929 --> 00:09:43,909
use the cosmic origins spectrograph and

239
00:09:41,289 --> 00:09:45,439
they can observe in the ultraviolet so

240
00:09:43,909 --> 00:09:49,159
they have ultraviolet sensitive

241
00:09:45,440 --> 00:09:52,040
detectors fortunately these detectors

242
00:09:49,159 --> 00:09:56,929
are very susceptible to damage and even

243
00:09:52,039 --> 00:09:58,429
destruction by / illumination and so for

244
00:09:56,929 --> 00:10:00,049
every observation we do with any of

245
00:09:58,429 --> 00:10:02,659
these detectors we have to do a very

246
00:10:00,049 --> 00:10:05,389
careful screening of the target and even

247
00:10:02,659 --> 00:10:07,459
the field around the target to make sure

248
00:10:05,389 --> 00:10:09,230
that it's safe that the cap rates won't

249
00:10:07,460 --> 00:10:12,320
be too high for the safety of the

250
00:10:09,230 --> 00:10:14,360
detectors and that's a big job that's as

251
00:10:12,320 --> 00:10:17,090
you can imagine we have thousands of

252
00:10:14,360 --> 00:10:19,789
targets a year and somebody has to do

253
00:10:17,090 --> 00:10:21,950
that for each one that's a good part of

254
00:10:19,789 --> 00:10:26,240
my time here what I do on my technical

255
00:10:21,950 --> 00:10:27,800
side so you're you're always worried

256
00:10:26,240 --> 00:10:29,570
about whether or not me people forget

257

00:10:27,799 --> 00:10:32,000
this Hubble is designed to view very

258
00:10:29,570 --> 00:10:34,670
very faint things and so even something

259
00:10:32,000 --> 00:10:36,559
reasonably bright can do some damage

260
00:10:34,669 --> 00:10:37,969
to Hubble so do you spend a lot of your

261
00:10:36,559 --> 00:10:41,569
time worrying about things like that is

262
00:10:37,970 --> 00:10:43,730
that one of your jobs yes exactly we

263
00:10:41,570 --> 00:10:47,840
have to screen every target and we have

264
00:10:43,730 --> 00:10:50,389
software systems to help us do that too

265
00:10:47,840 --> 00:10:52,720
and Andy there is a detector for each

266
00:10:50,389 --> 00:10:55,519
config sorry a limit for each

267
00:10:52,720 --> 00:10:58,970
configuration involving a given detector

268
00:10:55,519 --> 00:11:02,120
which apertures being used filters

269
00:10:58,970 --> 00:11:04,879
whatever and we can calculate what the

270
00:11:02,120 --> 00:11:08,179
count rate will be given the input data

271
00:11:04,879 --> 00:11:10,899

about the target and so we checked that

272

00:11:08,179 --> 00:11:14,899

for everyone to make sure that it's safe

273

00:11:10,899 --> 00:11:16,698

so that was done for all of lorises

274

00:11:14,899 --> 00:11:18,470

targets and i have to say maybe semi

275

00:11:16,698 --> 00:11:21,500

humorously that that was kind of a no-no

276

00:11:18,470 --> 00:11:24,319

factor when his program arrived because

277

00:11:21,500 --> 00:11:26,899

he had 40 some of these targets and it's

278

00:11:24,318 --> 00:11:28,909

a lot of work and not only do they have

279

00:11:26,899 --> 00:11:31,399

to be screened in their question state

280

00:11:28,909 --> 00:11:34,629

which we hope and intend to observe them

281

00:11:31,399 --> 00:11:37,610

in but these objects are also subject to

282

00:11:34,629 --> 00:11:39,589

unpredictable almost instantaneous

283

00:11:37,610 --> 00:11:41,688

flares that increase the ultraviolet

284

00:11:39,589 --> 00:11:43,459

brightness by huge factor so it could be

285

00:11:41,688 --> 00:11:45,828

perfectly safe in its question state

286
00:11:43,458 --> 00:11:47,838
which we have data about and destroy the

287
00:11:45,828 --> 00:11:51,438
detector if it happened to have an

288
00:11:47,839 --> 00:11:53,480
outburst during the observation so the

289
00:11:51,438 --> 00:11:55,309
last words were told me that that could

290
00:11:53,480 --> 00:11:57,259
be on order of anywhere from three to

291
00:11:55,309 --> 00:12:00,588
seven magnitudes right I mean that

292
00:11:57,259 --> 00:12:02,990
brightness yes there's a real threat it

293
00:12:00,589 --> 00:12:04,639
is that's a huge amount and there are

294
00:12:02,990 --> 00:12:06,769
onboard safety mechanisms which are

295
00:12:04,639 --> 00:12:08,149
designed to shut that he Tector down in

296
00:12:06,769 --> 00:12:09,709
time if it detects such an over

297
00:12:08,149 --> 00:12:14,958
elimination but such a sudden huge

298
00:12:09,708 --> 00:12:16,638
increase might get through and damage

299
00:12:14,958 --> 00:12:19,969
something also if we have such a

300
00:12:16,639 --> 00:12:22,308
shutdown it fouls up the whole hubble

301
00:12:19,970 --> 00:12:24,319
schedule and things have to be redone

302
00:12:22,308 --> 00:12:26,958
and time may be lost so we want to avoid

303
00:12:24,318 --> 00:12:28,639
that well we can't predict this and so

304
00:12:26,958 --> 00:12:30,318
we can't be absolutely certain that it's

305
00:12:28,639 --> 00:12:32,299
not going to happen but we've thought

306
00:12:30,318 --> 00:12:34,719
about the statistics and how frequent

307
00:12:32,299 --> 00:12:37,849
these outbursts might be maybe centuries

308
00:12:34,720 --> 00:12:39,290
in this well it's different there

309
00:12:37,850 --> 00:12:41,420
different subcategories of these which

310
00:12:39,289 --> 00:12:43,938
Morris can tell you about I'm not an

311
00:12:41,419 --> 00:12:49,068
expert on it and but their properties

312
00:12:43,938 --> 00:12:50,599
are known and we can predict

313
00:12:49,068 --> 00:12:52,578
statistically how often these outbursts

314

00:12:50,600 --> 00:12:54,680
fight a curb but not when one is going

315
00:12:52,578 --> 00:12:58,188
to occur in a given object so the

316
00:12:54,679 --> 00:12:59,599
mechanism we settled on is to make sure

317
00:12:58,188 --> 00:13:01,818
that the object is still in its

318
00:12:59,600 --> 00:13:04,850
quiescent state and safe according to

319
00:13:01,818 --> 00:13:10,068
our screening 24 hours ahead of the

320
00:13:04,850 --> 00:13:11,750
observation and of course that requires

321
00:13:10,068 --> 00:13:12,669
a lot of work on the part of a lot of

322
00:13:11,750 --> 00:13:14,919
people and

323
00:13:12,669 --> 00:13:16,599
pudding now so let's yeah so let's get

324
00:13:14,919 --> 00:13:18,429
to that for so so part of the problem is

325
00:13:16,600 --> 00:13:20,500
you needed observations because before

326
00:13:18,429 --> 00:13:22,000
you point the Hubble anywhere you want

327
00:13:20,500 --> 00:13:24,460
to make sure that everything is still

328
00:13:22,000 --> 00:13:26,049

safe and so you're you need somebody to

329

00:13:24,460 --> 00:13:29,290

monitor these targets so all these

330

00:13:26,049 --> 00:13:32,229

targets the Boris came up with needed to

331

00:13:29,289 --> 00:13:34,240

be looked at right before you turn HST

332

00:13:32,230 --> 00:13:36,370

over and there was a system you guys put

333

00:13:34,240 --> 00:13:38,289

in place for that right and who would

334

00:13:36,370 --> 00:13:40,000

what would what Arnie would you be the

335

00:13:38,289 --> 00:13:42,429

one that coordinated those efforts are

336

00:13:40,000 --> 00:13:45,610

with that just with that be Boris I want

337

00:13:42,429 --> 00:13:47,169

someone to talk about how you who was

338

00:13:45,610 --> 00:13:50,680

doing the monitoring of these targets

339

00:13:47,169 --> 00:13:54,639

before HST was pointed well sort of a

340

00:13:50,679 --> 00:13:56,979

combination or certainly was the one who

341

00:13:54,639 --> 00:13:59,019

talked to HST to let them know the

342

00:13:56,980 --> 00:14:02,649

results of the monitoring that took

343

00:13:59,019 --> 00:14:05,740

place but I was the one who helped

344

00:14:02,649 --> 00:14:09,220

coordinate the various amateur

345

00:14:05,740 --> 00:14:10,840

activities related to that we generated

346

00:14:09,220 --> 00:14:14,350

finding charts for each one of the

347

00:14:10,840 --> 00:14:16,120

objects and then set up a campaign for

348

00:14:14,350 --> 00:14:20,879

each of the objects as they were coming

349

00:14:16,120 --> 00:14:23,379

up on the HST queue to have the amateurs

350

00:14:20,879 --> 00:14:27,909

observe these objects and monitor them

351

00:14:23,379 --> 00:14:30,639

and to ensure that they hadn't gone into

352

00:14:27,909 --> 00:14:33,549

outburst as it was mentioned the

353

00:14:30,639 --> 00:14:34,960

outburst as many magnitudes in size so

354

00:14:33,549 --> 00:14:36,870

it's really easy to see whether an

355

00:14:34,960 --> 00:14:39,910

object is in quiescence or whether it's

356

00:14:36,870 --> 00:14:42,519

far brighter than that so it's a very

357
00:14:39,909 --> 00:14:43,889
simple observation to make but it's one

358
00:14:42,519 --> 00:14:46,029
where you need to have people

359
00:14:43,889 --> 00:14:48,309
geographically distributed across the

360
00:14:46,029 --> 00:14:50,289
globe so if they can catch the opposite

361
00:14:48,309 --> 00:14:52,869
dot any kind of an outburst just as it

362
00:14:50,289 --> 00:14:57,490
starts beginning especially within that

363
00:14:52,870 --> 00:14:59,470
24-hour window that HST required so we

364
00:14:57,490 --> 00:15:04,389
enlisted the aid of a large group of

365
00:14:59,470 --> 00:15:06,430
amateurs partly from the aavso itself

366
00:15:04,389 --> 00:15:08,529
but then also the various members it

367
00:15:06,429 --> 00:15:10,659
excuse me various observers around the

368
00:15:08,529 --> 00:15:13,120
globe who also submit observations to us

369
00:15:10,659 --> 00:15:15,189
and everybody got very enthused about

370
00:15:13,120 --> 00:15:17,409
the project even though there's 40 some

371

00:15:15,190 --> 00:15:22,330
objects i mean this a lot of observing

372
00:15:17,409 --> 00:15:24,730
that has to be done but the the amateurs

373
00:15:22,330 --> 00:15:26,139
rough ford and they had observations for

374
00:15:24,730 --> 00:15:29,920
every single one of those

375
00:15:26,139 --> 00:15:33,309
targets within the time frame that HST

376
00:15:29,919 --> 00:15:38,169
required so we have Gordon Myers in our

377
00:15:33,309 --> 00:15:40,269
know oksanen here as examples of I guess

378
00:15:38,169 --> 00:15:42,459
you were two very instrumental amateurs

379
00:15:40,269 --> 00:15:45,850
and getting these observations done are

380
00:15:42,460 --> 00:15:50,680
you guys members of apps oh yes yes I am

381
00:15:45,850 --> 00:15:52,120
okay and so so do you have really do but

382
00:15:50,679 --> 00:15:53,709
do you guys have a backyard full of

383
00:15:52,120 --> 00:15:55,060
really amazing equipment or do you have

384
00:15:53,710 --> 00:15:57,100
disorder you know regular off-the-shelf

385
00:15:55,059 --> 00:15:58,539

telescopes I mean tell us tell us what

386

00:15:57,100 --> 00:16:00,879

you used and i'll start with gordon and

387

00:15:58,539 --> 00:16:03,039

then go to you or to darna yeah actually

388

00:16:00,879 --> 00:16:06,309

i was using some scopes that were

389

00:16:03,039 --> 00:16:09,189

remotely located a fairly large scope

390

00:16:06,309 --> 00:16:12,369

down in Australia and then also had

391

00:16:09,190 --> 00:16:16,630

access to a scope in New Mexico and also

392

00:16:12,370 --> 00:16:19,120

in Spain so we were often trying to now

393

00:16:16,629 --> 00:16:21,159

how to the clouds glad what how did that

394

00:16:19,120 --> 00:16:23,169

happen you don't own telescopes in all

395

00:16:21,159 --> 00:16:25,389

those areas do you know there's some

396

00:16:23,169 --> 00:16:28,479

organizations that allow you to rent

397

00:16:25,389 --> 00:16:30,189

time on telescopes by the minute and you

398

00:16:28,480 --> 00:16:32,350

can coordinate with them and get things

399

00:16:30,190 --> 00:16:35,080

scheduled so that you can you know

400
00:16:32,350 --> 00:16:36,909
observe targets at various times and

401
00:16:35,080 --> 00:16:39,520
that worked quite well other than when

402
00:16:36,909 --> 00:16:41,139
the clouds would show up or if somebody

403
00:16:39,519 --> 00:16:42,939
else already have the scope schedule but

404
00:16:41,139 --> 00:16:44,590
I think it was very enjoyable for the

405
00:16:42,940 --> 00:16:46,750
amateurs because we got a chance to

406
00:16:44,590 --> 00:16:48,639
really you know help the scientific

407
00:16:46,750 --> 00:16:49,629
observations go off on schedule and I

408
00:16:48,639 --> 00:16:52,480
think that's one of the things the

409
00:16:49,629 --> 00:16:55,600
amateurs enjoy the most now is this a is

410
00:16:52,480 --> 00:16:57,970
this like I telescope net is that yeah

411
00:16:55,600 --> 00:17:00,250
yeah was that one that's the 1i use yes

412
00:16:57,970 --> 00:17:02,290
ok yeah you're in very well I've worked

413
00:17:00,250 --> 00:17:04,359
with him the past they're fantastic yeah

414
00:17:02,289 --> 00:17:05,559
I want to have a hangout on just that

415
00:17:04,359 --> 00:17:07,240
what it's like to use some of these

416
00:17:05,559 --> 00:17:08,409
various online telescopes at some point

417
00:17:07,240 --> 00:17:10,359
in the future because I think that's a

418
00:17:08,410 --> 00:17:12,339
resource becoming more and more valuable

419
00:17:10,359 --> 00:17:13,389
and it might even be better and maybe we

420
00:17:12,338 --> 00:17:15,609
will talk about it here but it may even

421
00:17:13,390 --> 00:17:16,870
be better than buying your own scope or

422
00:17:15,609 --> 00:17:20,109
something named who knows I don't know

423
00:17:16,869 --> 00:17:21,578
but it is an interesting idea is that is

424
00:17:20,109 --> 00:17:24,039
that what you did our toes well you did

425
00:17:21,578 --> 00:17:26,799
did you do that or what did you do yeah

426
00:17:24,039 --> 00:17:29,559
I'll see you soon in itely operated

427
00:17:26,799 --> 00:17:33,039
tennis coach as well also you were also

428

00:17:29,559 --> 00:17:35,139
using online telescopes yes 11 in fatal

429
00:17:33,039 --> 00:17:36,159
on other one in Chile so let me get this

430
00:17:35,140 --> 00:17:37,360
straight are you guys paying for the

431
00:17:36,160 --> 00:17:38,920
side of your own pocket you guys are

432
00:17:37,359 --> 00:17:39,928
buying this telescope time is it

433
00:17:38,920 --> 00:17:43,110
expensive

434
00:17:39,929 --> 00:17:46,889
and uh today i stopped i'm using in

435
00:17:43,109 --> 00:17:50,609
finland it it is owned by my utterly

436
00:17:46,888 --> 00:17:54,240
mchale Club to club tennis court and the

437
00:17:50,609 --> 00:17:58,079
one in Chile it's owned by a friend it's

438
00:17:54,240 --> 00:18:00,359
a private telescope but i can use point

439
00:17:58,079 --> 00:18:01,740
three any of it man amateur astronomy

440
00:18:00,359 --> 00:18:04,439
has sure changed since i was doing and I

441
00:18:01,740 --> 00:18:06,538
know that it's like the the Internet has

442
00:18:04,440 --> 00:18:08,460

made everything possible nobody who need

443

00:18:06,538 --> 00:18:11,490

no such thing as a cloudy night anymore

444

00:18:08,460 --> 00:18:13,769

just go to another part in the world is

445

00:18:11,490 --> 00:18:17,519

card to a question then so so you

446

00:18:13,769 --> 00:18:19,829

haven't estranha then and and you own

447

00:18:17,519 --> 00:18:21,868

one telescope or several telescopes and

448

00:18:19,829 --> 00:18:23,548

then you have to make the case you have

449

00:18:21,868 --> 00:18:26,628

to kind of proposed to your group hey I

450

00:18:23,548 --> 00:18:29,759

want to go that's my recollection yeah

451

00:18:26,628 --> 00:18:36,388

we don't have too many observers but be

452

00:18:29,759 --> 00:18:41,940

okay founded on our personal right Sarah

453

00:18:36,388 --> 00:18:44,638

so first common with basically nice okay

454

00:18:41,940 --> 00:18:46,320

so Boris how hard was it to coordinate

455

00:18:44,638 --> 00:18:48,329

all of this I mean now you're you're

456

00:18:46,319 --> 00:18:49,769

getting ready to look at the point the

457
00:18:48,329 --> 00:18:51,118
Hubble somewhere you don't know if it's

458
00:18:49,769 --> 00:18:52,618
scary or not you don't know if you're

459
00:18:51,118 --> 00:18:56,099
going to burn out detectors and you and

460
00:18:52,618 --> 00:18:57,418
Nolan her you know making sure how what

461
00:18:56,099 --> 00:18:58,859
was that like give us a sense of what

462
00:18:57,419 --> 00:19:03,230
that was like to get all that put

463
00:18:58,859 --> 00:19:05,548
together it was frightening because

464
00:19:03,230 --> 00:19:09,419
because this these systems they're

465
00:19:05,548 --> 00:19:11,490
unpredictable as Nolan said we

466
00:19:09,419 --> 00:19:14,369
statistically we can tell how often the

467
00:19:11,490 --> 00:19:16,079
outburst saw every three month every six

468
00:19:14,368 --> 00:19:19,829
months but you never know they could be

469
00:19:16,079 --> 00:19:21,928
tomorrow and so every single time that I

470
00:19:19,829 --> 00:19:24,839
got an email that the next edges the

471
00:19:21,929 --> 00:19:26,669
observation is scheduled I would get in

472
00:19:24,839 --> 00:19:28,759
touch with Arnie and send out an email

473
00:19:26,669 --> 00:19:31,470
to the amateurs I know personally and

474
00:19:28,759 --> 00:19:34,440
start to collect observations and then

475
00:19:31,470 --> 00:19:37,019
we had three or four near misses where

476
00:19:34,440 --> 00:19:39,470
the systems went into an opera is about

477
00:19:37,019 --> 00:19:42,149
a week before the HST observations and

478
00:19:39,470 --> 00:19:44,490
then the question was would they fade

479
00:19:42,148 --> 00:19:47,788
rapidly enough that it's safer agency to

480
00:19:44,490 --> 00:19:51,538
observe and so the the kind of closest

481
00:19:47,788 --> 00:19:53,339
call we had was one system very far in

482
00:19:51,538 --> 00:19:54,000
the southern hemisphere but the problem

483
00:19:53,339 --> 00:19:55,529
there is that the

484
00:19:54,000 --> 00:19:56,940
southern hemisphere doesn't have a lot

485

00:19:55,529 --> 00:20:00,389
of land so there are not many telescopes

486
00:19:56,940 --> 00:20:02,910
that are available it's Australia South

487
00:20:00,390 --> 00:20:06,570
America and South Africa right so I was

488
00:20:02,910 --> 00:20:09,150
myself just on a trip to Chile and got

489
00:20:06,569 --> 00:20:10,799
an email while I was in the taxi going

490
00:20:09,150 --> 00:20:12,600
to the observatory there that one of the

491
00:20:10,799 --> 00:20:15,059
stars scheduled for hs2 observations

492
00:20:12,599 --> 00:20:18,089
later the week that we had gone into all

493
00:20:15,059 --> 00:20:20,039
person so I was frenetically emailing

494
00:20:18,089 --> 00:20:23,069
outer oh and some other people in South

495
00:20:20,039 --> 00:20:25,680
Africa that they get on to the star and

496
00:20:23,069 --> 00:20:27,269
so they did what they could do and they

497
00:20:25,680 --> 00:20:29,070
could show demonstrate to space

498
00:20:27,269 --> 00:20:31,710
telescope demonstrate to Nolan and

499
00:20:29,069 --> 00:20:34,289

Helena that the star was fading rapidly

500

00:20:31,710 --> 00:20:36,329

and that it was back in quiescence about

501

00:20:34,289 --> 00:20:38,009

12 hours before a chest he would salute

502

00:20:36,329 --> 00:20:39,659

to it and so then they were happy and

503

00:20:38,009 --> 00:20:43,220

they said okay go ahead we do the

504

00:20:39,660 --> 00:20:48,200

observation wow that's amazing I know I

505

00:20:43,220 --> 00:20:50,490

was it was really real time 24 hours

506

00:20:48,200 --> 00:20:52,680

working on that program to make sure

507

00:20:50,490 --> 00:20:54,630

that the communication works that we can

508

00:20:52,680 --> 00:20:56,400

fill in gaps if there's bad weather in

509

00:20:54,630 --> 00:20:58,530

one continent that we can work from

510

00:20:56,400 --> 00:21:01,259

somewhere else and then people like

511

00:20:58,529 --> 00:21:04,349

people like Otto and Gordon just

512

00:21:01,259 --> 00:21:06,930

responded so brilliantly to to my

513

00:21:04,349 --> 00:21:08,819

requests over and over again that's

514
00:21:06,930 --> 00:21:11,730
awesome so for the benefit of those who

515
00:21:08,819 --> 00:21:13,409
might be watching that might want to do

516
00:21:11,730 --> 00:21:16,319
this kind of thing get involved in this

517
00:21:13,410 --> 00:21:18,240
kind of thing with Hubble science how

518
00:21:16,319 --> 00:21:20,579
did how did you guys find out about it

519
00:21:18,240 --> 00:21:23,789
arto and Gordon what was it through apps

520
00:21:20,579 --> 00:21:26,730
oh yeah in my case it definitely was

521
00:21:23,789 --> 00:21:29,159
yeah i mean the the alerts from double a

522
00:21:26,730 --> 00:21:31,620
VSO were the ones that i really tied

523
00:21:29,160 --> 00:21:33,630
into and then through those ended up

524
00:21:31,619 --> 00:21:35,909
doing emails directly with worse in

525
00:21:33,630 --> 00:21:37,860
several situations but yeah it was the

526
00:21:35,910 --> 00:21:41,040
coordination through a VSO that really

527
00:21:37,859 --> 00:21:42,990
made it all happen ok and same in same

528
00:21:41,039 --> 00:21:46,680
for you or you found it you found it out

529
00:21:42,990 --> 00:21:49,650
same way yeah I think so I learned it by

530
00:21:46,680 --> 00:21:51,990
aavso but probably got a email from

531
00:21:49,650 --> 00:21:53,370
Boris as well well there you go Arnie

532
00:21:51,990 --> 00:21:54,750
there's a good plug for why you need to

533
00:21:53,369 --> 00:21:57,750
get more members they're getting become

534
00:21:54,750 --> 00:22:00,630
get a member of the organization what's

535
00:21:57,750 --> 00:22:02,369
it like tell us how to do that what is

536
00:22:00,630 --> 00:22:07,650
that so and what why should how can

537
00:22:02,369 --> 00:22:10,019
people sign up well a VSO

538
00:22:07,650 --> 00:22:12,150
I know I was so I just don't have it

539
00:22:10,019 --> 00:22:16,079
sorry yeah well I mean there's am so a

540
00:22:12,150 --> 00:22:17,610
via so you know you pick your way of

541
00:22:16,079 --> 00:22:20,429
pronouncing the acronym that's fine with

542

00:22:17,609 --> 00:22:22,619
me but is the American Association of

543
00:22:20,430 --> 00:22:24,840
variable star observers and what that

544
00:22:22,619 --> 00:22:26,789
means is exactly what it says is people

545
00:22:24,839 --> 00:22:29,069
who have the an interest in variable

546
00:22:26,789 --> 00:22:31,470
stars they can be professional they can

547
00:22:29,069 --> 00:22:34,799
be amateur they can be just interested

548
00:22:31,470 --> 00:22:38,250
in doing database design whatever but we

549
00:22:34,799 --> 00:22:42,180
give equal weight to everyone we do have

550
00:22:38,250 --> 00:22:44,039
a website that you can go to a VSO org

551
00:22:42,180 --> 00:22:47,670
and on there there's a way in which you

552
00:22:44,039 --> 00:22:50,039
can join the organization it's not that

553
00:22:47,670 --> 00:22:51,930
expensive we do actually have a robotic

554
00:22:50,039 --> 00:22:55,980
telescope Network that you can get to

555
00:22:51,930 --> 00:22:58,009
for free if you remember and so it's a I

556
00:22:55,980 --> 00:23:00,329

think it's an exciting time for

557

00:22:58,009 --> 00:23:02,400

astronomy in general and for the amateur

558

00:23:00,329 --> 00:23:04,980

community in particular and for the

559

00:23:02,400 --> 00:23:06,450

professional amateur collaboration world

560

00:23:04,980 --> 00:23:08,039

as well I mean there's a lot of these

561

00:23:06,450 --> 00:23:10,170

kind of collaborations happening now as

562

00:23:08,039 --> 00:23:12,710

a result of your efforts I remember in

563

00:23:10,170 --> 00:23:16,050

the 70s when I was a member of apps

564

00:23:12,710 --> 00:23:18,090

double a VSO what I did was I took my

565

00:23:16,049 --> 00:23:19,769

little c 8 out and I would just plot

566

00:23:18,089 --> 00:23:22,230

light curves of different variable stars

567

00:23:19,769 --> 00:23:24,990

send the man via mail and you guys would

568

00:23:22,230 --> 00:23:26,640

process them and and and and do your do

569

00:23:24,990 --> 00:23:28,410

some make it available to professional

570

00:23:26,640 --> 00:23:30,509

science scientists for people who needed

571
00:23:28,410 --> 00:23:32,850
light curves of variable stars that's

572
00:23:30,509 --> 00:23:35,819
what I did when I was in high school and

573
00:23:32,849 --> 00:23:38,219
I have a question actually about the

574
00:23:35,819 --> 00:23:44,099
process so so you're sending out alerts

575
00:23:38,220 --> 00:23:46,380
and the members are responding um do

576
00:23:44,099 --> 00:23:49,679
they go directly to Boris then and start

577
00:23:46,380 --> 00:23:52,560
reporting they make measurements and

578
00:23:49,680 --> 00:23:55,110
report the measurements to somebody

579
00:23:52,559 --> 00:23:56,819
collect all the observations for use

580
00:23:55,109 --> 00:24:00,029
later I mean maybe those observations

581
00:23:56,819 --> 00:24:02,369
are worth something in reference to the

582
00:24:00,029 --> 00:24:04,950
HST observation so what about the data

583
00:24:02,369 --> 00:24:08,819
and and all of that what happens with

584
00:24:04,950 --> 00:24:11,190
all of that Oh Carol all that happens we

585
00:24:08,819 --> 00:24:14,220
do have an online public publicly

586
00:24:11,190 --> 00:24:15,809
accessible database and we encourage all

587
00:24:14,220 --> 00:24:17,970
the observers to submit their

588
00:24:15,809 --> 00:24:20,759
observations to that database and it's

589
00:24:17,970 --> 00:24:21,600
real time so that means then that Boris

590
00:24:20,759 --> 00:24:24,210
or whomever

591
00:24:21,599 --> 00:24:26,939
can actually access the database and see

592
00:24:24,210 --> 00:24:29,910
what the latest reported observations

593
00:24:26,940 --> 00:24:32,400
are in addition to that we have online

594
00:24:29,910 --> 00:24:34,410
forums and so there was a forum it was

595
00:24:32,400 --> 00:24:37,350
set up and people who report any kind of

596
00:24:34,410 --> 00:24:39,750
immediate notification there may not

597
00:24:37,349 --> 00:24:42,000
have been a quality observation yet but

598
00:24:39,750 --> 00:24:47,730
they wanted to alert somebody about it

599

00:24:42,000 --> 00:24:50,759
and then finally Boris was available

600
00:24:47,730 --> 00:24:52,589
they seem like 24 7 and so he was you

601
00:24:50,759 --> 00:24:54,150
could just email him and let him know if

602
00:24:52,589 --> 00:24:57,538
you saw anything that was important so

603
00:24:54,150 --> 00:24:59,159
we encourage that as well okay well that

604
00:24:57,538 --> 00:25:00,569
that is a great resource so I would

605
00:24:59,159 --> 00:25:02,190
encourage anybody interested in getting

606
00:25:00,569 --> 00:25:03,538
involved to go to that website and see

607
00:25:02,190 --> 00:25:05,429
and learn more about it themselves and

608
00:25:03,538 --> 00:25:06,779
get involved I mean this is the best you

609
00:25:05,429 --> 00:25:08,429
know this is a golden age of astronomy

610
00:25:06,779 --> 00:25:10,710
for amateurs as well and you can really

611
00:25:08,429 --> 00:25:12,538
help pro professional astronomers in

612
00:25:10,710 --> 00:25:15,509
ways that have never really been before

613
00:25:12,538 --> 00:25:17,460

may possible so I would encourage you to

614

00:25:15,509 --> 00:25:19,379

do that I want to go back to the science

615

00:25:17,460 --> 00:25:20,730

a little bit now and then I want to get

616

00:25:19,380 --> 00:25:23,429

to some questions and comments that we

617

00:25:20,730 --> 00:25:27,298

have on the various things but so we

618

00:25:23,429 --> 00:25:30,659

have these white dwarfs there Nolan's

619

00:25:27,298 --> 00:25:33,029

waving yes yeah I think it's important

620

00:25:30,659 --> 00:25:37,380

to add a bit more about what we actually

621

00:25:33,029 --> 00:25:39,990

have to do here to make this work at at

622

00:25:37,380 --> 00:25:41,610

the Hubble I kind of left it that yeah

623

00:25:39,990 --> 00:25:43,919

we have to know whether it feels safe be

624

00:25:41,609 --> 00:25:46,109

four we point the Hubble there but it's

625

00:25:43,919 --> 00:25:48,030

not quite that simple as you know the

626

00:25:46,109 --> 00:25:49,889

Hubble is in low Earth orbit goes around

627

00:25:48,029 --> 00:25:51,928

the earth every 96 minutes and we can't

628
00:25:49,890 --> 00:25:55,530
have continuous communication with it

629
00:25:51,929 --> 00:25:58,320
and the way it works is that a mission

630
00:25:55,529 --> 00:26:01,109
schedule is prepared and sent up to the

631
00:25:58,319 --> 00:26:03,418
telescope once a week i believe it

632
00:26:01,109 --> 00:26:07,109
starts on saturday or sunday and forget

633
00:26:03,419 --> 00:26:09,480
and then runs for a week so but as I

634
00:26:07,109 --> 00:26:12,769
said we're making this decision 24 hours

635
00:26:09,480 --> 00:26:16,140
before the observation so there's a

636
00:26:12,769 --> 00:26:17,849
compatibility there so a very rather

637
00:26:16,140 --> 00:26:20,280
complex and intricate system has been

638
00:26:17,849 --> 00:26:23,939
developed to do this involving a lot of

639
00:26:20,279 --> 00:26:26,579
people actually not only the at one

640
00:26:23,940 --> 00:26:29,340
level we heard how the observers provide

641
00:26:26,579 --> 00:26:33,220
the information Boris coordinates it

642
00:26:29,339 --> 00:26:37,449
sends it to the year to Eleanor and then

643
00:26:33,220 --> 00:26:39,819
I give an approval if it's safe 24 hours

644
00:26:37,450 --> 00:26:42,490
in advance but in order to make that

645
00:26:39,819 --> 00:26:44,889
happen the telescope has to be scheduled

646
00:26:42,490 --> 00:26:48,190
in a very special way and the way this

647
00:26:44,890 --> 00:26:51,159
is done is that it's set up so that the

648
00:26:48,190 --> 00:26:57,519
telescope will go and point at a blank

649
00:26:51,159 --> 00:27:00,419
field very near the target and there is

650
00:26:57,519 --> 00:27:04,679
communication possible with the Hubble

651
00:27:00,419 --> 00:27:08,770
some hours a day through the NASA and

652
00:27:04,679 --> 00:27:10,750
tracking and data relay satellite system

653
00:27:08,769 --> 00:27:12,548
so all of this has to be set up and

654
00:27:10,750 --> 00:27:13,929
coordinated with our engineers at some

655
00:27:12,548 --> 00:27:15,308
point it's out of the hands of the

656

00:27:13,929 --> 00:27:17,530
astronomers and in the hands of the

657
00:27:15,308 --> 00:27:19,149
engineers because we don't talk to the

658
00:27:17,529 --> 00:27:20,980
telescope and engineers here at the

659
00:27:19,150 --> 00:27:23,080
Institute and then a Goddard Space

660
00:27:20,980 --> 00:27:27,279
Flight Center where the vehicle is

661
00:27:23,079 --> 00:27:29,859
controlled so there's a flag set on

662
00:27:27,279 --> 00:27:31,058
board and you know Alan well to use and

663
00:27:29,859 --> 00:27:32,469
here he's one of the engineers who does

664
00:27:31,058 --> 00:27:34,178
is and though it does knows a lot more

665
00:27:32,470 --> 00:27:39,640
about the details i do but in broad

666
00:27:34,179 --> 00:27:43,330
terms this flag has to be cleared so

667
00:27:39,640 --> 00:27:45,850
that the telescope will go to the real

668
00:27:43,329 --> 00:27:48,990
field and not to the blank one after the

669
00:27:45,849 --> 00:27:51,849
ok comes in 24 hours in advance and

670
00:27:48,990 --> 00:27:53,950

hopefully that's not 3m or a 2 a.m. or

671

00:27:51,849 --> 00:27:56,589

whatever because of our budget cuts

672

00:27:53,950 --> 00:27:58,960

nessa only operates nine to five or

673

00:27:56,589 --> 00:28:02,019

eight to five now found there so it's a

674

00:27:58,960 --> 00:28:05,679

bit intricate but we men should do it

675

00:28:02,019 --> 00:28:07,750

and this flag gets cleared and then the

676

00:28:05,679 --> 00:28:09,788

telescope actually goes and points to

677

00:28:07,750 --> 00:28:12,819

the real target and does the observation

678

00:28:09,788 --> 00:28:14,769

and virus I don't recall where any I

679

00:28:12,819 --> 00:28:16,470

think there were among year 40 some

680

00:28:14,769 --> 00:28:19,629

targets one or two that were actually

681

00:28:16,470 --> 00:28:22,480

aborted and the observation was not

682

00:28:19,630 --> 00:28:25,240

conducted is that true that's right we

683

00:28:22,480 --> 00:28:28,419

lost we out of 41 targets we lost one

684

00:28:25,240 --> 00:28:30,400

and that one that that was just one of

685
00:28:28,419 --> 00:28:32,169
those cataclysmic variables that just

686
00:28:30,400 --> 00:28:34,538
behaves in a completely unpredictable

687
00:28:32,169 --> 00:28:36,070
way it didn't go into a proper all

688
00:28:34,538 --> 00:28:37,869
purpose but it was brightening and

689
00:28:36,069 --> 00:28:40,629
fading in a very irregular fashion and I

690
00:28:37,869 --> 00:28:43,119
remember I was having dinner and Elena

691
00:28:40,630 --> 00:28:45,340
called me at what it was dinner time

692
00:28:43,119 --> 00:28:47,048
over here in the UK and we were

693
00:28:45,339 --> 00:28:48,999
discussing it and she said I'm sorry

694
00:28:47,048 --> 00:28:50,739
just it's it's just too risky to go

695
00:28:48,999 --> 00:28:53,079
ahead and she said she cannot sign that

696
00:28:50,739 --> 00:28:55,480
one off so we lost that once though but

697
00:28:53,079 --> 00:28:57,398
all the other 40 were successfully

698
00:28:55,480 --> 00:28:59,950
observed here so that's the really great

699
00:28:57,398 --> 00:29:02,288
success so yeah it is it's a tribute to

700
00:28:59,950 --> 00:29:04,629
everybody involved all over the world

701
00:29:02,288 --> 00:29:06,669
that we achieved that success rate and

702
00:29:04,628 --> 00:29:08,980
but it shows there's a human judgment

703
00:29:06,669 --> 00:29:10,749
involved here too it's some ways kind of

704
00:29:08,980 --> 00:29:12,878
like a legal criteria beyond a

705
00:29:10,749 --> 00:29:14,589
reasonable doubt and not only for these

706
00:29:12,878 --> 00:29:16,089
observations it's for all Hubble

707
00:29:14,589 --> 00:29:17,829
observations we can never prove one

708
00:29:16,089 --> 00:29:20,829
hundred percent that something is safe

709
00:29:17,829 --> 00:29:23,589
but it's up to contact scientists in the

710
00:29:20,829 --> 00:29:25,449
ultimate instance to decide whether he

711
00:29:23,589 --> 00:29:26,829
or she feels comfortable that to the

712
00:29:25,450 --> 00:29:28,899
best of our ability and the best of our

713

00:29:26,829 --> 00:29:31,269
knowledge this target is safe and that's

714
00:29:28,898 --> 00:29:35,229
what applied also to this rather unusual

715
00:29:31,269 --> 00:29:37,388
case nice okay good good good summary so

716
00:29:35,230 --> 00:29:38,679
that was good to know so like I said I

717
00:29:37,388 --> 00:29:40,988
want to get back to the science a little

718
00:29:38,679 --> 00:29:42,309
bit we were trying you were trying to

719
00:29:40,989 --> 00:29:45,340
answer the question we said this at the

720
00:29:42,308 --> 00:29:46,928
top of the show about you were trying to

721
00:29:45,339 --> 00:29:49,418
find out if these white dwarves in these

722
00:29:46,929 --> 00:29:51,639
binary systems actually grew in mass and

723
00:29:49,419 --> 00:29:54,399
if they did how efficient is that

724
00:29:51,638 --> 00:29:56,378
process of getting larger so here we

725
00:29:54,398 --> 00:29:59,378
have a white dwarf they are all of the

726
00:29:56,378 --> 00:30:00,668
roughly the same size correct Carol all

727
00:29:59,378 --> 00:30:06,099

white dwarfs are more or less the same

728

00:30:00,669 --> 00:30:10,119

same mass right you're muted actually

729

00:30:06,099 --> 00:30:12,158

Boris okay Joe was trying to he actually

730

00:30:10,118 --> 00:30:19,148

told us that they were there different

731

00:30:12,159 --> 00:30:21,549

masses oh but the blood janitors also

732

00:30:19,148 --> 00:30:24,128

are different sizes but then above some

733

00:30:21,548 --> 00:30:26,528

math size it can't become white dwarfs

734

00:30:24,128 --> 00:30:29,558

anymore because they have too much mass

735

00:30:26,528 --> 00:30:31,960

so there is a limit and then beyond that

736

00:30:29,558 --> 00:30:33,398

they become something more exotic all

737

00:30:31,960 --> 00:30:36,608

the white dwarf so I'm pretty darn

738

00:30:33,398 --> 00:30:38,229

exotic anyway so I guess I'm confused

739

00:30:36,608 --> 00:30:39,699

about well first of all I'm just get to

740

00:30:38,230 --> 00:30:44,679

the punch line would you find out are

741

00:30:39,700 --> 00:30:48,278

they getting bigger Boris can you hear

742
00:30:44,679 --> 00:30:50,470
me Tony I missed that oh I was asking so

743
00:30:48,278 --> 00:30:55,419
what you find out where you AR they are

744
00:30:50,470 --> 00:30:57,669
they growing a mass well well we have we

745
00:30:55,419 --> 00:30:59,499
have just the we have obtained the last

746
00:30:57,669 --> 00:31:00,460
observation of this poem Justin mouth so

747
00:30:59,499 --> 00:31:05,019
we are still in the pros

748
00:31:00,460 --> 00:31:06,940
of analyzing the data and and it's not

749
00:31:05,019 --> 00:31:08,920
as straightforward just that we measure

750
00:31:06,940 --> 00:31:10,210
the mass traded for right away from the

751
00:31:08,920 --> 00:31:11,769
observation because another piece of

752
00:31:10,210 --> 00:31:14,200
information that we need to know is the

753
00:31:11,769 --> 00:31:16,059
distance to these stars which together

754
00:31:14,200 --> 00:31:18,220
with the huddle observation we will then

755
00:31:16,059 --> 00:31:19,750
be able to convert into mass but but

756
00:31:18,220 --> 00:31:22,660
just coming back briefly to the point

757
00:31:19,750 --> 00:31:25,420
about why 12 masses your your textbook

758
00:31:22,660 --> 00:31:27,850
why 12 on this guy has a mass of about

759
00:31:25,420 --> 00:31:29,890
point 6 solar masses so sixty percent

760
00:31:27,849 --> 00:31:33,309
the mass of the Sun that's what I would

761
00:31:29,890 --> 00:31:34,750
end yeah and so most most white walls

762
00:31:33,309 --> 00:31:37,269
have that DeadMau so the average

763
00:31:34,750 --> 00:31:39,190
mother's point six and looking at

764
00:31:37,269 --> 00:31:42,039
cataclysmic variables the data we had

765
00:31:39,190 --> 00:31:45,910
before this HST project on something

766
00:31:42,039 --> 00:31:48,220
like 20-25 stars showed that they have

767
00:31:45,910 --> 00:31:50,950
average mass of point eight solar masses

768
00:31:48,220 --> 00:31:54,009
or eighty percent of the mass of the Sun

769
00:31:50,950 --> 00:31:55,660
so they're about a third heavier then

770

00:31:54,009 --> 00:31:57,849
your average single way too often that

771
00:31:55,660 --> 00:32:01,570
that was the clue why we think they may

772
00:31:57,849 --> 00:32:02,709
grow in mass now the the few objects we

773
00:32:01,569 --> 00:32:05,950
have analyzed in a little bit more

774
00:32:02,710 --> 00:32:12,759
detail from the HST project they all

775
00:32:05,950 --> 00:32:15,190
confirm this the same suspicion that

776
00:32:12,759 --> 00:32:17,529
they are more massive so they are they

777
00:32:15,190 --> 00:32:21,400
come in at mazel point 8.9 solar masses

778
00:32:17,529 --> 00:32:24,190
so why don't you think Galaxy isn't is

779
00:32:21,400 --> 00:32:26,950
about point six but one in a system like

780
00:32:24,190 --> 00:32:28,660
this is a little bit heavier and you

781
00:32:26,950 --> 00:32:31,480
think it might be due to this accreting

782
00:32:28,660 --> 00:32:35,050
material or they don't more due process

783
00:32:31,480 --> 00:32:37,150
is it very very that the process is very

784
00:32:35,049 --> 00:32:39,970

efficient somehow masses is not not all

785

00:32:37,150 --> 00:32:44,019

the masses being released right in the

786

00:32:39,970 --> 00:32:46,150

explosion yeah well so the kind of fact

787

00:32:44,019 --> 00:32:48,190

the fact that we are working towards at

788

00:32:46,150 --> 00:32:49,600

the moment is that these these white

789

00:32:48,190 --> 00:32:52,299

Wilson characters make martyrs are

790

00:32:49,599 --> 00:32:55,059

definitely much more massive than your

791

00:32:52,299 --> 00:32:57,399

typical single bite off in the galaxy

792

00:32:55,059 --> 00:32:59,769

and they're basically just two

793

00:32:57,400 --> 00:33:01,960

explanations either they grow in mass or

794

00:32:59,769 --> 00:33:05,920

they are just born with a much higher

795

00:33:01,960 --> 00:33:08,140

mass right at the beginning and making

796

00:33:05,920 --> 00:33:09,820

all these systems with much more massive

797

00:33:08,140 --> 00:33:12,850

weight loss is incredibly difficult to

798

00:33:09,819 --> 00:33:14,349

when this to explain so mass growth

799

00:33:12,849 --> 00:33:16,359
seems to be the natural

800

00:33:14,349 --> 00:33:17,949
explanation you know they're quite a

801

00:33:16,359 --> 00:33:19,298
number of people who feel uncomfortable

802

00:33:17,950 --> 00:33:20,740
about that as well but that's the good

803

00:33:19,298 --> 00:33:23,490
thing about science we have two offices

804

00:33:20,740 --> 00:33:27,819
in both of them both of them don't work

805

00:33:23,490 --> 00:33:29,769
so could I ask just what just another

806

00:33:27,819 --> 00:33:32,829
question so at the beginning of this

807

00:33:29,769 --> 00:33:36,129
course you were talking about looking

808

00:33:32,829 --> 00:33:40,178
for causes for type 1 supernova and you

809

00:33:36,130 --> 00:33:42,490
mentioned the binary systems so we're in

810

00:33:40,179 --> 00:33:44,950
the spectrum of cataclysmic variables

811

00:33:42,490 --> 00:33:47,679
and Nova are the binary systems because

812

00:33:44,950 --> 00:33:50,710
they can be white dwarfs as well is that

813
00:33:47,679 --> 00:33:54,100
correct I missed I missed all of your

814
00:33:50,710 --> 00:33:57,190
abacus the progenitors foresight type 1a

815
00:33:54,099 --> 00:34:00,428
supernovae you mentioned binary just

816
00:33:57,190 --> 00:34:04,750
white dwarfs yeah yeah where do they fit

817
00:34:00,429 --> 00:34:07,720
in this scheme they fit in this scheme

818
00:34:04,750 --> 00:34:10,510
in the sense that they you need to have

819
00:34:07,720 --> 00:34:12,070
a different type of stellar system to

820
00:34:10,510 --> 00:34:15,909
make two by twelves in the first place

821
00:34:12,070 --> 00:34:19,480
and so you need to have two fairly

822
00:34:15,909 --> 00:34:22,119
massive massive stars that have that can

823
00:34:19,480 --> 00:34:24,760
evolve relatively rapidly into white

824
00:34:22,119 --> 00:34:27,519
wolves both of them and then merge

825
00:34:24,760 --> 00:34:29,109
within the age of the of the galaxy to

826
00:34:27,519 --> 00:34:31,659
become a type 1a supernovae so there are

827

00:34:29,108 --> 00:34:34,000
different breed of binary styles it in

828
00:34:31,659 --> 00:34:36,190
general type 1 ace I think nobody has

829
00:34:34,000 --> 00:34:38,648
any doubt that type 1 ace must be

830
00:34:36,190 --> 00:34:40,179
related to white wolves in some kind of

831
00:34:38,648 --> 00:34:42,549
binary stars the big question is what

832
00:34:40,179 --> 00:34:43,809
kind of binary stars are those and my

833
00:34:42,550 --> 00:34:49,419
personal feeling is they're probably

834
00:34:43,809 --> 00:34:51,070
more than one type that can work so so

835
00:34:49,418 --> 00:34:52,569
Scott has a little diagram little

836
00:34:51,070 --> 00:34:55,510
cartoon of a couple of white dwarfs

837
00:34:52,570 --> 00:34:58,720
orbiting to sort of underscore what

838
00:34:55,510 --> 00:35:00,070
you're talking about there I guess one

839
00:34:58,719 --> 00:35:01,509
thing that worries me though is that you

840
00:35:00,070 --> 00:35:04,030
said that you still needed to know their

841
00:35:01,510 --> 00:35:06,790

distances to really know if they were

842

00:35:04,030 --> 00:35:10,660

gaining mass I I thought type 1a

843

00:35:06,789 --> 00:35:13,119

supernovae were yard sticks they told us

844

00:35:10,659 --> 00:35:17,769

how far away things were don't you know

845

00:35:13,119 --> 00:35:19,570

that that's that's right if you want to

846

00:35:17,769 --> 00:35:23,920

measure this and I'll let you comment on

847

00:35:19,570 --> 00:35:25,720

it right away if you want if you want to

848

00:35:23,920 --> 00:35:27,400

measure distances to galaxies far far

849

00:35:25,719 --> 00:35:28,209

away then you want an exploding white

850

00:35:27,400 --> 00:35:29,980

dwarf in it

851

00:35:28,210 --> 00:35:32,369

but here we are looking at the actual

852

00:35:29,980 --> 00:35:34,630

weight loss before they explode and so

853

00:35:32,369 --> 00:35:36,010

for the measurement we have in mind we

854

00:35:34,630 --> 00:35:37,838

need to know we need to know the

855

00:35:36,010 --> 00:35:39,700

distance and just just to make it clear

856
00:35:37,838 --> 00:35:42,730
this these white walls they're really

857
00:35:39,699 --> 00:35:44,379
nearby we are talking about a few 10 and

858
00:35:42,730 --> 00:35:47,019
at most a few hundred light years so

859
00:35:44,380 --> 00:35:49,599
they're basically parallax to figure it

860
00:35:47,019 --> 00:35:52,659
out exactly and so we can use paradoxes

861
00:35:49,599 --> 00:35:55,420
and the the European Space Agency has

862
00:35:52,659 --> 00:35:57,759
launched their mission Gaia just lost I

863
00:35:55,420 --> 00:36:00,309
think was January that we provide us

864
00:35:57,760 --> 00:36:03,000
with super accurate distances within the

865
00:36:00,309 --> 00:36:06,009
next few years so we can get some

866
00:36:03,000 --> 00:36:08,380
preliminary answer within the next year

867
00:36:06,010 --> 00:36:11,080
or so and then the final answer we have

868
00:36:08,380 --> 00:36:14,289
to wait for about 34 years before we

869
00:36:11,079 --> 00:36:16,299
have the final decisions all right great

870
00:36:14,289 --> 00:36:17,710
thank you for clarifying that I will get

871
00:36:16,300 --> 00:36:19,089
back to what parallax is in a minute but

872
00:36:17,710 --> 00:36:20,760
let me let Nolan make his comment go

873
00:36:19,088 --> 00:36:23,139
ahead and all right yeah thank you I

874
00:36:20,760 --> 00:36:24,280
have an uncomfortable feeling that if

875
00:36:23,139 --> 00:36:27,159
they're people listening who aren't

876
00:36:24,280 --> 00:36:28,900
familiar with the basic astronomy here

877
00:36:27,159 --> 00:36:31,210
or haven't heard the previous hangout on

878
00:36:28,900 --> 00:36:33,700
supernovae or whatever they may be a bit

879
00:36:31,210 --> 00:36:36,190
confused and so I think we useful just

880
00:36:33,699 --> 00:36:38,469
to run through a few basic things a

881
00:36:36,190 --> 00:36:40,769
white dwarf for a star to be a white

882
00:36:38,469 --> 00:36:43,118
dwarf to have this phenomenon of

883
00:36:40,769 --> 00:36:45,429
electron degeneracy and its interior

884

00:36:43,119 --> 00:36:47,970
that holds it up and then further

885
00:36:45,429 --> 00:36:50,649
collapsing there's a mass limit that

886
00:36:47,969 --> 00:36:53,289
Superman chandrasekar first derived in

887
00:36:50,650 --> 00:36:56,280
won the nobel prize for it's about 1.4

888
00:36:53,289 --> 00:36:59,500
times the mass of a sun so of the Sun so

889
00:36:56,280 --> 00:37:01,869
we think that stars up to maybe is

890
00:36:59,500 --> 00:37:04,420
massive is eight solar masses can lose

891
00:37:01,869 --> 00:37:08,200
enough mass to get down to that limit

892
00:37:04,420 --> 00:37:10,930
and form a white dwarf has to be 1.4

893
00:37:08,199 --> 00:37:12,460
solar masses or less so if you just have

894
00:37:10,929 --> 00:37:14,409
a single star from your white dwarf

895
00:37:12,460 --> 00:37:17,470
that's it it won't do anything else but

896
00:37:14,409 --> 00:37:19,809
in a binary system if it's either too

897
00:37:17,469 --> 00:37:23,049
wide or so that can merge and therefore

898
00:37:19,809 --> 00:37:26,559

exceed that limit of 1.4 you're going to

899

00:37:23,050 --> 00:37:28,510

get a 1a supernova or in a normal in a

900

00:37:26,559 --> 00:37:32,500

binary with a white dwarf in a normal

901

00:37:28,510 --> 00:37:34,900

star that Boris is favoring the normal

902

00:37:32,500 --> 00:37:37,510

star can lose mass and transfer it to

903

00:37:34,900 --> 00:37:38,889

the white dwarf and I thought there was

904

00:37:37,510 --> 00:37:40,480

a bit of a confusion there these these

905

00:37:38,889 --> 00:37:41,828

outbursts that we're concerned about

906

00:37:40,480 --> 00:37:44,228

these are these are

907

00:37:41,829 --> 00:37:46,359

explosions nuclear explosions there

908

00:37:44,228 --> 00:37:50,348

there are a gravitational chrétien

909

00:37:46,358 --> 00:37:52,298

events which produce an instability and

910

00:37:50,349 --> 00:37:55,479

and produces outburst of ultraviolet

911

00:37:52,298 --> 00:37:57,759

light what happens though in these

912

00:37:55,478 --> 00:38:01,868

binary systems is a phenomenon that we

913
00:37:57,759 --> 00:38:03,458
call novi and so material is transferred

914
00:38:01,869 --> 00:38:05,769
from the normal companion to the white

915
00:38:03,458 --> 00:38:07,449
dwarf gets very hot and at some point

916
00:38:05,768 --> 00:38:09,548
there is a nuclear explosion on the

917
00:38:07,449 --> 00:38:12,848
surface of the star and that produces

918
00:38:09,548 --> 00:38:16,809
nova and it ejects mass so if that

919
00:38:12,849 --> 00:38:18,489
happens before the Chandrasekhar limit

920
00:38:16,809 --> 00:38:20,499
is reached how can you ever get a

921
00:38:18,489 --> 00:38:22,358
supernova because you transfer some mass

922
00:38:20,498 --> 00:38:24,218
and there's a nova and it loses a bunch

923
00:38:22,358 --> 00:38:25,630
and then come back and over and over

924
00:38:24,219 --> 00:38:31,450
again and somebody's never known to be

925
00:38:25,630 --> 00:38:33,789
recurrent that's tip how do you transfer

926
00:38:31,449 --> 00:38:36,248
mass onto the white dwarf from what kind

927
00:38:33,789 --> 00:38:39,339
of a star and and not have it get lost

928
00:38:36,248 --> 00:38:40,988
in nova asian so that it can build up to

929
00:38:39,338 --> 00:38:44,849
exceed the Chandrasekhar limit and

930
00:38:40,989 --> 00:38:46,749
produce a supernova so that's the basic

931
00:38:44,849 --> 00:38:47,979
phenomenology that we're talking about

932
00:38:46,748 --> 00:38:49,689
here and I just thought it might be

933
00:38:47,978 --> 00:38:51,189
useful to review thought that was great

934
00:38:49,690 --> 00:38:53,858
I'm glad you did that I was something I

935
00:38:51,190 --> 00:38:55,838
tried to do periodically throughout the

936
00:38:53,858 --> 00:38:57,130
the discussion but that was a really

937
00:38:55,838 --> 00:38:58,568
good overview so thanks for that I

938
00:38:57,130 --> 00:39:01,088
appreciate it and you're absolutely

939
00:38:58,568 --> 00:39:03,369
right we need to be I hope I hope that

940
00:39:01,088 --> 00:39:06,239
clarifies some of the the Astronomy

941

00:39:03,369 --> 00:39:08,410
network that we're dealing with here so

942
00:39:06,239 --> 00:39:09,789
we're still working on the results

943
00:39:08,409 --> 00:39:13,629
you're still analyzing the data that

944
00:39:09,789 --> 00:39:16,209
everybody took and presumably all of the

945
00:39:13,630 --> 00:39:18,608
data are in good shape and the Hubble

946
00:39:16,208 --> 00:39:21,278
wasn't blinded by any of this thanks to

947
00:39:18,608 --> 00:39:24,130
the amateurs so let me go to some of the

948
00:39:21,278 --> 00:39:30,699
questions here that I'm seeing on the

949
00:39:24,130 --> 00:39:32,170
Q&A app let's see I want to go how can a

950
00:39:30,699 --> 00:39:35,499
telescope measure and this is from

951
00:39:32,170 --> 00:39:38,318
pardieu matamata poly I believe I

952
00:39:35,498 --> 00:39:40,419
forgive me if I'm miss mispronouncing

953
00:39:38,318 --> 00:39:42,998
this is from the Q&A app how can a

954
00:39:40,420 --> 00:39:46,209
telescope measure the distance of a far

955
00:39:42,998 --> 00:39:48,338

celestial body from us telescope

956

00:39:46,208 --> 00:39:52,748

receives light from the body and the

957

00:39:48,338 --> 00:39:54,759

image of the body is magnified how then

958

00:39:52,748 --> 00:39:55,750

how can it measure the distance so how

959

00:39:54,759 --> 00:39:57,519

do we know the distance

960

00:39:55,750 --> 00:40:00,849

two things I mean how can a telescope

961

00:39:57,519 --> 00:40:02,079

tell us this and I'll give that to let's

962

00:40:00,849 --> 00:40:04,509

go with you boys can you give us a

963

00:40:02,079 --> 00:40:07,269

little oak and take that on yeah okay I

964

00:40:04,510 --> 00:40:10,420

can I can give it a try so besides

965

00:40:07,269 --> 00:40:11,949

besides collecting more light than you

966

00:40:10,420 --> 00:40:14,800

can collect with your eye or your

967

00:40:11,949 --> 00:40:16,599

binocular telescope can measure very

968

00:40:14,800 --> 00:40:19,030

very accurately the position of a star

969

00:40:16,599 --> 00:40:21,420

in the sky and so you have to imagine

970
00:40:19,030 --> 00:40:25,480
that as the earth goes around the Sun

971
00:40:21,420 --> 00:40:28,420
the apparent position on of the nearby

972
00:40:25,480 --> 00:40:29,740
start changes because of our emotions

973
00:40:28,420 --> 00:40:32,409
are basically if you look at the sky

974
00:40:29,739 --> 00:40:34,239
that star that you are looking at wood

975
00:40:32,409 --> 00:40:37,119
over the course of a year describe a

976
00:40:34,239 --> 00:40:40,029
little circle a little elliptical little

977
00:40:37,119 --> 00:40:41,380
lips on the sky so it looks like the

978
00:40:40,030 --> 00:40:43,780
stars moving but that's just the

979
00:40:41,380 --> 00:40:46,300
reflection of the earth moving your

980
00:40:43,780 --> 00:40:48,580
telescope moving and so that's what we

981
00:40:46,300 --> 00:40:51,550
call the parallax motion of stars and

982
00:40:48,579 --> 00:40:53,529
from that through basic trigonometry you

983
00:40:51,550 --> 00:40:56,769
can calculate the distance if you

984
00:40:53,530 --> 00:41:00,519
measure the size of that parallax Alex

985
00:40:56,769 --> 00:41:01,809
motion now to do that you need to

986
00:41:00,519 --> 00:41:04,119
measure the position very very

987
00:41:01,809 --> 00:41:05,409
accurately and if you try to get from

988
00:41:04,119 --> 00:41:07,329
the ground you are a little bit in

989
00:41:05,409 --> 00:41:09,969
trouble because the earth atmosphere is

990
00:41:07,329 --> 00:41:12,549
turbulent and blurs the images of the

991
00:41:09,969 --> 00:41:15,129
stars and so you are limited to heart

992
00:41:12,550 --> 00:41:16,690
rate you can measure the position and

993
00:41:15,130 --> 00:41:19,960
that means from the ground you can

994
00:41:16,690 --> 00:41:23,769
measure parallaxes to a few hundred

995
00:41:19,960 --> 00:41:26,260
light years at most and if you want to

996
00:41:23,769 --> 00:41:28,630
measure distances of styles that are

997
00:41:26,260 --> 00:41:30,490
further away an hour making way then you

998

00:41:28,630 --> 00:41:32,860
need to have telescopes in space that

999
00:41:30,489 --> 00:41:34,629
are above the atmosphere and can measure

1000
00:41:32,860 --> 00:41:37,030
the position much more accurately than

1001
00:41:34,630 --> 00:41:39,010
you can do from the ground very awesome

1002
00:41:37,030 --> 00:41:40,570
glad we worked at in perfect so there

1003
00:41:39,010 --> 00:41:44,740
you go that's what parallax is and i

1004
00:41:40,570 --> 00:41:46,720
hears from hamza arshad also from the

1005
00:41:44,739 --> 00:41:49,059
Q&A app i can't select these questions

1006
00:41:46,719 --> 00:41:51,849
unfortunately otherwise i bring them

1007
00:41:49,059 --> 00:41:54,519
make them prominent i am a student in

1008
00:41:51,849 --> 00:41:56,289
birmingham met i think it says it says

1009
00:41:54,519 --> 00:41:58,929
neat Boris actually but I think instead

1010
00:41:56,289 --> 00:42:00,639
of met Boris actually I was on I was

1011
00:41:58,929 --> 00:42:03,099
wondering what is the Chandrasekhar

1012
00:42:00,639 --> 00:42:05,019

limit now Nolan touched on this very

1013

00:42:03,099 --> 00:42:08,230

briefly about this idea of electron

1014

00:42:05,019 --> 00:42:09,489

degeneracy anybody want to give a real

1015

00:42:08,230 --> 00:42:13,059

brief answer on what

1016

00:42:09,489 --> 00:42:16,000

that might be and how about you know

1017

00:42:13,059 --> 00:42:18,309

then you gave a pretty good summary

1018

00:42:16,000 --> 00:42:19,750

before tell us about what is she under

1019

00:42:18,309 --> 00:42:23,170

say car lemon I mean what in electron

1020

00:42:19,750 --> 00:42:28,050

degeneracy sure at a very high level I'm

1021

00:42:23,170 --> 00:42:33,250

sure Boris give a far more physical

1022

00:42:28,050 --> 00:42:36,340

explanation but at a high level you know

1023

00:42:33,250 --> 00:42:39,429

it you have to go back really to what a

1024

00:42:36,340 --> 00:42:42,900

star is and star formation a star is a

1025

00:42:39,429 --> 00:42:48,730

huge mass of gas in balance between

1026

00:42:42,900 --> 00:42:50,410

gravity inward and and the pressure from

1027
00:42:48,730 --> 00:42:54,159
the nuclear reactions and its interior

1028
00:42:50,409 --> 00:42:55,690
outward and but at some point the fuel

1029
00:42:54,159 --> 00:42:58,480
that it's burning is going to get used

1030
00:42:55,690 --> 00:43:01,420
up and the gravity will never go away

1031
00:42:58,480 --> 00:43:04,840
it's always there but when the nuclear

1032
00:43:01,420 --> 00:43:06,849
reactions and the pressure and stopped

1033
00:43:04,840 --> 00:43:10,420
because the fuels used up then there's a

1034
00:43:06,849 --> 00:43:12,279
problem and so their various outcomes of

1035
00:43:10,420 --> 00:43:14,680
this problem depending on what the

1036
00:43:12,280 --> 00:43:16,359
initial mass of the star was and we're

1037
00:43:14,679 --> 00:43:19,149
talking here about the relatively low

1038
00:43:16,358 --> 00:43:21,940
mass stars with initial mass is less

1039
00:43:19,150 --> 00:43:25,059
than about eight solar masses and they

1040
00:43:21,940 --> 00:43:29,440
have a solution which is fairly quiet

1041
00:43:25,059 --> 00:43:31,779
sent they can lose enough mass from

1042
00:43:29,440 --> 00:43:34,750
their outer layers to get down to or

1043
00:43:31,780 --> 00:43:38,050
below this one point for solar mass

1044
00:43:34,750 --> 00:43:39,969
limit in the core and form a white dwarf

1045
00:43:38,050 --> 00:43:43,420
and that's a stable configuration that

1046
00:43:39,969 --> 00:43:45,309
will never do anything else if nothing

1047
00:43:43,420 --> 00:43:47,829
else happens to it it will just cool off

1048
00:43:45,309 --> 00:43:51,608
and sit there forever and become a cold

1049
00:43:47,829 --> 00:43:52,779
dark cinder in in space right it's

1050
00:43:51,608 --> 00:43:54,369
important to point up in a point not

1051
00:43:52,780 --> 00:43:56,460
burning your not shining in any way

1052
00:43:54,369 --> 00:43:59,108
other than der the energy from the

1053
00:43:56,460 --> 00:44:01,059
compression I guess right no there there

1054
00:43:59,108 --> 00:44:02,579
shining the way that we see there the

1055

00:44:01,059 --> 00:44:05,409
shiny because they're still hot from the

1056
00:44:02,579 --> 00:44:06,759
the nuclear burning phase and there but

1057
00:44:05,409 --> 00:44:09,279
they're just cooling down so they're

1058
00:44:06,760 --> 00:44:14,140
cooling curves and all of this is pretty

1059
00:44:09,280 --> 00:44:17,260
well understood so they're they're just

1060
00:44:14,139 --> 00:44:19,569
shining by releasing the the heat the

1061
00:44:17,260 --> 00:44:21,220
thermal energy that heated them up in

1062
00:44:19,570 --> 00:44:22,990
the first place and they don't have any

1063
00:44:21,219 --> 00:44:23,359
way to produce any more energy so that's

1064
00:44:22,989 --> 00:44:25,939
why

1065
00:44:23,360 --> 00:44:28,490
just become cold dead cinders now

1066
00:44:25,940 --> 00:44:32,630
electron degeneracy is a very

1067
00:44:28,489 --> 00:44:36,500
interesting physical phenomenon that was

1068
00:44:32,630 --> 00:44:38,750
discovered by chandrasekhara there's

1069
00:44:36,500 --> 00:44:41,119

that we have a very nearby star Sirius

1070

00:44:38,750 --> 00:44:43,550

the brightest star in the sky and it has

1071

00:44:41,119 --> 00:44:44,839

a white dwarf companion and it's far

1072

00:44:43,550 --> 00:44:46,760

enough away and the stars close enough

1073

00:44:44,840 --> 00:44:49,610

we can actually resolve them visually

1074

00:44:46,760 --> 00:44:53,930

and he was concerned about what this

1075

00:44:49,610 --> 00:44:56,599

very hot dim star was it was a companion

1076

00:44:53,929 --> 00:44:59,419

to Sirius as a normal a star big bright

1077

00:44:56,599 --> 00:45:02,779

thing but here's this little a hot thing

1078

00:44:59,420 --> 00:45:04,250

and which is much hotter than serious

1079

00:45:02,780 --> 00:45:05,810

and at the time John just like our work

1080

00:45:04,250 --> 00:45:08,449

there was no explanation for such an

1081

00:45:05,809 --> 00:45:11,360

object it seemed impossible and he

1082

00:45:08,449 --> 00:45:14,179

derived this solution that the thing has

1083

00:45:11,360 --> 00:45:19,480

become as the core has condensed and

1084
00:45:14,179 --> 00:45:22,789
become so dense the a white dwarf as

1085
00:45:19,480 --> 00:45:24,110
Boris said is a massive sixty percent

1086
00:45:22,789 --> 00:45:26,239
eighty percent up to the Chandrasekhar

1087
00:45:24,110 --> 00:45:28,849
limit of the Sun but in a volume equal

1088
00:45:26,239 --> 00:45:31,159
to the size of the earth so the density

1089
00:45:28,849 --> 00:45:33,639
inside is huge and at these densities

1090
00:45:31,159 --> 00:45:36,500
what changes sake I realized is that

1091
00:45:33,639 --> 00:45:39,429
electrons no longer belong to individual

1092
00:45:36,500 --> 00:45:43,219
nuclei there's just a sea of electrons

1093
00:45:39,429 --> 00:45:44,989
in this object and the nuclei are all

1094
00:45:43,219 --> 00:45:47,179
separate the new the electrons were kind

1095
00:45:44,989 --> 00:45:49,909
of all shared and that's what electron

1096
00:45:47,179 --> 00:45:53,809
degeneracy means and there is this is a

1097
00:45:49,909 --> 00:45:56,119
stable quasi like solid or quasi

1098
00:45:53,809 --> 00:45:58,429
crystalline state they will hold up the

1099
00:45:56,119 --> 00:46:00,579
the remnants of this star this core

1100
00:45:58,429 --> 00:46:02,449
forever against the force of gravity

1101
00:46:00,579 --> 00:46:04,699
yeah I've always I've always

1102
00:46:02,449 --> 00:46:06,439
oversimplified it by imagining this star

1103
00:46:04,699 --> 00:46:08,899
where the all of the electrons are

1104
00:46:06,440 --> 00:46:10,340
squished so tightly together that

1105
00:46:08,900 --> 00:46:11,900
they're not like you say they're not

1106
00:46:10,340 --> 00:46:13,640
part of an individual atom anymore

1107
00:46:11,900 --> 00:46:15,320
they're just there's just no more space

1108
00:46:13,639 --> 00:46:17,449
there and they're all kind of tightly

1109
00:46:15,320 --> 00:46:20,900
packed into this sort way as you said

1110
00:46:17,449 --> 00:46:22,759
maybe a crystal and kind of structure

1111
00:46:20,900 --> 00:46:24,349
not really but and just kind of wrap

1112

00:46:22,760 --> 00:46:25,940
that up so there we have this white Dwarf

1113
00:46:24,349 --> 00:46:27,650
then so to just sit there forever but if

1114
00:46:25,940 --> 00:46:29,929
you have some mechanism of dumping more

1115
00:46:27,650 --> 00:46:31,579
material onto it or merging two of them

1116
00:46:29,929 --> 00:46:33,199
such that you exceed that one point four

1117
00:46:31,579 --> 00:46:35,098
solar mass limit then you're going to

1118
00:46:33,199 --> 00:46:37,318
get a 1a supernova

1119
00:46:35,099 --> 00:46:38,609
and there you go so thank good quite

1120
00:46:37,318 --> 00:46:41,068
good job that was that was a tough

1121
00:46:38,608 --> 00:46:43,380
concept so I hope that made a lot of

1122
00:46:41,068 --> 00:46:45,478
sense i find that these my favorite

1123
00:46:43,380 --> 00:46:47,700
thing about it is you can you can you

1124
00:46:45,478 --> 00:46:49,048
can always use the word degenerate now

1125
00:46:47,699 --> 00:46:53,608
in astronomy and have it have been

1126
00:46:49,048 --> 00:46:57,809

something good and now that's also true

1127

00:46:53,608 --> 00:46:59,998

/ GG generous II so um okay so there was

1128

00:46:57,809 --> 00:47:01,829

a question here I wanted to get to a

1129

00:46:59,998 --> 00:47:03,268

little a comment from Russell Bateman

1130

00:47:01,829 --> 00:47:06,059

this was to you Carol this is off topic

1131

00:47:03,268 --> 00:47:08,879

he says but is that 3d printing going on

1132

00:47:06,059 --> 00:47:11,130

in the background yes it's 3d printing

1133

00:47:08,880 --> 00:47:14,130

going on in the background we have a

1134

00:47:11,130 --> 00:47:15,778

project to create objects with a 3d

1135

00:47:14,130 --> 00:47:19,950

printer actually for the visually

1136

00:47:15,778 --> 00:47:22,889

impaired and unfortunately because the

1137

00:47:19,949 --> 00:47:25,228

printers in my office the intern sets up

1138

00:47:22,889 --> 00:47:28,469

the job and it runs for seven hours and

1139

00:47:25,228 --> 00:47:30,899

there's nothing I can help you with that

1140

00:47:28,469 --> 00:47:33,598

send it on over my way and I'll take

1141
00:47:30,900 --> 00:47:36,088
care of it it's trying to make a galaxy

1142
00:47:33,599 --> 00:47:38,970
only a really big one in fluorescent

1143
00:47:36,088 --> 00:47:41,639
orange and we put textures on them so

1144
00:47:38,969 --> 00:47:44,218
they can feel what it feels like since

1145
00:47:41,639 --> 00:47:46,228
they can't see the images we haven't

1146
00:47:44,219 --> 00:47:48,650
figured out how to make a white dwarf or

1147
00:47:46,228 --> 00:47:51,960
a cosmic Cataclysm prepared oh boy yeah

1148
00:47:48,650 --> 00:47:57,719
because one of the spheres would would

1149
00:47:51,960 --> 00:47:59,309
do the surrogate for what yeah well

1150
00:47:57,719 --> 00:48:02,309
there you go that's really cool printer

1151
00:47:59,309 --> 00:48:04,920
to either so many apologies for the

1152
00:48:02,309 --> 00:48:06,539
noise no it's great it's a we knew I

1153
00:48:04,920 --> 00:48:08,969
should have a can hang out on that as a

1154
00:48:06,539 --> 00:48:12,299
3d printing and used as an astronomy so

1155
00:48:08,969 --> 00:48:14,608
a manual conceal I believe is how you

1156
00:48:12,298 --> 00:48:16,798
pronounce his last name was pointing out

1157
00:48:14,608 --> 00:48:19,078
that observation campaigns past and

1158
00:48:16,798 --> 00:48:21,748
current for pro-am collaboration are

1159
00:48:19,079 --> 00:48:24,089
available on the absa website and he

1160
00:48:21,748 --> 00:48:26,338
says it said ave so org slash observing

1161
00:48:24,088 --> 00:48:30,509
dash campaigns so you can get a sense of

1162
00:48:26,338 --> 00:48:32,578
what's going on already uh right Arnie

1163
00:48:30,509 --> 00:48:34,259
so you can kind of already get an

1164
00:48:32,579 --> 00:48:39,329
overview of what's what's being done

1165
00:48:34,259 --> 00:48:40,920
with in-app so maybe so okay so I have

1166
00:48:39,329 --> 00:48:43,019
well that brings up a point I had a

1167
00:48:40,920 --> 00:48:45,659
question about the observation that were

1168
00:48:43,018 --> 00:48:48,358
they were taking the art oh and Gordon

1169

00:48:45,659 --> 00:48:49,440
were doing for Boris was there a lot of

1170
00:48:48,358 --> 00:48:52,650
communication

1171
00:48:49,440 --> 00:48:55,710
among you like oh I observed it in its

1172
00:48:52,650 --> 00:48:58,500
blah blah you know magnitude and report

1173
00:48:55,710 --> 00:49:02,639
or do you use basically send things to

1174
00:48:58,500 --> 00:49:04,769
Boris and to the aavso for further

1175
00:49:02,639 --> 00:49:06,960
processing so how much communication in

1176
00:49:04,769 --> 00:49:10,440
these companion campaigns goes on

1177
00:49:06,960 --> 00:49:13,440
between the APS all members yeah maybe

1178
00:49:10,440 --> 00:49:16,349
report and then our token could explain

1179
00:49:13,440 --> 00:49:18,780
that yeah primarily it was by submitting

1180
00:49:16,349 --> 00:49:20,220
the data to the aavso website so it was

1181
00:49:18,780 --> 00:49:22,290
kind of an indirect communication like

1182
00:49:20,219 --> 00:49:24,959
with our tow and others now when things

1183
00:49:22,289 --> 00:49:26,818

got really kind of critical the last 24

1184

00:49:24,960 --> 00:49:28,588

hours then there were occasional emails

1185

00:49:26,818 --> 00:49:30,449

going back and forth between us directly

1186

00:49:28,588 --> 00:49:35,099

is that everybody was trying to get the

1187

00:49:30,449 --> 00:49:39,449

app duration that the HST needed yeah

1188

00:49:35,099 --> 00:49:44,670

that's on top of it and and do you do

1189

00:49:39,449 --> 00:49:46,858

you both join campaigns regularly yeah I

1190

00:49:44,670 --> 00:49:48,510

mean I in my case yeah I do mean to me

1191

00:49:46,858 --> 00:49:50,549

that's the enjoyment of the amateur

1192

00:49:48,510 --> 00:49:52,380

astronomy I think people go one of two

1193

00:49:50,550 --> 00:49:55,380

ways in amateur astronomy the beautiful

1194

00:49:52,380 --> 00:49:56,670

photographs or science support and my

1195

00:49:55,380 --> 00:50:00,568

particular Vance working with the

1196

00:49:56,670 --> 00:50:06,180

scientists and how are you are tell you

1197

00:50:00,568 --> 00:50:08,190

is that the staple simple me great thank

1198
00:50:06,179 --> 00:50:10,169
you all right so christian alexander we

1199
00:50:08,190 --> 00:50:13,349
durer is asking where in this maybe

1200
00:50:10,170 --> 00:50:15,838
maybe Nolan you know or Carol where can

1201
00:50:13,349 --> 00:50:19,500
I find an overview about all HST

1202
00:50:15,838 --> 00:50:21,480
observation orders or any statistics

1203
00:50:19,500 --> 00:50:23,608
about the observations and also about

1204
00:50:21,480 --> 00:50:25,050
the usage of color filters things like

1205
00:50:23,608 --> 00:50:28,619
that is there a place people can go to

1206
00:50:25,050 --> 00:50:32,849
see where HST is about to observe yes

1207
00:50:28,619 --> 00:50:36,150
actually I just looked it up and you can

1208
00:50:32,849 --> 00:50:38,359
go to the website which i will tell you

1209
00:50:36,150 --> 00:50:42,990
but you can also do a google search on

1210
00:50:38,358 --> 00:50:45,809
HST observing programs and there is a

1211
00:50:42,989 --> 00:50:48,209
page that talks about the programs that

1212
00:50:45,809 --> 00:50:49,889
are in the queue for the week nolan

1213
00:50:48,210 --> 00:50:52,068
talked about that there's a queue built

1214
00:50:49,889 --> 00:50:56,489
for week so you can actually look at the

1215
00:50:52,068 --> 00:51:00,239
observations for week and then we we

1216
00:50:56,489 --> 00:51:02,919
have this process where every year we

1217
00:51:00,239 --> 00:51:06,219
have proposals like boris and others

1218
00:51:02,920 --> 00:51:08,559
put in a proposal to get time on HST and

1219
00:51:06,219 --> 00:51:11,588
then their peer reviewed and the

1220
00:51:08,559 --> 00:51:14,290
calendar then those proposals that one

1221
00:51:11,588 --> 00:51:16,078
are published as well and all of those

1222
00:51:14,289 --> 00:51:19,750
are through the Hubble Space Telescope

1223
00:51:16,079 --> 00:51:22,359
mission office web page which is from

1224
00:51:19,750 --> 00:51:28,389
the Space Telescope page so i will say

1225
00:51:22,358 --> 00:51:30,969
it slowly and it's ww course got stsci

1226

00:51:28,389 --> 00:51:34,838
which stands for Space Telescope Science

1227
00:51:30,969 --> 00:51:37,118
Institute edu and if you go to that page

1228
00:51:34,838 --> 00:51:39,489
and you look under missions there's a

1229
00:51:37,119 --> 00:51:43,119
chesty mission and all the things about

1230
00:51:39,489 --> 00:51:46,750
this the observations in what's called

1231
00:51:43,119 --> 00:51:49,240
cycle 21 cycle 22 was just peer reviewed

1232
00:51:46,750 --> 00:51:51,010
and that will be published soon all the

1233
00:51:49,239 --> 00:51:54,368
previous cycles of things that have been

1234
00:51:51,010 --> 00:51:56,230
observed um we of course have our press

1235
00:51:54,369 --> 00:51:58,329
releases that highlight some of the

1236
00:51:56,230 --> 00:52:01,329
discoveries and then there is the

1237
00:51:58,329 --> 00:52:03,190
schedule that says HST program for the

1238
00:52:01,329 --> 00:52:06,880
week post or you can see what's

1239
00:52:03,190 --> 00:52:09,159
happening or back where the week so all

1240
00:52:06,880 --> 00:52:11,950

that information is out there for you to

1241

00:52:09,159 --> 00:52:15,578

peruse youngest on over there yeah

1242

00:52:11,949 --> 00:52:17,169

fighting an astronomer okay so I want to

1243

00:52:15,579 --> 00:52:18,789

respond to one comment I'm staying on

1244

00:52:17,170 --> 00:52:20,710

here about that there aren't any there

1245

00:52:18,789 --> 00:52:22,269

aren't any answered questions showing up

1246

00:52:20,710 --> 00:52:24,940

under the Q&A app and the reason for

1247

00:52:22,269 --> 00:52:27,880

that is I have I don't have the ability

1248

00:52:24,940 --> 00:52:30,010

to select them i am not running the

1249

00:52:27,880 --> 00:52:31,690

running the Hangout so i don't get the

1250

00:52:30,010 --> 00:52:33,309

ability to actually choose which

1251

00:52:31,690 --> 00:52:35,679

questions but we are answering questions

1252

00:52:33,309 --> 00:52:37,119

right now I just can't select them and

1253

00:52:35,679 --> 00:52:38,798

have them be highlighted now I'm going

1254

00:52:37,119 --> 00:52:41,500

to work with Elena on fixing that next

1255
00:52:38,798 --> 00:52:44,679
week so I just want to let people know

1256
00:52:41,500 --> 00:52:49,139
that that is we are answering questions

1257
00:52:44,679 --> 00:52:52,149
so so that was good so let's see um

1258
00:52:49,139 --> 00:52:53,920
let's see well finally we'll take let me

1259
00:52:52,150 --> 00:52:57,329
Scott am I missing any on do you have

1260
00:52:53,920 --> 00:52:59,230
you been looking by any chance at the

1261
00:52:57,329 --> 00:53:02,230
comment tracker I've been looking

1262
00:52:59,230 --> 00:53:04,599
primarily at the and a lot of our stuff

1263
00:53:02,230 --> 00:53:05,949
is in the Q&A app oh there I am blowing

1264
00:53:04,599 --> 00:53:12,789
up the Hubble hanging out twitter feed

1265
00:53:05,949 --> 00:53:14,828
so go Twitter awesome great so let me

1266
00:53:12,789 --> 00:53:16,090
check that real quick and oh you are

1267
00:53:14,829 --> 00:53:18,690
look at all that great job

1268
00:53:16,090 --> 00:53:22,870
um so Q and a nap has been fantastic

1269
00:53:18,690 --> 00:53:24,010
yeah using it yeah so that's been the

1270
00:53:22,869 --> 00:53:27,489
primary way people have been interacting

1271
00:53:24,010 --> 00:53:29,710
with us so thank you guys for that is so

1272
00:53:27,489 --> 00:53:33,039
where are we going for here what's next

1273
00:53:29,710 --> 00:53:35,409
Oh Morris left um hmm okay I'm staying

1274
00:53:33,039 --> 00:53:37,329
here well you're their own thing I

1275
00:53:35,409 --> 00:53:39,250
thought you dropped out yeah I dropped

1276
00:53:37,329 --> 00:53:41,679
off but I joined again oh good good so

1277
00:53:39,250 --> 00:53:43,239
what's next where are you just going to

1278
00:53:41,679 --> 00:53:48,039
keep analyzing data or do you have any

1279
00:53:43,239 --> 00:53:50,139
what we tell us what to look for uh well

1280
00:53:48,039 --> 00:53:54,070
so so will be will be busy with that

1281
00:53:50,139 --> 00:53:56,170
data set for a while um I've got I've

1282
00:53:54,070 --> 00:53:58,269
got some other agency programs but

1283

00:53:56,170 --> 00:53:59,500
nothing on nothing on exploding white

1284
00:53:58,269 --> 00:54:03,099
dwarfs oh that's that's a completely

1285
00:53:59,500 --> 00:54:05,289
different story there okay Morris is one

1286
00:54:03,099 --> 00:54:09,099
of our most successful Hubble proposal

1287
00:54:05,289 --> 00:54:10,840
proposers and he's every cycle he's on

1288
00:54:09,099 --> 00:54:12,639
multiple proposals I don't know how many

1289
00:54:10,840 --> 00:54:15,160
for this cycle but I know it's more than

1290
00:54:12,639 --> 00:54:16,839
if more than two or three that's a good

1291
00:54:15,159 --> 00:54:18,309
point I mean he got a hundred and twenty

1292
00:54:16,840 --> 00:54:20,170
two orbits for this particular that's a

1293
00:54:18,309 --> 00:54:23,559
lot of time that's a long got another

1294
00:54:20,170 --> 00:54:27,849
ones as well so how many are you on the

1295
00:54:23,559 --> 00:54:32,199
cycle Boris I think six so so long one

1296
00:54:27,849 --> 00:54:33,610
is a pinc and five SS class nice good

1297
00:54:32,199 --> 00:54:38,079

we'll have you back I can see that

1298

00:54:33,610 --> 00:54:40,570

that's busy yeah yeah so Eric charland

1299

00:54:38,079 --> 00:54:42,519

has commented that great idea Tony I'd

1300

00:54:40,570 --> 00:54:44,289

watch for sure living in a big city no

1301

00:54:42,519 --> 00:54:47,429

point in buying a big telescope you know

1302

00:54:44,289 --> 00:54:51,400

these virtual telescope idea really is

1303

00:54:47,429 --> 00:54:53,859

it's fantastic yeah i love the ID the

1304

00:54:51,400 --> 00:54:55,329

possibilities for it you can use a

1305

00:54:53,860 --> 00:54:57,760

telescope on the other side of the world

1306

00:54:55,329 --> 00:55:00,699

get your data and contribute to science

1307

00:54:57,760 --> 00:55:02,260

I mean that's um I love seeing it being

1308

00:55:00,699 --> 00:55:03,639

used this way because we use them

1309

00:55:02,260 --> 00:55:05,260

everyone smile for the virtual star

1310

00:55:03,639 --> 00:55:07,329

party so we have friends at I telescope

1311

00:55:05,260 --> 00:55:10,770

that do let us use them for the show

1312
00:55:07,329 --> 00:55:13,179
that's nice and so we did we get to see

1313
00:55:10,769 --> 00:55:15,190
we get to see amazing views from across

1314
00:55:13,179 --> 00:55:16,539
the world that's not initially from our

1315
00:55:15,190 --> 00:55:18,820
strong words that are in so seeing it

1316
00:55:16,539 --> 00:55:21,369
being used for for science in this way

1317
00:55:18,820 --> 00:55:22,870
and really you know supporting the

1318
00:55:21,369 --> 00:55:25,750
Hubble Space Telescope I mean it's

1319
00:55:22,869 --> 00:55:28,179
something that I think is fantastic with

1320
00:55:25,750 --> 00:55:29,949
people think that being able to do

1321
00:55:28,179 --> 00:55:33,159
science

1322
00:55:29,949 --> 00:55:34,419
with a space observatory is so far away

1323
00:55:33,159 --> 00:55:37,750
from them but it's something that you

1324
00:55:34,420 --> 00:55:41,170
can really take part in and it's not a

1325
00:55:37,750 --> 00:55:43,719
big threshold to get into you there's a

1326
00:55:41,170 --> 00:55:46,809
lot of resources available to let you

1327
00:55:43,719 --> 00:55:49,389
actively contribute to science of

1328
00:55:46,809 --> 00:55:52,750
content today well so you're likely not

1329
00:55:49,389 --> 00:55:55,509
expose yeah sounds like it's not yet

1330
00:55:52,750 --> 00:55:58,420
Carol d it sounds like it's a non zero

1331
00:55:55,510 --> 00:56:00,820
cost so there's there's still money in a

1332
00:55:58,420 --> 00:56:02,139
bowl and things like that there ma I

1333
00:56:00,820 --> 00:56:03,940
definitely it can get expensive

1334
00:56:02,139 --> 00:56:05,108
depending by that much time you observe

1335
00:56:03,940 --> 00:56:07,179
on the other hand if you're just

1336
00:56:05,108 --> 00:56:09,009
tracking you know a couple of stars and

1337
00:56:07,179 --> 00:56:11,769
measuring their magnitudes you know once

1338
00:56:09,010 --> 00:56:13,630
a day it's not that bad what we didn't

1339
00:56:11,769 --> 00:56:15,070
talk much about the processing I mean so

1340

00:56:13,630 --> 00:56:16,300
Scott you said people have used them on

1341
00:56:15,070 --> 00:56:18,070
virtual stark don't you have to process

1342
00:56:16,300 --> 00:56:19,359
these images they come back needing dark

1343
00:56:18,070 --> 00:56:20,619
subtractions and all kinds of things

1344
00:56:19,358 --> 00:56:24,039
right i mean you can't just throw them

1345
00:56:20,619 --> 00:56:26,588
up there is that true as some of them

1346
00:56:24,039 --> 00:56:28,210
that we use with I telescope have just

1347
00:56:26,588 --> 00:56:30,039
used regular color cameras so we haven't

1348
00:56:28,210 --> 00:56:31,389
used any of the scientific data coming

1349
00:56:30,039 --> 00:56:33,608
through it we're just using the

1350
00:56:31,389 --> 00:56:35,529
photographs are coming down from the

1351
00:56:33,608 --> 00:56:37,358
cameras that we've used which you know

1352
00:56:35,530 --> 00:56:39,730
we have like a half meter telescope

1353
00:56:37,358 --> 00:56:41,588
which is great to use for four beautiful

1354
00:56:39,730 --> 00:56:44,409

photography I don't know about you guys

1355

00:56:41,588 --> 00:56:47,469

with with your scientific observations

1356

00:56:44,409 --> 00:56:49,299

what what Dad are you receiving from the

1357

00:56:47,469 --> 00:56:51,719

detector how do you process that before

1358

00:56:49,300 --> 00:56:53,680

you're sending it on to the Hubble team

1359

00:56:51,719 --> 00:56:56,348

yeah we actually get you know you

1360

00:56:53,679 --> 00:56:58,659

download all the images from the scopes

1361

00:56:56,349 --> 00:57:01,269

directly onto your laptop computer right

1362

00:56:58,659 --> 00:57:02,858

and then you process all those and get

1363

00:57:01,269 --> 00:57:05,079

the magnitude measurements and uploads

1364

00:57:02,858 --> 00:57:07,210

those back to the double a BSO website

1365

00:57:05,079 --> 00:57:11,859

so yeah that's how we get the data from

1366

00:57:07,210 --> 00:57:13,659

from the remote site I want a nap I want

1367

00:57:11,858 --> 00:57:16,150

to be able to you go out and want a nap

1368

00:57:13,659 --> 00:57:18,940

i'm gonna point it up in the sky have

1369
00:57:16,150 --> 00:57:24,579
Hubble use my stuff and I'm sure our

1370
00:57:18,940 --> 00:57:27,818
knees working on okay we're gonna I got

1371
00:57:24,579 --> 00:57:28,930
one final question it's very uh it's one

1372
00:57:27,818 --> 00:57:30,429
of the older ones and it's got two

1373
00:57:28,929 --> 00:57:33,250
pluses so I want to make sure i mention

1374
00:57:30,429 --> 00:57:35,980
it's from got new raju i'm in india

1375
00:57:33,250 --> 00:57:39,550
india is in asia asia is on earth earth

1376
00:57:35,980 --> 00:57:42,519
is in the universe universes in a galaxy

1377
00:57:39,550 --> 00:57:43,880
well other way around but where is the

1378
00:57:42,519 --> 00:57:45,349
galaxy and how long

1379
00:57:43,880 --> 00:57:47,210
has it so the gal I guess the simple

1380
00:57:45,349 --> 00:57:50,750
answer might be that the galaxy is one

1381
00:57:47,210 --> 00:57:53,690
of a much larger structure of other

1382
00:57:50,750 --> 00:57:55,670
galaxies around us we have we're in

1383
00:57:53,690 --> 00:57:57,980
something called the local group and

1384
00:57:55,670 --> 00:57:59,838
those galaxies are kind of merging some

1385
00:57:57,980 --> 00:58:01,130
in fact we're on a way of colliding with

1386
00:57:59,838 --> 00:58:02,869
one of them right now the Andromeda

1387
00:58:01,130 --> 00:58:05,930
galaxy but on a much larger scale

1388
00:58:02,869 --> 00:58:08,358
universe is composed of this structure

1389
00:58:05,929 --> 00:58:11,598
of galaxies all of which are interacting

1390
00:58:08,358 --> 00:58:13,369
in a variety of complicated ways but

1391
00:58:11,599 --> 00:58:17,000
overall the universe is also expanding

1392
00:58:13,369 --> 00:58:18,710
and accelerating so it's good to point

1393
00:58:17,000 --> 00:58:20,869
out that you start in one spot and as

1394
00:58:18,710 --> 00:58:23,088
your scale gets larger the kinds of

1395
00:58:20,869 --> 00:58:24,230
things that become important change a

1396
00:58:23,088 --> 00:58:25,369
little bit with the scale that you're

1397

00:58:24,230 --> 00:58:28,519
looking at so thank you for that

1398
00:58:25,369 --> 00:58:33,470
question and I guess guys I want to

1399
00:58:28,518 --> 00:58:36,798
thank everybody Boris Nolan art oh and

1400
00:58:33,469 --> 00:58:38,298
Gordon and everybody thank you very much

1401
00:58:36,798 --> 00:58:41,210
for joining us this was a really great

1402
00:58:38,298 --> 00:58:43,608
hangout Carol Scott awesome as always a

1403
00:58:41,210 --> 00:58:45,858
lot of fun I want to thank you guys for

1404
00:58:43,608 --> 00:58:47,239
watching we're still monitor all of

1405
00:58:45,858 --> 00:58:48,828
those channels for a while to answer

1406
00:58:47,239 --> 00:58:51,618
your questions if you still have some I

1407
00:58:48,829 --> 00:58:53,660
want to thank you all for watching next

1408
00:58:51,619 --> 00:58:56,358
week we have a Hubble hang out what's up

1409
00:58:53,659 --> 00:59:01,429
next week Carol oh you would I don't

1410
00:58:56,358 --> 00:59:04,509
know keep talking purpose because I

1411
00:59:01,429 --> 00:59:08,509

didn't have the schedule in front of me

1412

00:59:04,509 --> 00:59:12,139

maybe Scott can answer I can google that

1413

00:59:08,509 --> 00:59:15,318

is will we get my calendar you meant up

1414

00:59:12,139 --> 00:59:17,629

which is why yeah I put on spot that was

1415

00:59:15,318 --> 00:59:22,639

unfair july 17 we're gonna be talking

1416

00:59:17,630 --> 00:59:24,349

about planetary let me um lemme uh yeah

1417

00:59:22,639 --> 00:59:28,009

we're going to be looking at far-uv

1418

00:59:24,349 --> 00:59:29,450

observations using HST and so we hope

1419

00:59:28,009 --> 00:59:32,059

you'll join us for that at the same

1420

00:59:29,449 --> 00:59:34,489

bat-time say no same Hubble time same

1421

00:59:32,059 --> 00:59:37,160

Hubble channel again so that's that's

1422

00:59:34,489 --> 00:59:39,018

looking at see not only earth have

1423

00:59:37,159 --> 00:59:40,250

Aurora but the other planets in the

1424

00:59:39,018 --> 00:59:42,949

solar system and we're just going to

1425

00:59:40,250 --> 00:59:45,619

talk about that we hope you'll join us

1426
00:59:42,949 --> 00:59:47,538
and we have below and bring us your

1427
00:59:45,619 --> 00:59:49,369
questions and comments that's it for

1428
00:59:47,539 --> 00:59:54,039
this time folks thank you all for

1429
00:59:49,369 --> 00:59:54,039
watching and as always keep looking up