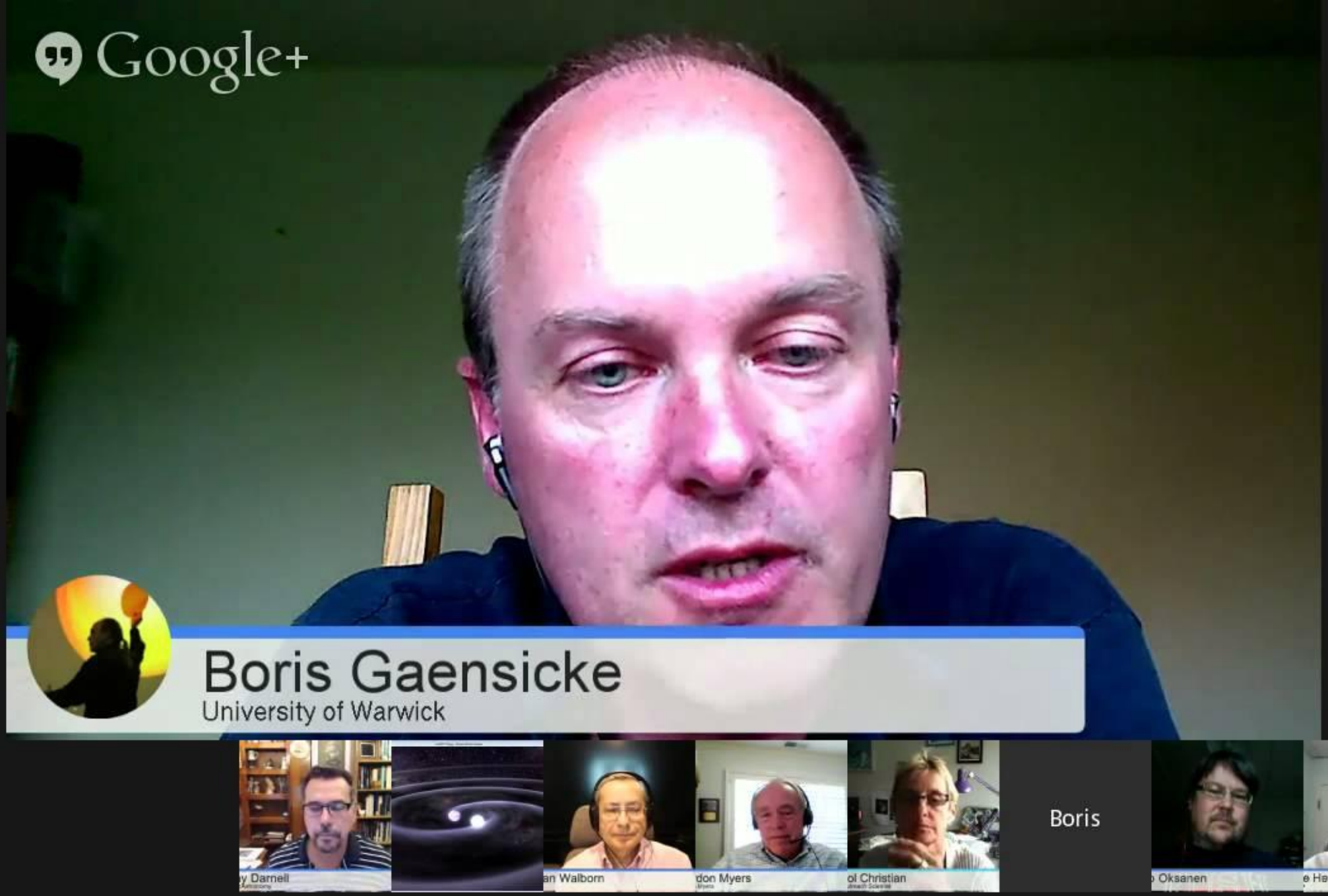
Google+
Boris Gaensicke
University of Warwick
Boris

1
00:00:05,090 --> 00:00:02,929
hello everybody and welcome to our

2
00:00:06,619 --> 00:00:05,100
latest Hubble hang out my name is Tony

3
00:00:08,690 --> 00:00:06,629
Darnell I work at the Space Telescope

4
00:00:10,520 --> 00:00:08,700
Science Institute and today we've got a

5
00:00:11,600 --> 00:00:10,530
really interesting hangout planned for

6
00:00:13,999 --> 00:00:11,610
you today we're going to be talking

7
00:00:15,640 --> 00:00:14,009
about white dwarfs clattuc cataclysmic

8
00:00:18,050 --> 00:00:15,650
variables the Hubble Space Telescope

9
00:00:22,820 --> 00:00:18,060
amateur astronomers all kinds of really

10
00:00:25,550 --> 00:00:22,830
interesting topics today and so the

11
00:00:26,689 --> 00:00:25,560
basic premise of today is the

12
00:00:28,730 --> 00:00:26,699
astronomers using the Hubble Space

13
00:00:31,609 --> 00:00:28,740

Telescope wanted to try and answer the

14
00:00:33,770 --> 00:00:31,619
question can white dwarf stars grow in

15
00:00:34,970 --> 00:00:33,780
mass among other things they live one of

16
00:00:36,850 --> 00:00:34,980
the questions they were trying to answer

17
00:00:40,310 --> 00:00:36,860
and today we're going to explore that

18
00:00:42,410 --> 00:00:40,320
with me today tall weighs is my good

19
00:00:43,760 --> 00:00:42,420
friend and colleague dr. carol christian

20
00:00:46,100 --> 00:00:43,770
she's from the Space Telescope Science

21
00:00:49,100 --> 00:00:46,110
Institute also she knows about all

22
00:00:50,750 --> 00:00:49,110
things Hubble and she's going to be

23
00:00:52,459 --> 00:00:50,760
helping me with this discussion also is

24
00:00:55,340 --> 00:00:52,469
scott lewis from know the cosmos calm

25
00:00:58,040 --> 00:00:55,350
and he'll be he'll be on hand to help

26
00:01:00,080 --> 00:00:58,050
provide his unique perspective as well

27
00:01:02,540 --> 00:01:00,090
before I get to the introductions of our

28
00:01:04,160 --> 00:01:02,550
group today though I want to point out

29
00:01:05,750 --> 00:01:04,170
that we we hope you'll interact with us

30
00:01:08,300 --> 00:01:05,760
we hope you'll send questions already

31
00:01:09,859 --> 00:01:08,310
I'm encouraged by what I see in the Q

32
00:01:12,230 --> 00:01:09,869
and a half there's already a lot of

33
00:01:13,820 --> 00:01:12,240
things there for us to get to and we're

34
00:01:14,990 --> 00:01:13,830
going to promise we'll get to as many as

35
00:01:16,880 --> 00:01:15,000
we can throughout the course of the

36
00:01:18,920 --> 00:01:16,890
discussion but if you're wondering how

37
00:01:20,420 --> 00:01:18,930
you can interact one of them is the Q&A

38
00:01:22,789 --> 00:01:20,430

app you'll see that if you're watching

39
00:01:25,100 --> 00:01:22,799
this on youtube or on the Google+ event

40
00:01:26,870 --> 00:01:25,110
page I just type in a question or a

41
00:01:30,319 --> 00:01:26,880
comment and I will see it come up on our

42
00:01:32,480 --> 00:01:30,329
window pane also the YouTube comments

43
00:01:36,370 --> 00:01:32,490
feel free to leave a comment there you

44
00:01:39,380 --> 00:01:36,380
can tweet using the habit the hubble hat

45
00:01:40,880 --> 00:01:39,390
hubble hang out hashtag one day I'll get

46
00:01:43,550 --> 00:01:40,890
that without stumbling hey I'm

47
00:01:45,590 --> 00:01:43,560
monitoring that on as well as well as

48
00:01:47,420 --> 00:01:45,600
the Google+ event page so there's lots

49
00:01:49,370 --> 00:01:47,430
of ways for you to leave us comments

50
00:01:50,810 --> 00:01:49,380
Scott Carol and I are looking at all of

51
00:01:54,249 --> 00:01:50,820
those so we encourage you to ask us

52
00:01:59,719 --> 00:01:54,259
questions okay so today we have with us

53
00:02:02,810 --> 00:01:59,729
from the University of Warwick I we have

54
00:02:05,060 --> 00:02:02,820
dr. Boris ken sekine he was the p.i of

55
00:02:06,230 --> 00:02:05,070
the program and he will be giving us a

56
00:02:07,869 --> 00:02:06,240
background of some of the scientific

57
00:02:09,740 --> 00:02:07,879
motivations and what they were doing

58
00:02:11,240 --> 00:02:09,750
what they were trying to accomplish

59
00:02:13,530 --> 00:02:11,250
scientifically with the Hubble Space

60
00:02:15,690 --> 00:02:13,540
Telescope also dr. Norton

61
00:02:17,069 --> 00:02:15,700
in woburn also of the Space Telescope

62
00:02:19,649 --> 00:02:17,079
Science Institute he's a member of the

63
00:02:21,630 --> 00:02:19,659

cost team and the cosmic origins

64
00:02:23,309 --> 00:02:21,640
spectrograph team who was also

65
00:02:28,500 --> 00:02:23,319
responsible for various things on the

66
00:02:30,449 --> 00:02:28,510
project Alan well T is here didn't know

67
00:02:34,110 --> 00:02:30,459
he's on here I'm sorry Alan he did and

68
00:02:37,890 --> 00:02:34,120
we have got Gordon Meyer and hard oh ok

69
00:02:39,210 --> 00:02:37,900
Sonnen from the word who were too here's

70
00:02:40,949 --> 00:02:39,220
the way bourse describes him he's

71
00:02:42,660 --> 00:02:40,959
describes them as two of the most

72
00:02:45,599 --> 00:02:42,670
professional amateurs you can imagine

73
00:02:47,220 --> 00:02:45,609
from they operated remote telescopes and

74
00:02:49,349 --> 00:02:47,230
without them we would certainly have

75
00:02:53,610 --> 00:02:49,359
struggled to complete this HST program

76
00:02:56,159 --> 00:02:53,620
so welcome guys we also have Arnie

77
00:02:58,229 --> 00:02:56,169
Hendon from the American Association

78
00:03:00,089 --> 00:02:58,239
from variable star observers he was

79
00:03:01,649 --> 00:03:00,099
where he was good he was responsible for

80
00:03:06,059 --> 00:03:01,659
organizing some of the campaigns so

81
00:03:08,729 --> 00:03:06,069
welcome Arnie and um we also and I think

82
00:03:10,409 --> 00:03:08,739
that covers everybody so let's go ahead

83
00:03:12,720 --> 00:03:10,419
and get started and Boris I'd like to

84
00:03:14,520 --> 00:03:12,730
start with you as the p.i give us some

85
00:03:16,319 --> 00:03:14,530
background of what you were trying to

86
00:03:20,039 --> 00:03:16,329
accomplish with this you had been given

87
00:03:21,780 --> 00:03:20,049
a hundred and twenty-two Hubble orbits

88
00:03:23,729 --> 00:03:21,790

to accomplish what you wanted to

89
00:03:24,890 --> 00:03:23,739
accomplish so give us them give us a

90
00:03:28,949 --> 00:03:24,900
background what were you trying to do

91
00:03:30,780 --> 00:03:28,959
okay Tony so so I guess you've talked

92
00:03:33,559 --> 00:03:30,790
about type 1a supernovae and past

93
00:03:35,819 --> 00:03:33,569
hangouts which are the among the most

94
00:03:38,219 --> 00:03:35,829
powerful explosions in the universe and

95
00:03:41,849 --> 00:03:38,229
they have been used to discover dark

96
00:03:45,420 --> 00:03:41,859
energy and led to the nobel prize in

97
00:03:47,789 --> 00:03:45,430
physics in 2011 and one big problems

98
00:03:49,949 --> 00:03:47,799
that we still don't know exactly what

99
00:03:52,349 --> 00:03:49,959
kind of stars explode under what

100
00:03:55,409 --> 00:03:52,359
conditions to make a type 1a supernova

101
00:03:57,929 --> 00:03:55,419
now most most astronomers agree that

102
00:04:00,210 --> 00:03:57,939
it's probably why twelves that reach the

103
00:04:01,589 --> 00:04:00,220
so-called Chandrasekhar limit a maximum

104
00:04:03,839 --> 00:04:01,599
limit that they have and then they

105
00:04:05,879 --> 00:04:03,849
explode and that means these white

106
00:04:08,699 --> 00:04:05,889
wolves need in some way to grow in mass

107
00:04:11,969 --> 00:04:08,709
and so that was the key question we want

108
00:04:15,390 --> 00:04:11,979
to address in in one type of white walls

109
00:04:16,800 --> 00:04:15,400
in binary stars ok you just interrupt

110
00:04:18,539 --> 00:04:16,810
you very briefly for a moment here and

111
00:04:20,399 --> 00:04:18,549
say one important thing about type 1a

112
00:04:22,250 --> 00:04:20,409
supernovae that I want to make sure we

113
00:04:24,899 --> 00:04:22,260

mentioned and that is they are basically

114
00:04:26,519 --> 00:04:24,909
possible yard sticks they are very

115
00:04:27,120 --> 00:04:26,529
important for measuring how far away

116
00:04:29,670 --> 00:04:27,130
things are

117
00:04:31,650 --> 00:04:29,680
in the universe because they when they

118
00:04:33,300 --> 00:04:31,660
do explode they explode with an own

119
00:04:35,100 --> 00:04:33,310
intrinsic brightness and that is a

120
00:04:37,770 --> 00:04:35,110
brightness that they would be if they

121
00:04:39,630 --> 00:04:37,780
were right next to us and if we see how

122
00:04:41,310 --> 00:04:39,640
bright they are very far away and we

123
00:04:42,690 --> 00:04:41,320
know how the light falls off a distance

124
00:04:45,270 --> 00:04:42,700
we can figure out how far they are so

125
00:04:47,820 --> 00:04:45,280
that's why type 1a supernovae are so

126
00:04:50,610 --> 00:04:47,830
important and as for said we don't know

127
00:04:52,170 --> 00:04:50,620
exactly the kinds of stars that cause

128
00:04:53,250 --> 00:04:52,180
them which which I guess surprises me

129
00:04:56,340 --> 00:04:53,260
course I thought we did have a good

130
00:04:57,930 --> 00:04:56,350
handle on that well it depends on a

131
00:04:59,820 --> 00:04:57,940
fashion that you follow a bit at the

132
00:05:01,860 --> 00:04:59,830
moment probably most people would say

133
00:05:05,180 --> 00:05:01,870
that they believe it's it's merging

134
00:05:08,070 --> 00:05:05,190
double weight loss to weight lost it

135
00:05:10,380 --> 00:05:08,080
merge together and thence exceed the

136
00:05:12,030 --> 00:05:10,390
Chandrasekhar limit but there's still

137
00:05:14,640 --> 00:05:12,040
quite a number of problems with that

138
00:05:16,470 --> 00:05:14,650

model as well so we wanted to explore an

139
00:05:20,100 --> 00:05:16,480
alternative route that may need to type

140
00:05:21,840 --> 00:05:20,110
1a supernovae and so the system that we

141
00:05:24,390 --> 00:05:21,850
were interested are called cataclysmic

142
00:05:28,020 --> 00:05:24,400
variables and in those systems you have

143
00:05:30,570 --> 00:05:28,030
a white dwarf that is accreting material

144
00:05:32,430 --> 00:05:30,580
from a relatively low mass companion

145
00:05:34,830 --> 00:05:32,440
stuff so something like the Sun or even

146
00:05:37,020 --> 00:05:34,840
less massive than the Sun and I think

147
00:05:41,930 --> 00:05:37,030
you might have a diagram on that real

148
00:05:44,430 --> 00:05:41,940
quick to put up okay here we go go ahead

149
00:05:47,190 --> 00:05:44,440
so yeah guys are just showing what what

150
00:05:48,510 --> 00:05:47,200
Boris is talking about okay so any

151
00:05:50,970 --> 00:05:48,520
contact as maghreb you have a white

152
00:05:53,520 --> 00:05:50,980
dwarf that accretes material from that

153
00:05:56,070 --> 00:05:53,530
companion star and you form an accretion

154
00:06:00,240 --> 00:05:56,080
disk of mainly hydrogen that then flows

155
00:06:02,610 --> 00:06:00,250
on to the y-12 and probably 20-30 years

156
00:06:05,070 --> 00:06:02,620
ago astronomers have excluded these kind

157
00:06:09,060 --> 00:06:05,080
of systems as potential type 1a

158
00:06:10,590 --> 00:06:09,070
progenitors because they go periodically

159
00:06:13,260 --> 00:06:10,600
through a process which is called the

160
00:06:16,290 --> 00:06:13,270
classic in nova where the hydrogen that

161
00:06:18,390 --> 00:06:16,300
flows on the surface of the y-12 starts

162
00:06:19,830 --> 00:06:18,400
to burn and then eject all the material

163
00:06:22,620 --> 00:06:19,840

that has been accreted back into space

164
00:06:25,680 --> 00:06:22,630
so if that really is true these white

165
00:06:27,900 --> 00:06:25,690
dwarfs they couldn't grow in mass yet

166
00:06:31,530 --> 00:06:27,910
there are some some question marks to

167
00:06:33,810 --> 00:06:31,540
those problems and some recent studies

168
00:06:36,300 --> 00:06:33,820
suggested well the weight loss NC in

169
00:06:38,219 --> 00:06:36,310
catechism acabas are actually more

170
00:06:41,190 --> 00:06:38,229
massive than we expected them to be and

171
00:06:43,590 --> 00:06:41,200
so that's where we initiated the

172
00:06:45,960 --> 00:06:43,600
large HST program to measure accurately

173
00:06:48,240 --> 00:06:45,970
the masses of faulty cataclysmic

174
00:06:51,210 --> 00:06:48,250
variables to have a bigger statistical

175
00:06:52,740 --> 00:06:51,220
sample on the bigger group of stars for

176
00:06:54,960 --> 00:06:52,750
which we have accurate masses and can

177
00:06:58,380 --> 00:06:54,970
learn something about the the mass

178
00:07:00,180 --> 00:06:58,390
distribution of these white walls so can

179
00:07:03,240 --> 00:07:00,190
I this cow can I just ask a quick

180
00:07:05,970 --> 00:07:03,250
question here so if there's a

181
00:07:08,310 --> 00:07:05,980
distribution of masses of these objects

182
00:07:10,980 --> 00:07:08,320
called cataclysmic variables is it

183
00:07:13,710 --> 00:07:10,990
possible that some could be supernova

184
00:07:17,880 --> 00:07:13,720
and some could be knowable or you don't

185
00:07:20,880 --> 00:07:17,890
know yet we don't know yet probably if

186
00:07:23,700 --> 00:07:20,890
if any of them become supernova it's a

187
00:07:26,280 --> 00:07:23,710
very small fraction of that type I style

188
00:07:32,310 --> 00:07:26,290

probably probably only the heaviest one

189
00:07:34,080 --> 00:07:32,320
will ever get to that point okay so you

190
00:07:36,960 --> 00:07:34,090
are looking so you wanted to see if

191
00:07:40,050 --> 00:07:36,970
these if these white dwarfs were getting

192
00:07:42,600 --> 00:07:40,060
more massive and it looked looking at

193
00:07:44,370 --> 00:07:42,610
that diagram that Scott has there I can

194
00:07:46,500 --> 00:07:44,380
already see that there are some

195
00:07:49,200 --> 00:07:46,510
challenges to actually measuring the

196
00:07:50,730 --> 00:07:49,210
white dwarf itself you want to explain

197
00:07:53,100 --> 00:07:50,740
some of the some of the real problems

198
00:07:57,000 --> 00:07:53,110
with making this observation yeah sure

199
00:07:58,650 --> 00:07:57,010
so one problem is that in these in these

200
00:08:01,770 --> 00:07:58,660
cataclysmic variables if you observe

201
00:08:03,440 --> 00:08:01,780
them at optical wavelengths so from the

202
00:08:06,090 --> 00:08:03,450
ground with a conventional telescope

203
00:08:09,480 --> 00:08:06,100
what you see is mainly the accretion

204
00:08:11,340 --> 00:08:09,490
disk and the companion star and they're

205
00:08:13,170 --> 00:08:11,350
much brighter than the y-12 at optical

206
00:08:15,000 --> 00:08:13,180
wavelengths and so you can't actually

207
00:08:17,550 --> 00:08:15,010
learn much about the white dwarf let

208
00:08:19,320 --> 00:08:17,560
alone its mass and that means if you

209
00:08:22,290 --> 00:08:19,330
want to study the way 12 you need to

210
00:08:24,750 --> 00:08:22,300
move into the ultraviolet and obtain

211
00:08:26,640 --> 00:08:24,760
observations at wavelengths that are

212
00:08:27,870 --> 00:08:26,650
like much shorter than the light that

213
00:08:29,220 --> 00:08:27,880

can penetrate through the Earth's

214
00:08:31,620 --> 00:08:29,230
atmosphere and that's where Hubble comes

215
00:08:33,839 --> 00:08:31,630
into play because Hubble is currently

216
00:08:37,230 --> 00:08:33,849
the only instrument that can do which

217
00:08:38,760 --> 00:08:37,240
are valid observations so let's bring no

218
00:08:40,230 --> 00:08:38,770
one in on this so Nolan is this where

219
00:08:43,320 --> 00:08:40,240
you took it over is this where you were

220
00:08:46,830 --> 00:08:43,330
involved with the Cubs with the with the

221
00:08:53,530 --> 00:08:49,900
that time is that very ominous yeah did

222
00:08:56,830 --> 00:08:53,540
I do that sorry it's great a cab is now

223
00:09:01,480 --> 00:08:56,840
no variable right there yeah I'm

224
00:09:04,000 --> 00:09:01,490
introduction so well yes partially I

225
00:09:05,830 --> 00:09:04,010
should I guess say deference to a

226
00:09:11,190 --> 00:09:05,840
colleague who since left and gone back

227
00:09:14,380 --> 00:09:11,200
to Italy Ilana musang she really was the

228
00:09:18,340 --> 00:09:14,390
staff contact for this program initially

229
00:09:19,780 --> 00:09:18,350
and did I would say most of the work but

230
00:09:25,110 --> 00:09:19,790
she's gone on to a different position

231
00:09:31,080 --> 00:09:27,850
the so we heard about ultraviolet and

232
00:09:33,220 --> 00:09:31,090
Hubble and the Hubble is the only

233
00:09:36,670 --> 00:09:33,230
observatory have that can do this kind

234
00:09:38,920 --> 00:09:36,680
of work that Boris want to do and so we

235
00:09:41,280 --> 00:09:38,930
have some spectrographs one of which you

236
00:09:43,900 --> 00:09:41,290
use the cosmic origins spectrograph and

237
00:09:45,430 --> 00:09:43,910
they can observe in the ultraviolet so

238
00:09:49,150 --> 00:09:45,440

they have ultraviolet sensitive

239
00:09:52,030 --> 00:09:49,160
detectors fortunately these detectors

240
00:09:56,920 --> 00:09:52,040
are very susceptible to damage and even

241
00:09:58,420 --> 00:09:56,930
destruction by / illumination and so for

242
00:10:00,040 --> 00:09:58,430
every observation we do with any of

243
00:10:02,650 --> 00:10:00,050
these detectors we have to do a very

244
00:10:05,380 --> 00:10:02,660
careful screening of the target and even

245
00:10:07,450 --> 00:10:05,390
the field around the target to make sure

246
00:10:09,220 --> 00:10:07,460
that it's safe that the cap rates won't

247
00:10:12,310 --> 00:10:09,230
be too high for the safety of the

248
00:10:14,350 --> 00:10:12,320
detectors and that's a big job that's as

249
00:10:17,080 --> 00:10:14,360
you can imagine we have thousands of

250
00:10:19,780 --> 00:10:17,090
targets a year and somebody has to do

251
00:10:21,940 --> 00:10:19,790
that for each one that's a good part of

252
00:10:26,230 --> 00:10:21,950
my time here what I do on my technical

253
00:10:27,790 --> 00:10:26,240
side so you're you're always worried

254
00:10:29,560 --> 00:10:27,800
about whether or not me people forget

255
00:10:31,990 --> 00:10:29,570
this Hubble is designed to view very

256
00:10:34,660 --> 00:10:32,000
very faint things and so even something

257
00:10:36,550 --> 00:10:34,670
reasonably bright can can do some damage

258
00:10:37,960 --> 00:10:36,560
to Hubble so do you spend a lot of your

259
00:10:41,560 --> 00:10:37,970
time worrying about things like that is

260
00:10:43,720 --> 00:10:41,570
that one of your jobs yes exactly we

261
00:10:47,830 --> 00:10:43,730
have to screen every target and we have

262
00:10:50,380 --> 00:10:47,840
software systems to help us do that too

263
00:10:52,710 --> 00:10:50,390

and Andy there is a detector for each

264
00:10:55,510 --> 00:10:52,720
config sorry a limit for each

265
00:10:58,960 --> 00:10:55,520
configuration involving a given detector

266
00:11:02,110 --> 00:10:58,970
which apertures being used filters

267
00:11:04,869 --> 00:11:02,120
whatever and we can calculate what the

268
00:11:08,170 --> 00:11:04,879
count rate will be given the input data

269
00:11:10,889 --> 00:11:08,180
about the target and so we checked that

270
00:11:14,889 --> 00:11:10,899
for everyone to make sure that it's safe

271
00:11:16,689 --> 00:11:14,899
so that was done for all of lorises

272
00:11:18,460 --> 00:11:16,699
targets and i have to say maybe semi

273
00:11:21,490 --> 00:11:18,470
humorously that that was kind of a no-no

274
00:11:24,309 --> 00:11:21,500
factor when his program arrived because

275
00:11:26,889 --> 00:11:24,319
he had 40 some of these targets and it's

276
00:11:28,900 --> 00:11:26,899
a lot of work and not only do they have

277
00:11:31,389 --> 00:11:28,910
to be screened in their question state

278
00:11:34,619 --> 00:11:31,399
which we hope and intend to observe them

279
00:11:37,600 --> 00:11:34,629
in but these objects are also subject to

280
00:11:39,579 --> 00:11:37,610
unpredictable almost instantaneous

281
00:11:41,679 --> 00:11:39,589
flares that increase the ultraviolet

282
00:11:43,449 --> 00:11:41,689
brightness by huge factor so it could be

283
00:11:45,819 --> 00:11:43,459
perfectly safe in its question state

284
00:11:47,829 --> 00:11:45,829
which we have data about and destroy the

285
00:11:51,429 --> 00:11:47,839
detector if it happened to have an

286
00:11:53,470 --> 00:11:51,439
outburst during the observation so the

287
00:11:55,300 --> 00:11:53,480
last words were told me that that could

288
00:11:57,249 --> 00:11:55,310

be on order of anywhere from three to

289
00:12:00,579 --> 00:11:57,259
seven magnitudes right I mean that

290
00:12:02,980 --> 00:12:00,589
brightness yes there's a real threat it

291
00:12:04,629 --> 00:12:02,990
is that's a huge amount and there are

292
00:12:06,759 --> 00:12:04,639
onboard safety mechanisms which are

293
00:12:08,139 --> 00:12:06,769
designed to shut that he Tector down in

294
00:12:09,699 --> 00:12:08,149
time if it detects such an over

295
00:12:14,949 --> 00:12:09,709
elimination but such a sudden huge

296
00:12:16,629 --> 00:12:14,959
increase might get through and damage

297
00:12:19,960 --> 00:12:16,639
something also if we have such a

298
00:12:22,299 --> 00:12:19,970
shutdown it fouls up the whole hubble

299
00:12:24,309 --> 00:12:22,309
schedule and things have to be redone

300
00:12:26,949 --> 00:12:24,319
and time may be lost so we want to avoid

301
00:12:28,629 --> 00:12:26,959
that well we can't predict this and so

302
00:12:30,309 --> 00:12:28,639
we can't be absolutely certain that it's

303
00:12:32,290 --> 00:12:30,319
not going to happen but we've thought

304
00:12:34,710 --> 00:12:32,300
about the statistics and how frequent

305
00:12:37,840 --> 00:12:34,720
these outbursts might be maybe centuries

306
00:12:39,280 --> 00:12:37,850
in this well it's different there

307
00:12:41,410 --> 00:12:39,290
different subcategories of these which

308
00:12:43,929 --> 00:12:41,420
Morris can tell you about I'm not an

309
00:12:49,059 --> 00:12:43,939
expert on it and but their properties

310
00:12:50,590 --> 00:12:49,069
are known and we can predict

311
00:12:52,569 --> 00:12:50,600
statistically how often these outbursts

312
00:12:54,670 --> 00:12:52,579
fight a curb but not when one is going

313
00:12:58,179 --> 00:12:54,680

to occur in a given object so the

314
00:12:59,590 --> 00:12:58,189
mechanism we settled on is to make sure

315
00:13:01,809 --> 00:12:59,600
that the object is still in its

316
00:13:04,840 --> 00:13:01,819
quiescent state and safe according to

317
00:13:10,059 --> 00:13:04,850
our screening 24 hours ahead of the

318
00:13:11,740 --> 00:13:10,069
observation and of course that requires

319
00:13:12,660 --> 00:13:11,750
a lot of work on the part of a lot of

320
00:13:14,910 --> 00:13:12,670
people and

321
00:13:16,590 --> 00:13:14,920
pudding now so let's yeah so let's get

322
00:13:18,420 --> 00:13:16,600
to that for so so part of the problem is

323
00:13:20,490 --> 00:13:18,430
you needed observations because before

324
00:13:21,990 --> 00:13:20,500
you point the Hubble anywhere you want

325
00:13:24,450 --> 00:13:22,000
to make sure that everything is still

326
00:13:26,040 --> 00:13:24,460
safe and so you're you need somebody to

327
00:13:29,280 --> 00:13:26,050
monitor these targets so all these

328
00:13:32,220 --> 00:13:29,290
targets the Boris came up with needed to

329
00:13:34,230 --> 00:13:32,230
be looked at right before you turn HST

330
00:13:36,360 --> 00:13:34,240
over and there was a system you guys put

331
00:13:38,280 --> 00:13:36,370
in place for that right and who would

332
00:13:39,990 --> 00:13:38,290
what would what Arnie would you be the

333
00:13:42,420 --> 00:13:40,000
one that coordinated those efforts are

334
00:13:45,600 --> 00:13:42,430
with that just with that be Boris I want

335
00:13:47,160 --> 00:13:45,610
someone to talk about how you who was

336
00:13:50,670 --> 00:13:47,170
doing the monitoring of these targets

337
00:13:54,630 --> 00:13:50,680
before HST was pointed well sort of a

338
00:13:56,970 --> 00:13:54,640

combination or certainly was the one who

339
00:13:59,010 --> 00:13:56,980
talked to HST to let them know the

340
00:14:02,640 --> 00:13:59,020
results of the monitoring that took

341
00:14:05,730 --> 00:14:02,650
place but I was the one who helped

342
00:14:09,210 --> 00:14:05,740
coordinate the various amateur

343
00:14:10,830 --> 00:14:09,220
activities related to that we generated

344
00:14:14,340 --> 00:14:10,840
finding charts for each one of the

345
00:14:16,110 --> 00:14:14,350
objects and then set up a campaign for

346
00:14:20,870 --> 00:14:16,120
each of the objects as they were coming

347
00:14:23,370 --> 00:14:20,880
up on the HST queue to have the amateurs

348
00:14:27,900 --> 00:14:23,380
observe these objects and monitor them

349
00:14:30,630 --> 00:14:27,910
and to ensure that they hadn't gone into

350
00:14:33,540 --> 00:14:30,640
outburst as it was mentioned the

351
00:14:34,950 --> 00:14:33,550
outburst as many magnitudes in size so

352
00:14:36,860 --> 00:14:34,960
it's really easy to see whether an

353
00:14:39,900 --> 00:14:36,870
object is in quiescence or whether it's

354
00:14:42,510 --> 00:14:39,910
far brighter than that so it's a very

355
00:14:43,880 --> 00:14:42,520
simple observation to make but it's one

356
00:14:46,020 --> 00:14:43,890
where you need to have people

357
00:14:48,300 --> 00:14:46,030
geographically distributed across the

358
00:14:50,280 --> 00:14:48,310
globe so if they can catch the opposite

359
00:14:52,860 --> 00:14:50,290
dot any kind of an outburst just as it

360
00:14:57,480 --> 00:14:52,870
starts beginning especially within that

361
00:14:59,460 --> 00:14:57,490
24-hour window that HST required so we

362
00:15:04,380 --> 00:14:59,470
enlisted the aid of a large group of

363
00:15:06,420 --> 00:15:04,390

amateurs partly from the aavso itself

364
00:15:08,520 --> 00:15:06,430
but then also the various members it

365
00:15:10,650 --> 00:15:08,530
excuse me various observers around the

366
00:15:13,110 --> 00:15:10,660
globe who also submit observations to us

367
00:15:15,180 --> 00:15:13,120
and everybody got very enthused about

368
00:15:17,400 --> 00:15:15,190
the project even though there's 40 some

369
00:15:22,320 --> 00:15:17,410
objects i mean this a lot of observing

370
00:15:24,720 --> 00:15:22,330
that has to be done but the the amateurs

371
00:15:26,130 --> 00:15:24,730
rough ford and they had observations for

372
00:15:29,910 --> 00:15:26,140
every single one of those

373
00:15:33,300 --> 00:15:29,920
targets within the time frame that HST

374
00:15:38,160 --> 00:15:33,310
required so we have Gordon Myers in our

375
00:15:40,260 --> 00:15:38,170
know oksanen here as examples of I guess

376
00:15:42,450 --> 00:15:40,270
you were two very instrumental amateurs

377
00:15:45,840 --> 00:15:42,460
and getting these observations done are

378
00:15:50,670 --> 00:15:45,850
you guys members of apps oh yes yes I am

379
00:15:52,110 --> 00:15:50,680
okay and so so do you have really do but

380
00:15:53,700 --> 00:15:52,120
do you guys have a backyard full of

381
00:15:55,050 --> 00:15:53,710
really amazing equipment or do you have

382
00:15:57,090 --> 00:15:55,060
disorder you know regular off-the-shelf

383
00:15:58,530 --> 00:15:57,100
telescopes I mean tell us tell us what

384
00:16:00,870 --> 00:15:58,540
you used and i'll start with gordon and

385
00:16:03,030 --> 00:16:00,880
then go to you or to darna yeah actually

386
00:16:06,300 --> 00:16:03,040
i was using some scopes that were

387
00:16:09,180 --> 00:16:06,310
remotely located a fairly large scope

388
00:16:12,360 --> 00:16:09,190

down in Australia and then also had

389
00:16:16,620 --> 00:16:12,370
access to a scope in New Mexico and also

390
00:16:19,110 --> 00:16:16,630
in Spain so we were often trying to now

391
00:16:21,150 --> 00:16:19,120
how to the clouds glad what how did that

392
00:16:23,160 --> 00:16:21,160
happen you don't own telescopes in all

393
00:16:25,380 --> 00:16:23,170
those areas do you know there's some

394
00:16:28,470 --> 00:16:25,390
organizations that allow you to rent

395
00:16:30,180 --> 00:16:28,480
time on telescopes by the minute and you

396
00:16:32,340 --> 00:16:30,190
can coordinate with them and get things

397
00:16:35,070 --> 00:16:32,350
scheduled so that you can you know

398
00:16:36,900 --> 00:16:35,080
observe targets at various times and

399
00:16:39,510 --> 00:16:36,910
that worked quite well other than when

400
00:16:41,130 --> 00:16:39,520
the clouds would show up or if somebody

401
00:16:42,930 --> 00:16:41,140
else already have the scope schedule but

402
00:16:44,580 --> 00:16:42,940
I think it was very enjoyable for the

403
00:16:46,740 --> 00:16:44,590
amateurs because we got a chance to

404
00:16:48,630 --> 00:16:46,750
really you know help the scientific

405
00:16:49,620 --> 00:16:48,640
observations go off on schedule and I

406
00:16:52,470 --> 00:16:49,630
think that's one of the things the

407
00:16:55,590 --> 00:16:52,480
amateurs enjoy the most now is this a is

408
00:16:57,960 --> 00:16:55,600
this like I telescope net is that yeah

409
00:17:00,240 --> 00:16:57,970
yeah was that one that's the 1i use yes

410
00:17:02,280 --> 00:17:00,250
ok yeah you're in very well I've worked

411
00:17:04,350 --> 00:17:02,290
with him the past they're fantastic yeah

412
00:17:05,550 --> 00:17:04,360
I want to have a hangout on just that

413
00:17:07,230 --> 00:17:05,560

what it's like to use some of these

414
00:17:08,400 --> 00:17:07,240
various online telescopes at some point

415
00:17:10,350 --> 00:17:08,410
in the future because I think that's a

416
00:17:12,329 --> 00:17:10,360
resource becoming more and more valuable

417
00:17:13,380 --> 00:17:12,339
and it might even be better and maybe we

418
00:17:15,600 --> 00:17:13,390
will talk about it here but it may even

419
00:17:16,860 --> 00:17:15,610
be better than buying your own scope or

420
00:17:20,100 --> 00:17:16,870
something named who knows I don't know

421
00:17:21,569 --> 00:17:20,110
but it is an interesting idea is that is

422
00:17:24,030 --> 00:17:21,579
that what you did our toes well you did

423
00:17:26,790 --> 00:17:24,040
did you do that or what did you do yeah

424
00:17:29,550 --> 00:17:26,800
I'll see you soon initely operated

425
00:17:33,030 --> 00:17:29,560
tennis coach as well also you were also

426
00:17:35,130 --> 00:17:33,040
using online telescopes yes 11 in fatal

427
00:17:36,150 --> 00:17:35,140
on other one in Chile so let me get this

428
00:17:37,350 --> 00:17:36,160
straight are you guys paying for the

429
00:17:38,910 --> 00:17:37,360
side of your own pocket you guys are

430
00:17:39,919 --> 00:17:38,920
buying this telescope time is it

431
00:17:43,100 --> 00:17:39,929
expensive

432
00:17:46,879 --> 00:17:43,110
and uh today i stopped i'm using in

433
00:17:50,600 --> 00:17:46,889
finland it it is owned by my utterly

434
00:17:54,230 --> 00:17:50,610
mchale Club to club tennis court and the

435
00:17:58,070 --> 00:17:54,240
one in Chile it's owned by a friend it's

436
00:18:00,350 --> 00:17:58,080
a private telescope but i can use point

437
00:18:01,730 --> 00:18:00,360
three any of it man amateur astronomy

438
00:18:04,430 --> 00:18:01,740

has sure changed since i was doing and I

439
00:18:06,529 --> 00:18:04,440
know that it's like the the Internet has

440
00:18:08,450 --> 00:18:06,539
made everything possible nobody who need

441
00:18:11,480 --> 00:18:08,460
no such thing as a cloudy night anymore

442
00:18:13,759 --> 00:18:11,490
just go to another part in the world is

443
00:18:17,509 --> 00:18:13,769
card to a question then so so you

444
00:18:19,820 --> 00:18:17,519
haven't estranha then and and you own

445
00:18:21,859 --> 00:18:19,830
one telescope or several telescopes and

446
00:18:23,539 --> 00:18:21,869
then you have to make the case you have

447
00:18:26,619 --> 00:18:23,549
to kind of proposed to your group hey I

448
00:18:29,749 --> 00:18:26,629
want to go that's my recollection yeah

449
00:18:36,379 --> 00:18:29,759
we don't have too many observers but be

450
00:18:41,930 --> 00:18:36,389
okay founded on our personal right Sarah

451
00:18:44,629 --> 00:18:41,940
so first common with basically nice okay

452
00:18:46,310 --> 00:18:44,639
so Boris how hard was it to coordinate

453
00:18:48,320 --> 00:18:46,320
all of this I mean now you're you're

454
00:18:49,759 --> 00:18:48,330
getting ready to look at the point the

455
00:18:51,109 --> 00:18:49,769
Hubble somewhere you don't know if it's

456
00:18:52,609 --> 00:18:51,119
scary or not you don't know if you're

457
00:18:56,090 --> 00:18:52,619
going to burn out detectors and you and

458
00:18:57,409 --> 00:18:56,100
Nolan her you know making sure how what

459
00:18:58,850 --> 00:18:57,419
was that like give us a sense of what

460
00:19:03,220 --> 00:18:58,860
that was like to get all that put

461
00:19:05,539 --> 00:19:03,230
together it was frightening because

462
00:19:09,409 --> 00:19:05,549
because this these systems they're

463
00:19:11,480 --> 00:19:09,419

unpredictable as Nolan said we

464
00:19:14,359 --> 00:19:11,490
statistically we can tell how often the

465
00:19:16,070 --> 00:19:14,369
outburst saw every three month every six

466
00:19:19,820 --> 00:19:16,080
months but you never know they could be

467
00:19:21,919 --> 00:19:19,830
tomorrow and so every single time that I

468
00:19:24,830 --> 00:19:21,929
got an email that the next edges the

469
00:19:26,659 --> 00:19:24,840
observation is scheduled I would get in

470
00:19:28,749 --> 00:19:26,669
touch with Arnie and send out an email

471
00:19:31,460 --> 00:19:28,759
to the amateurs I know personally and

472
00:19:34,430 --> 00:19:31,470
start to collect observations and then

473
00:19:37,009 --> 00:19:34,440
we had three or four near misses where

474
00:19:39,460 --> 00:19:37,019
the systems went into an opera is about

475
00:19:42,139 --> 00:19:39,470
a week before the HST observations and

476
00:19:44,480 --> 00:19:42,149
then the question was would they fade

477
00:19:47,779 --> 00:19:44,490
rapidly enough that it's safer agency to

478
00:19:51,529 --> 00:19:47,789
observe and so the the kind of closest

479
00:19:53,330 --> 00:19:51,539
call we had was one system very far in

480
00:19:53,990 --> 00:19:53,340
the southern hemisphere but the problem

481
00:19:55,520 --> 00:19:54,000
there is that the

482
00:19:56,930 --> 00:19:55,530
southern hemisphere doesn't have a lot

483
00:20:00,380 --> 00:19:56,940
of land so there are not many telescopes

484
00:20:02,900 --> 00:20:00,390
that are available it's Australia South

485
00:20:06,560 --> 00:20:02,910
America and South Africa right so I was

486
00:20:09,140 --> 00:20:06,570
myself just on a trip to Chile and got

487
00:20:10,790 --> 00:20:09,150
an email while I was in the taxi going

488
00:20:12,590 --> 00:20:10,800

to the observatory there that one of the

489
00:20:15,050 --> 00:20:12,600
stars scheduled for hs2 observations

490
00:20:18,080 --> 00:20:15,060
later the week that we had gone into all

491
00:20:20,030 --> 00:20:18,090
person so I was frenetically emailing

492
00:20:23,060 --> 00:20:20,040
outer oh and some other people in South

493
00:20:25,670 --> 00:20:23,070
Africa that they get on to the star and

494
00:20:27,260 --> 00:20:25,680
so they did what they could do and they

495
00:20:29,060 --> 00:20:27,270
could show demonstrate to space

496
00:20:31,700 --> 00:20:29,070
telescope demonstrate to Nolan and

497
00:20:34,280 --> 00:20:31,710
Helena that the star was fading rapidly

498
00:20:36,320 --> 00:20:34,290
and that it was back in quiescence about

499
00:20:38,000 --> 00:20:36,330
12 hours before a chest he would salute

500
00:20:39,650 --> 00:20:38,010
to it and so then they were happy and

501
00:20:43,210 --> 00:20:39,660
they said okay go ahead we do the

502
00:20:48,190 --> 00:20:43,220
observation wow that's amazing I know I

503
00:20:50,480 --> 00:20:48,200
was it was really real time 24 hours

504
00:20:52,670 --> 00:20:50,490
working on that program to make sure

505
00:20:54,620 --> 00:20:52,680
that the communication works that we can

506
00:20:56,390 --> 00:20:54,630
fill in gaps if there's bad weather in

507
00:20:58,520 --> 00:20:56,400
one continent that we can work from

508
00:21:01,250 --> 00:20:58,530
somewhere else and then people like

509
00:21:04,340 --> 00:21:01,260
people like Otto and Gordon just

510
00:21:06,920 --> 00:21:04,350
responded so brilliantly to to my

511
00:21:08,810 --> 00:21:06,930
requests over and over again that's

512
00:21:11,720 --> 00:21:08,820
awesome so for the benefit of those who

513
00:21:13,400 --> 00:21:11,730

might be watching that might want to do

514
00:21:16,310 --> 00:21:13,410
this kind of thing get involved in this

515
00:21:18,230 --> 00:21:16,320
kind of thing with Hubble science how

516
00:21:20,570 --> 00:21:18,240
did how did you guys find out about it

517
00:21:23,780 --> 00:21:20,580
arto and Gordon what was it through apps

518
00:21:26,720 --> 00:21:23,790
oh yeah in my case it definitely was

519
00:21:29,150 --> 00:21:26,730
yeah i mean the the alerts from double a

520
00:21:31,610 --> 00:21:29,160
VSO were the ones that i really tied

521
00:21:33,620 --> 00:21:31,620
into and then through those ended up

522
00:21:35,900 --> 00:21:33,630
doing emails directly with worse in

523
00:21:37,850 --> 00:21:35,910
several situations but yeah it was the

524
00:21:41,030 --> 00:21:37,860
coordination through a VSO that really

525
00:21:42,980 --> 00:21:41,040
made it all happen ok and same in same

526
00:21:46,670 --> 00:21:42,990
for you or you found it you found it out

527
00:21:49,640 --> 00:21:46,680
same way yeah I think so I learned it by

528
00:21:51,980 --> 00:21:49,650
aavso but probably got a email from

529
00:21:53,360 --> 00:21:51,990
Boris as well well there you go Arnie

530
00:21:54,740 --> 00:21:53,370
there's a good plug for why you need to

531
00:21:57,740 --> 00:21:54,750
get more members they're getting become

532
00:22:00,620 --> 00:21:57,750
get a member of the organization what's

533
00:22:02,360 --> 00:22:00,630
it like tell us how to do that what is

534
00:22:07,640 --> 00:22:02,370
that so and what why should how can

535
00:22:10,010 --> 00:22:07,650
people sign up well a VSO

536
00:22:12,140 --> 00:22:10,020
I know I was so I just don't have it

537
00:22:16,070 --> 00:22:12,150
sorry yeah well I mean there's am so a

538
00:22:17,600 --> 00:22:16,080

via so you know you pick your way of

539
00:22:20,420 --> 00:22:17,610
pronouncing the acronym that's fine with

540
00:22:22,610 --> 00:22:20,430
me but is the American Association of

541
00:22:24,830 --> 00:22:22,620
variable star observers and what that

542
00:22:26,780 --> 00:22:24,840
means is exactly what it says is people

543
00:22:29,060 --> 00:22:26,790
who have the an interest in variable

544
00:22:31,460 --> 00:22:29,070
stars they can be professional they can

545
00:22:34,790 --> 00:22:31,470
be amateur they can be just interested

546
00:22:38,240 --> 00:22:34,800
in doing database design whatever but we

547
00:22:42,170 --> 00:22:38,250
give equal weight to everyone we do have

548
00:22:44,030 --> 00:22:42,180
a website that you can go to a VSO org

549
00:22:47,660 --> 00:22:44,040
and on there there's a way in which you

550
00:22:50,030 --> 00:22:47,670
can join the organization it's not that

551
00:22:51,920 --> 00:22:50,040
expensive we do actually have a robotic

552
00:22:55,970 --> 00:22:51,930
telescope Network that you can get to

553
00:22:58,000 --> 00:22:55,980
for free if you remember and so it's a I

554
00:23:00,320 --> 00:22:58,010
think it's an exciting time for

555
00:23:02,390 --> 00:23:00,330
astronomy in general and for the amateur

556
00:23:04,970 --> 00:23:02,400
community in particular and for the

557
00:23:06,440 --> 00:23:04,980
professional amateur collaboration world

558
00:23:08,030 --> 00:23:06,450
as well I mean there's a lot of these

559
00:23:10,160 --> 00:23:08,040
kind of collaborations happening now as

560
00:23:12,700 --> 00:23:10,170
a result of your efforts I remember in

561
00:23:16,040 --> 00:23:12,710
the 70s when I was a member of apps

562
00:23:18,080 --> 00:23:16,050
double a VSO what I did was I took my

563
00:23:19,760 --> 00:23:18,090

little c 8 out and I would just plot

564
00:23:22,220 --> 00:23:19,770
light curves of different variable stars

565
00:23:24,980 --> 00:23:22,230
send the man via mail and you guys would

566
00:23:26,630 --> 00:23:24,990
process them and and and and do your do

567
00:23:28,400 --> 00:23:26,640
some make it available to professional

568
00:23:30,500 --> 00:23:28,410
science scientists for people who needed

569
00:23:32,840 --> 00:23:30,510
light curves of variable stars that's

570
00:23:35,810 --> 00:23:32,850
what I did when I was in high school and

571
00:23:38,210 --> 00:23:35,820
I have a question actually about the

572
00:23:44,090 --> 00:23:38,220
process so so you're sending out alerts

573
00:23:46,370 --> 00:23:44,100
and the members are responding um do

574
00:23:49,670 --> 00:23:46,380
they go directly to Boris then and start

575
00:23:52,550 --> 00:23:49,680
reporting they make measurements and

576
00:23:55,100 --> 00:23:52,560
report the measurements to somebody

577
00:23:56,810 --> 00:23:55,110
collect all the observations for use

578
00:24:00,020 --> 00:23:56,820
later I mean maybe those observations

579
00:24:02,360 --> 00:24:00,030
are worth something in reference to the

580
00:24:04,940 --> 00:24:02,370
HST observation so what about the data

581
00:24:08,810 --> 00:24:04,950
and and all of that what happens with

582
00:24:11,180 --> 00:24:08,820
all of that Oh Carol all that happens we

583
00:24:14,210 --> 00:24:11,190
do have an online public publicly

584
00:24:15,800 --> 00:24:14,220
accessible database and we encourage all

585
00:24:17,960 --> 00:24:15,810
the observers to submit their

586
00:24:20,750 --> 00:24:17,970
observations to that database and it's

587
00:24:21,590 --> 00:24:20,760
real time so that means then that Boris

588
00:24:24,200 --> 00:24:21,600

or whomever

589
00:24:26,930 --> 00:24:24,210
can actually access the database and see

590
00:24:29,900 --> 00:24:26,940
what the latest reported observations

591
00:24:32,390 --> 00:24:29,910
are in addition to that we have online

592
00:24:34,400 --> 00:24:32,400
forums and so there was a forum it was

593
00:24:37,340 --> 00:24:34,410
set up and people who report any kind of

594
00:24:39,740 --> 00:24:37,350
immediate notification there may not

595
00:24:41,990 --> 00:24:39,750
have been a quality observation yet but

596
00:24:47,720 --> 00:24:42,000
they wanted to alert somebody about it

597
00:24:50,750 --> 00:24:47,730
and then finally Boris was available

598
00:24:52,580 --> 00:24:50,760
they seem like 24 7 and so he was you

599
00:24:54,140 --> 00:24:52,590
could just email him and let him know if

600
00:24:57,529 --> 00:24:54,150
you saw anything that was important so

601
00:24:59,149 --> 00:24:57,539
we encourage that as well okay well that

602
00:25:00,560 --> 00:24:59,159
that is a great resource so I would

603
00:25:02,180 --> 00:25:00,570
encourage anybody interested in getting

604
00:25:03,529 --> 00:25:02,190
involved to go to that website and see

605
00:25:05,419 --> 00:25:03,539
and learn more about it themselves and

606
00:25:06,770 --> 00:25:05,429
get involved I mean this is the best you

607
00:25:08,419 --> 00:25:06,780
know this is a golden age of astronomy

608
00:25:10,700 --> 00:25:08,429
for amateurs as well and you can really

609
00:25:12,529 --> 00:25:10,710
help pro professional astronomers in

610
00:25:15,500 --> 00:25:12,539
ways that have never really been before

611
00:25:17,450 --> 00:25:15,510
may possible so I would encourage you to

612
00:25:19,370 --> 00:25:17,460
do that I want to go back to the science

613
00:25:20,720 --> 00:25:19,380

a little bit now and then I want to get

614
00:25:23,419 --> 00:25:20,730
to some questions and comments that we

615
00:25:27,289 --> 00:25:23,429
have on the various things but so we

616
00:25:30,649 --> 00:25:27,299
have these white dwarfs there Nolan's

617
00:25:33,020 --> 00:25:30,659
waving yes yeah I think it's important

618
00:25:37,370 --> 00:25:33,030
to add a bit more about what we actually

619
00:25:39,980 --> 00:25:37,380
have to do here to make this work at at

620
00:25:41,600 --> 00:25:39,990
the Hubble I kind of left it that yeah

621
00:25:43,909 --> 00:25:41,610
we have to know whether it feels safe be

622
00:25:46,100 --> 00:25:43,919
four we point the Hubble there but it's

623
00:25:48,020 --> 00:25:46,110
not quite that simple as you know the

624
00:25:49,880 --> 00:25:48,030
Hubble is in low Earth orbit goes around

625
00:25:51,919 --> 00:25:49,890
the earth every 96 minutes and we can't

626
00:25:55,520 --> 00:25:51,929
have continuous communication with it

627
00:25:58,310 --> 00:25:55,530
and the way it works is that a mission

628
00:26:01,100 --> 00:25:58,320
schedule is prepared and sent up to the

629
00:26:03,409 --> 00:26:01,110
telescope once a week i believe it

630
00:26:07,100 --> 00:26:03,419
starts on saturday or sunday and forget

631
00:26:09,470 --> 00:26:07,110
and then runs for a week so but as I

632
00:26:12,760 --> 00:26:09,480
said we're making this decision 24 hours

633
00:26:16,130 --> 00:26:12,770
before the observation so there's a

634
00:26:17,840 --> 00:26:16,140
compatibility there so a very rather

635
00:26:20,270 --> 00:26:17,850
complex and intricate system has been

636
00:26:23,930 --> 00:26:20,280
developed to do this involving a lot of

637
00:26:26,570 --> 00:26:23,940
people actually not only the at one

638
00:26:29,330 --> 00:26:26,580

level we heard how the observers provide

639
00:26:33,210 --> 00:26:29,340
the information Boris coordinates it

640
00:26:37,440 --> 00:26:33,220
sends it to the year to Eleanor and then

641
00:26:39,810 --> 00:26:37,450
I give an approval if it's safe 24 hours

642
00:26:42,480 --> 00:26:39,820
in advance but in order to make that

643
00:26:44,880 --> 00:26:42,490
happen the telescope has to be scheduled

644
00:26:48,180 --> 00:26:44,890
in a very special way and the way this

645
00:26:51,149 --> 00:26:48,190
is done is that it's set up so that the

646
00:26:57,510 --> 00:26:51,159
telescope will go and point at a blank

647
00:27:00,409 --> 00:26:57,520
field very near the target and there is

648
00:27:04,669 --> 00:27:00,419
communication possible with the Hubble

649
00:27:08,760 --> 00:27:04,679
some hours a day through the NASA and

650
00:27:10,740 --> 00:27:08,770
tracking and data relay satellite system

651
00:27:12,539 --> 00:27:10,750
so all of this has to be set up and

652
00:27:13,919 --> 00:27:12,549
coordinated with our engineers at some

653
00:27:15,299 --> 00:27:13,929
point it's out of the hands of the

654
00:27:17,520 --> 00:27:15,309
astronomers and in the hands of the

655
00:27:19,140 --> 00:27:17,530
engineers because we don't talk to the

656
00:27:20,970 --> 00:27:19,150
telescope and engineers here at the

657
00:27:23,070 --> 00:27:20,980
Institute and then a Goddard Space

658
00:27:27,270 --> 00:27:23,080
Flight Center where the vehicle is

659
00:27:29,850 --> 00:27:27,280
controlled so there's a flag set on

660
00:27:31,049 --> 00:27:29,860
board and you know Alan well to use and

661
00:27:32,460 --> 00:27:31,059
here he's one of the engineers who does

662
00:27:34,169 --> 00:27:32,470
is and though it does knows a lot more

663
00:27:39,630 --> 00:27:34,179

about the details i do but in broad

664
00:27:43,320 --> 00:27:39,640
terms this flag has to be cleared so

665
00:27:45,840 --> 00:27:43,330
that the telescope will go to the real

666
00:27:48,980 --> 00:27:45,850
field and not to the blank one after the

667
00:27:51,840 --> 00:27:48,990
ok comes in 24 hours in advance and

668
00:27:53,940 --> 00:27:51,850
hopefully that's not 3m or a 2 a.m. or

669
00:27:56,580 --> 00:27:53,950
whatever because of our budget cuts

670
00:27:58,950 --> 00:27:56,590
nessa only operates nine to five or

671
00:28:02,010 --> 00:27:58,960
eight to five now found there so it's a

672
00:28:05,669 --> 00:28:02,020
bit intricate but we men should do it

673
00:28:07,740 --> 00:28:05,679
and this flag gets cleared and then the

674
00:28:09,779 --> 00:28:07,750
telescope actually goes and points to

675
00:28:12,810 --> 00:28:09,789
the real target and does the observation

676
00:28:14,760 --> 00:28:12,820
and virus I don't recall where any I

677
00:28:16,460 --> 00:28:14,770
think there were among year 40 some

678
00:28:19,620 --> 00:28:16,470
targets one or two that were actually

679
00:28:22,470 --> 00:28:19,630
aborted and the observation was not

680
00:28:25,230 --> 00:28:22,480
conducted is that true that's right we

681
00:28:28,409 --> 00:28:25,240
lost we out of 41 targets we lost one

682
00:28:30,390 --> 00:28:28,419
and that one that that was just one of

683
00:28:32,159 --> 00:28:30,400
those cataclysmic variables that just

684
00:28:34,529 --> 00:28:32,169
behaves in a completely unpredictable

685
00:28:36,060 --> 00:28:34,539
way it didn't go into a proper all

686
00:28:37,860 --> 00:28:36,070
purpose but it was brightening and

687
00:28:40,620 --> 00:28:37,870
fading in a very irregular fashion and I

688
00:28:43,110 --> 00:28:40,630

remember I was having dinner and Elena

689
00:28:45,330 --> 00:28:43,120
called me at what it was dinner time

690
00:28:47,039 --> 00:28:45,340
over here in the UK and we were

691
00:28:48,989 --> 00:28:47,049
discussing it and she said I'm sorry

692
00:28:50,729 --> 00:28:48,999
just it's it's just too risky to go

693
00:28:53,070 --> 00:28:50,739
ahead and she said she cannot sign that

694
00:28:55,470 --> 00:28:53,080
one off so we lost that once though but

695
00:28:57,389 --> 00:28:55,480
all the other 40 were successfully

696
00:28:59,940 --> 00:28:57,399
observed here so that's the really great

697
00:29:02,279 --> 00:28:59,950
success so yeah it is it's a tribute to

698
00:29:04,619 --> 00:29:02,289
everybody involved all over the world

699
00:29:06,659 --> 00:29:04,629
that we achieved that success rate and

700
00:29:08,970 --> 00:29:06,669
but it shows there's a human judgment

701
00:29:10,739 --> 00:29:08,980
involved here too it's some ways kind of

702
00:29:12,869 --> 00:29:10,749
like a legal criteria beyond a

703
00:29:14,580 --> 00:29:12,879
reasonable doubt and not only for these

704
00:29:16,080 --> 00:29:14,590
observations it's for all Hubble

705
00:29:17,820 --> 00:29:16,090
observations we can never prove one

706
00:29:20,820 --> 00:29:17,830
hundred percent that something is safe

707
00:29:23,580 --> 00:29:20,830
but it's up to contact scientists in the

708
00:29:25,440 --> 00:29:23,590
ultimate instance to decide whether he

709
00:29:26,820 --> 00:29:25,450
or she feels comfortable that to the

710
00:29:28,889 --> 00:29:26,830
best of our ability and the best of our

711
00:29:31,259 --> 00:29:28,899
knowledge this target is safe and that's

712
00:29:35,220 --> 00:29:31,269
what applied also to this rather unusual

713
00:29:37,379 --> 00:29:35,230

case nice okay good good good summary so

714
00:29:38,669 --> 00:29:37,389
that was good to know so like I said I

715
00:29:40,979 --> 00:29:38,679
want to get back to the science a little

716
00:29:42,299 --> 00:29:40,989
bit we were trying you were trying to

717
00:29:45,330 --> 00:29:42,309
answer the question we said this at the

718
00:29:46,919 --> 00:29:45,340
top of the show about you were trying to

719
00:29:49,409 --> 00:29:46,929
find out if these white dwarves in these

720
00:29:51,629 --> 00:29:49,419
binary systems actually grew in mass and

721
00:29:54,389 --> 00:29:51,639
if they did how efficient is that

722
00:29:56,369 --> 00:29:54,399
process of getting larger so here we

723
00:29:59,369 --> 00:29:56,379
have a white dwarf they are all of the

724
00:30:00,659 --> 00:29:59,379
roughly the same size correct Carol all

725
00:30:06,090 --> 00:30:00,669
white dwarfs are more or less the same

726
00:30:10,109 --> 00:30:06,100
same mass right you're muted actually

727
00:30:12,149 --> 00:30:10,119
Boris okay Joe was trying to he actually

728
00:30:19,139 --> 00:30:12,159
told us that they were there different

729
00:30:21,539 --> 00:30:19,149
masses oh but the blood janitors also

730
00:30:24,119 --> 00:30:21,549
are different sizes but then above some

731
00:30:26,519 --> 00:30:24,129
math size it can't become white dwarfs

732
00:30:29,549 --> 00:30:26,529
anymore because they have too much mass

733
00:30:31,950 --> 00:30:29,559
so there is a limit and then beyond that

734
00:30:33,389 --> 00:30:31,960
they become something more exotic all

735
00:30:36,599 --> 00:30:33,399
the white dwarf so I'm pretty darn

736
00:30:38,220 --> 00:30:36,609
exotic anyway so I guess I'm confused

737
00:30:39,690 --> 00:30:38,230
about well first of all I'm just get to

738
00:30:44,669 --> 00:30:39,700

the punch line would you find out are

739
00:30:48,269 --> 00:30:44,679
they getting bigger Boris can you hear

740
00:30:50,460 --> 00:30:48,279
me Tony I missed that oh I was asking so

741
00:30:55,409 --> 00:30:50,470
what you find out where you AR they are

742
00:30:57,659 --> 00:30:55,419
they growing a mass well well we have we

743
00:30:59,489 --> 00:30:57,669
have just the we have obtained the last

744
00:31:00,450 --> 00:30:59,499
observation of this poem Justin mouth so

745
00:31:05,010 --> 00:31:00,460
we are still in the pros

746
00:31:06,930 --> 00:31:05,020
of analyzing the data and and it's not

747
00:31:08,910 --> 00:31:06,940
as straightforward just that we measure

748
00:31:10,200 --> 00:31:08,920
the mass traded for right away from the

749
00:31:11,760 --> 00:31:10,210
observation because another piece of

750
00:31:14,190 --> 00:31:11,770
information that we need to know is the

751
00:31:16,050 --> 00:31:14,200
distance to these stars which together

752
00:31:18,210 --> 00:31:16,060
with the huddle observation we will then

753
00:31:19,740 --> 00:31:18,220
be able to convert into mass but but

754
00:31:22,650 --> 00:31:19,750
just coming back briefly to the point

755
00:31:25,410 --> 00:31:22,660
about why 12 masses your your textbook

756
00:31:27,840 --> 00:31:25,420
why 12 on this guy has a mass of about

757
00:31:29,880 --> 00:31:27,850
point 6 solar masses so sixty percent

758
00:31:33,300 --> 00:31:29,890
the mass of the Sun that's what I would

759
00:31:34,740 --> 00:31:33,310
end yeah and so most most white walls

760
00:31:37,260 --> 00:31:34,750
have that DeadMau so the average

761
00:31:39,180 --> 00:31:37,270
mother's point six and looking at

762
00:31:42,030 --> 00:31:39,190
cataclysmic variables the data we had

763
00:31:45,900 --> 00:31:42,040

before this HST project on something

764
00:31:48,210 --> 00:31:45,910
like 20-25 stars showed that they have

765
00:31:50,940 --> 00:31:48,220
average mass of point eight solar masses

766
00:31:54,000 --> 00:31:50,950
or eighty percent of the mass of the Sun

767
00:31:55,650 --> 00:31:54,010
so they're about a third heavier then

768
00:31:57,840 --> 00:31:55,660
your average single way too often that

769
00:32:01,560 --> 00:31:57,850
that was the clue why we think they may

770
00:32:02,700 --> 00:32:01,570
grow in mass now the the few objects we

771
00:32:05,940 --> 00:32:02,710
have analyzed in a little bit more

772
00:32:12,750 --> 00:32:05,950
detail from the HST project they all

773
00:32:15,180 --> 00:32:12,760
confirm this the same suspicion that

774
00:32:17,520 --> 00:32:15,190
they are more massive so they are they

775
00:32:21,390 --> 00:32:17,530
come in at mazel point 8.9 solar masses

776
00:32:24,180 --> 00:32:21,400
so why don't you think Galaxy isn't is

777
00:32:26,940 --> 00:32:24,190
about point six but one in a system like

778
00:32:28,650 --> 00:32:26,950
this is a little bit heavier and you

779
00:32:31,470 --> 00:32:28,660
think it might be due to this accreting

780
00:32:35,040 --> 00:32:31,480
material or they don't more due process

781
00:32:37,140 --> 00:32:35,050
is it very very that the process is very

782
00:32:39,960 --> 00:32:37,150
efficient somehow masses is not not all

783
00:32:44,010 --> 00:32:39,970
the masses being released right in the

784
00:32:46,140 --> 00:32:44,020
explosion yeah well so the kind of fact

785
00:32:48,180 --> 00:32:46,150
the fact that we are working towards at

786
00:32:49,590 --> 00:32:48,190
the moment is that these these white

787
00:32:52,290 --> 00:32:49,600
Wilson characters make martyrs are

788
00:32:55,050 --> 00:32:52,300

definitely much more massive than your

789
00:32:57,390 --> 00:32:55,060
typical single bite off in the galaxy

790
00:32:59,760 --> 00:32:57,400
and they're basically just two

791
00:33:01,950 --> 00:32:59,770
explanations either they grow in mass or

792
00:33:05,910 --> 00:33:01,960
they are just born with a much higher

793
00:33:08,130 --> 00:33:05,920
mass right at the beginning and making

794
00:33:09,810 --> 00:33:08,140
all these systems with much more massive

795
00:33:12,840 --> 00:33:09,820
weight loss is incredibly difficult to

796
00:33:14,340 --> 00:33:12,850
when this to explain so mass growth

797
00:33:16,350 --> 00:33:14,350
seems to be the natural

798
00:33:17,940 --> 00:33:16,360
explanation you know they're quite a

799
00:33:19,289 --> 00:33:17,950
number of people who feel uncomfortable

800
00:33:20,730 --> 00:33:19,299
about that as well but that's the good

801
00:33:23,480 --> 00:33:20,740
thing about science we have two offices

802
00:33:27,810 --> 00:33:23,490
in both of them both of them don't work

803
00:33:29,760 --> 00:33:27,820
so could I ask just what just another

804
00:33:32,820 --> 00:33:29,770
question so at the beginning of this

805
00:33:36,120 --> 00:33:32,830
course you were talking about looking

806
00:33:40,169 --> 00:33:36,130
for causes for type 1 supernova and you

807
00:33:42,480 --> 00:33:40,179
mentioned the binary systems so we're in

808
00:33:44,940 --> 00:33:42,490
the spectrum of cataclysmic variables

809
00:33:47,669 --> 00:33:44,950
and Nova are the binary systems because

810
00:33:50,700 --> 00:33:47,679
they can be white dwarfs as well is that

811
00:33:54,090 --> 00:33:50,710
correct I missed I missed all of your

812
00:33:57,180 --> 00:33:54,100
abacus the progenitors foresight type 1a

813
00:34:00,419 --> 00:33:57,190

supernovae you mentioned binary just

814
00:34:04,740 --> 00:34:00,429
white dwarfs yeah yeah where do they fit

815
00:34:07,710 --> 00:34:04,750
in this scheme they fit in this scheme

816
00:34:10,500 --> 00:34:07,720
in the sense that they you need to have

817
00:34:12,060 --> 00:34:10,510
a different type of stellar system to

818
00:34:15,899 --> 00:34:12,070
make two by twelves in the first place

819
00:34:19,470 --> 00:34:15,909
and so you need to have two fairly

820
00:34:22,109 --> 00:34:19,480
massive massive stars that have that can

821
00:34:24,750 --> 00:34:22,119
evolve relatively rapidly into white

822
00:34:27,510 --> 00:34:24,760
wolves both of them and then merge

823
00:34:29,099 --> 00:34:27,520
within the age of the of the galaxy to

824
00:34:31,649 --> 00:34:29,109
become a type 1a supernovae so there are

825
00:34:33,990 --> 00:34:31,659
different breed of binary styles it in

826
00:34:36,180 --> 00:34:34,000
general type 1 ace I think nobody has

827
00:34:38,639 --> 00:34:36,190
any doubt that type 1 ace must be

828
00:34:40,169 --> 00:34:38,649
related to white wolves in some kind of

829
00:34:42,540 --> 00:34:40,179
binary stars the big question is what

830
00:34:43,800 --> 00:34:42,550
kind of binary stars are those and my

831
00:34:49,409 --> 00:34:43,810
personal feeling is they're probably

832
00:34:51,060 --> 00:34:49,419
more than one type that can work so so

833
00:34:52,560 --> 00:34:51,070
Scott has a little diagram little

834
00:34:55,500 --> 00:34:52,570
cartoon of a couple of white dwarfs

835
00:34:58,710 --> 00:34:55,510
orbiting to sort of underscore what

836
00:35:00,060 --> 00:34:58,720
you're talking about there I guess one

837
00:35:01,500 --> 00:35:00,070
thing that worries me though is that you

838
00:35:04,020 --> 00:35:01,510

said that you still needed to know their

839
00:35:06,780 --> 00:35:04,030
distances to really know if they were

840
00:35:10,650 --> 00:35:06,790
gaining mass I I thought type 1a

841
00:35:13,109 --> 00:35:10,660
supernovae were yard sticks they told us

842
00:35:17,760 --> 00:35:13,119
how far away things were don't you know

843
00:35:19,560 --> 00:35:17,770
that that's that's right if you want to

844
00:35:23,910 --> 00:35:19,570
measure this and I'll let you comment on

845
00:35:25,710 --> 00:35:23,920
it right away if you want if you want to

846
00:35:27,390 --> 00:35:25,720
measure distances to galaxies far far

847
00:35:28,200 --> 00:35:27,400
away then you want an exploding white

848
00:35:29,970 --> 00:35:28,210
dwarf in it

849
00:35:32,359 --> 00:35:29,980
but here we are looking at the actual

850
00:35:34,620 --> 00:35:32,369
weight loss before they explode and so

851
00:35:36,000 --> 00:35:34,630
for the measurement we have in mind we

852
00:35:37,829 --> 00:35:36,010
need to know we need to know the

853
00:35:39,690 --> 00:35:37,839
distance and just just to make it clear

854
00:35:42,720 --> 00:35:39,700
this these white walls they're really

855
00:35:44,370 --> 00:35:42,730
nearby we are talking about a few 10 and

856
00:35:47,010 --> 00:35:44,380
at most a few hundred light years so

857
00:35:49,589 --> 00:35:47,020
they're basically parallax to figure it

858
00:35:52,650 --> 00:35:49,599
out exactly and so we can use paradoxes

859
00:35:55,410 --> 00:35:52,660
and the the European Space Agency has

860
00:35:57,750 --> 00:35:55,420
launched their mission Gaia just lost I

861
00:36:00,300 --> 00:35:57,760
think was January that we provide us

862
00:36:02,990 --> 00:36:00,310
with super accurate distances within the

863
00:36:06,000 --> 00:36:03,000

next few years so we can get some

864
00:36:08,370 --> 00:36:06,010
preliminary answer within the next year

865
00:36:11,070 --> 00:36:08,380
or so and then the final answer we have

866
00:36:14,280 --> 00:36:11,080
to wait for about 34 years before we

867
00:36:16,290 --> 00:36:14,290
have the final decisions all right great

868
00:36:17,700 --> 00:36:16,300
thank you for clarifying that I will get

869
00:36:19,079 --> 00:36:17,710
back to what parallax is in a minute but

870
00:36:20,750 --> 00:36:19,089
let me let Nolan make his comment go

871
00:36:23,130 --> 00:36:20,760
ahead and all right yeah thank you I

872
00:36:24,270 --> 00:36:23,140
have an uncomfortable feeling that if

873
00:36:27,150 --> 00:36:24,280
they're people listening who aren't

874
00:36:28,890 --> 00:36:27,160
familiar with the basic astronomy here

875
00:36:31,200 --> 00:36:28,900
or haven't heard the previous hangout on

876
00:36:33,690 --> 00:36:31,210
supernovae or whatever they may be a bit

877
00:36:36,180 --> 00:36:33,700
confused and so I think we useful just

878
00:36:38,460 --> 00:36:36,190
to run through a few basic things a

879
00:36:40,760 --> 00:36:38,470
white dwarf for a star to be a white

880
00:36:43,109 --> 00:36:40,770
dwarf to have this phenomenon of

881
00:36:45,420 --> 00:36:43,119
electron degeneracy and its interior

882
00:36:47,960 --> 00:36:45,430
that holds it up and then further

883
00:36:50,640 --> 00:36:47,970
collapsing there's a mass limit that

884
00:36:53,280 --> 00:36:50,650
Superman chandrasekar first derived in

885
00:36:56,270 --> 00:36:53,290
won the nobel prize for it's about 1.4

886
00:36:59,490 --> 00:36:56,280
times the mass of a son so of the Sun so

887
00:37:01,859 --> 00:36:59,500
we think that stars up to maybe is

888
00:37:04,410 --> 00:37:01,869

massive is eight solar masses can lose

889
00:37:08,190 --> 00:37:04,420
enough mass to get down to that limit

890
00:37:10,920 --> 00:37:08,200
and form a white dwarf has to be 1.4

891
00:37:12,450 --> 00:37:10,930
solar masses or less so if you just have

892
00:37:14,400 --> 00:37:12,460
a single star from your white dwarf

893
00:37:17,460 --> 00:37:14,410
that's it it won't do anything else but

894
00:37:19,800 --> 00:37:17,470
in a binary system if it's either too

895
00:37:23,040 --> 00:37:19,810
wide or so that can merge and therefore

896
00:37:26,550 --> 00:37:23,050
exceed that limit of 1.4 you're going to

897
00:37:28,500 --> 00:37:26,560
get a 1a supernova or in a normal in a

898
00:37:32,490 --> 00:37:28,510
binary with a white dwarf in a normal

899
00:37:34,890 --> 00:37:32,500
star that Boris is favoring the normal

900
00:37:37,500 --> 00:37:34,900
star can lose mass and transfer it to

901
00:37:38,880 --> 00:37:37,510
the white dwarf and I thought there was

902
00:37:40,470 --> 00:37:38,890
a bit of a confusion there these these

903
00:37:41,819 --> 00:37:40,480
outbursts that we're concerned about

904
00:37:44,219 --> 00:37:41,829
these are these are

905
00:37:46,349 --> 00:37:44,229
explosions nuclear explosions there

906
00:37:50,339 --> 00:37:46,359
there are a gravitational chrétien

907
00:37:52,289 --> 00:37:50,349
events which produce an instability and

908
00:37:55,469 --> 00:37:52,299
and produces outburst of ultraviolet

909
00:37:57,749 --> 00:37:55,479
light what happens though in these

910
00:38:01,859 --> 00:37:57,759
binary systems is a phenomenon that we

911
00:38:03,449 --> 00:38:01,869
call novi and so material is transferred

912
00:38:05,759 --> 00:38:03,459
from the normal companion to the white

913
00:38:07,440 --> 00:38:05,769

dwarf gets very hot and at some point

914
00:38:09,539 --> 00:38:07,450
there is a nuclear explosion on the

915
00:38:12,839 --> 00:38:09,549
surface of the star and that produces

916
00:38:16,799 --> 00:38:12,849
nova and it ejects mass so if that

917
00:38:18,479 --> 00:38:16,809
happens before the Chandrasekhar limit

918
00:38:20,489 --> 00:38:18,489
is reached how can you ever get a

919
00:38:22,349 --> 00:38:20,499
supernova because you transfer some ass

920
00:38:24,209 --> 00:38:22,359
and there's a nova and it loses a bunch

921
00:38:25,620 --> 00:38:24,219
and then come back and over and over

922
00:38:31,440 --> 00:38:25,630
again and somebody's noverre known to be

923
00:38:33,779 --> 00:38:31,450
recurrent that's tip how do you transfer

924
00:38:36,239 --> 00:38:33,789
mass onto the white dwarf from what kind

925
00:38:39,329 --> 00:38:36,249
of a star and and not have it get lost

926
00:38:40,979 --> 00:38:39,339
in nova asian so that it can build up to

927
00:38:44,839 --> 00:38:40,989
exceed the Chandrasekhar limit and

928
00:38:46,739 --> 00:38:44,849
produce a supernova so that's the basic

929
00:38:47,969 --> 00:38:46,749
phenomenology that we're talking about

930
00:38:49,680 --> 00:38:47,979
here and I just thought it might be

931
00:38:51,180 --> 00:38:49,690
useful to review thought that was great

932
00:38:53,849 --> 00:38:51,190
I'm glad you did that I was something I

933
00:38:55,829 --> 00:38:53,859
tried to do periodically throughout the

934
00:38:57,120 --> 00:38:55,839
the discussion but that was a really

935
00:38:58,559 --> 00:38:57,130
good overview so thanks for that I

936
00:39:01,079 --> 00:38:58,569
appreciate it and you're absolutely

937
00:39:03,359 --> 00:39:01,089
right we need to be I hope I hope that

938
00:39:06,229 --> 00:39:03,369

clarifies some of the the Astronomy

939
00:39:08,400 --> 00:39:06,239
network that we're dealing with here so

940
00:39:09,779 --> 00:39:08,410
we're still working on the results

941
00:39:13,620 --> 00:39:09,789
you're still analyzing the data that

942
00:39:16,199 --> 00:39:13,630
everybody took and presumably all of the

943
00:39:18,599 --> 00:39:16,209
data are in good shape and the Hubble

944
00:39:21,269 --> 00:39:18,609
wasn't blinded by any of this thanks to

945
00:39:24,120 --> 00:39:21,279
the amateurs so let me go to some of the

946
00:39:30,689 --> 00:39:24,130
questions here that I'm seeing on the

947
00:39:32,160 --> 00:39:30,699
Q&A app let's see I want to go how can a

948
00:39:35,489 --> 00:39:32,170
telescope measure and this is from

949
00:39:38,309 --> 00:39:35,499
pardieu matamata poly I believe I

950
00:39:40,410 --> 00:39:38,319
forgive me if I'm miss mispronouncing

951
00:39:42,989 --> 00:39:40,420
this is from the Q&A app how can a

952
00:39:46,199 --> 00:39:42,999
telescope measure the distance of a far

953
00:39:48,329 --> 00:39:46,209
celestial body from us telescope

954
00:39:52,739 --> 00:39:48,339
receives light from the body and the

955
00:39:54,749 --> 00:39:52,749
image of the body is magnified how then

956
00:39:55,740 --> 00:39:54,759
how can it measure the distance so how

957
00:39:57,510 --> 00:39:55,750
do we know the distance

958
00:40:00,840 --> 00:39:57,520
two things I mean how can a telescope

959
00:40:02,070 --> 00:40:00,850
tell us this and I'll give that to let's

960
00:40:04,500 --> 00:40:02,080
go with you boys can you give us a

961
00:40:07,260 --> 00:40:04,510
little oak and take that on yeah okay I

962
00:40:10,410 --> 00:40:07,270
can I can give it a try so besides

963
00:40:11,940 --> 00:40:10,420

besides collecting more light than you

964
00:40:14,790 --> 00:40:11,950
can collect with your eye or your

965
00:40:16,590 --> 00:40:14,800
binocular telescope can measure very

966
00:40:19,020 --> 00:40:16,600
very accurately the position of a star

967
00:40:21,410 --> 00:40:19,030
in the sky and so you have to imagine

968
00:40:25,470 --> 00:40:21,420
that as the earth goes around the Sun

969
00:40:28,410 --> 00:40:25,480
the apparent position on of the nearby

970
00:40:29,730 --> 00:40:28,420
start changes because of our emotions

971
00:40:32,400 --> 00:40:29,740
are basically if you look at the sky

972
00:40:34,230 --> 00:40:32,410
that star that you are looking at wood

973
00:40:37,110 --> 00:40:34,240
over the course of a year describe a

974
00:40:40,020 --> 00:40:37,120
little circle a little elliptical little

975
00:40:41,370 --> 00:40:40,030
lips on the sky so it looks like the

976
00:40:43,770 --> 00:40:41,380
stars moving but that's just the

977
00:40:46,290 --> 00:40:43,780
reflection of the earth moving your

978
00:40:48,570 --> 00:40:46,300
telescope moving and so that's what we

979
00:40:51,540 --> 00:40:48,580
call the parallax motion of stars and

980
00:40:53,520 --> 00:40:51,550
from that through basic trigonometry you

981
00:40:56,760 --> 00:40:53,530
can calculate the distance if you

982
00:41:00,510 --> 00:40:56,770
measure the size of that parallax Alex

983
00:41:01,800 --> 00:41:00,520
motion now to do that you need to

984
00:41:04,110 --> 00:41:01,810
measure the position very very

985
00:41:05,400 --> 00:41:04,120
accurately and if you try to get from

986
00:41:07,320 --> 00:41:05,410
the ground you are a little bit in

987
00:41:09,960 --> 00:41:07,330
trouble because the earth atmosphere is

988
00:41:12,540 --> 00:41:09,970

turbulent and blurs the images of the

989
00:41:15,120 --> 00:41:12,550
stars and so you are limited to heart

990
00:41:16,680 --> 00:41:15,130
rate you can measure the position and

991
00:41:19,950 --> 00:41:16,690
that means from the ground you can

992
00:41:23,760 --> 00:41:19,960
measure parallaxes to a few hundred

993
00:41:26,250 --> 00:41:23,770
light years at most and if you want to

994
00:41:28,620 --> 00:41:26,260
measure distances of styles that are

995
00:41:30,480 --> 00:41:28,630
further away an hour making way then you

996
00:41:32,850 --> 00:41:30,490
need to have telescopes in space that

997
00:41:34,620 --> 00:41:32,860
are above the atmosphere and can measure

998
00:41:37,020 --> 00:41:34,630
the position much more accurately than

999
00:41:39,000 --> 00:41:37,030
you can do from the ground very awesome

1000
00:41:40,560 --> 00:41:39,010
glad we worked at in perfect so there

1001
00:41:44,730 --> 00:41:40,570
you go that's what parallax is and i

1002
00:41:46,710 --> 00:41:44,740
hears from hamza arshad also from the

1003
00:41:49,050 --> 00:41:46,720
Q&A app i can't select these questions

1004
00:41:51,840 --> 00:41:49,060
unfortunately otherwise i bring them

1005
00:41:54,510 --> 00:41:51,850
make them prominent i am a student in

1006
00:41:56,280 --> 00:41:54,520
birmingham met i think it says it says

1007
00:41:58,920 --> 00:41:56,290
neat Boris actually but I think instead

1008
00:42:00,630 --> 00:41:58,930
of met Boris actually I was on I was

1009
00:42:03,090 --> 00:42:00,640
wondering what is the Chandrasekhar

1010
00:42:05,010 --> 00:42:03,100
limit now Nolan touched on this very

1011
00:42:08,220 --> 00:42:05,020
briefly about this idea of electron

1012
00:42:09,480 --> 00:42:08,230
degeneracy anybody want to give a real

1013
00:42:13,050 --> 00:42:09,490

brief answer on what

1014
00:42:15,990 --> 00:42:13,060
that might be and how about you know

1015
00:42:18,300 --> 00:42:16,000
then you gave a pretty good summary

1016
00:42:19,740 --> 00:42:18,310
before tell us about what is she under

1017
00:42:23,160 --> 00:42:19,750
say car lemon I mean what in electron

1018
00:42:28,040 --> 00:42:23,170
degeneracy sure at a very high level I'm

1019
00:42:33,240 --> 00:42:28,050
sure Boris give a far more physical

1020
00:42:36,330 --> 00:42:33,250
explanation but at a high level you know

1021
00:42:39,420 --> 00:42:36,340
it you have to go back really to what a

1022
00:42:42,890 --> 00:42:39,430
star is and star formation a star is a

1023
00:42:48,720 --> 00:42:42,900
huge mass of gas in balance between

1024
00:42:50,400 --> 00:42:48,730
gravity inward and and the pressure from

1025
00:42:54,150 --> 00:42:50,410
the nuclear reactions and its interior

1026
00:42:55,680 --> 00:42:54,160
outward and but at some point the fuel

1027
00:42:58,470 --> 00:42:55,690
that it's burning is going to get used

1028
00:43:01,410 --> 00:42:58,480
up and the gravity will never go away

1029
00:43:04,830 --> 00:43:01,420
it's always there but when the nuclear

1030
00:43:06,840 --> 00:43:04,840
reactions and the pressure and stopped

1031
00:43:10,410 --> 00:43:06,850
because the fuels used up then there's a

1032
00:43:12,270 --> 00:43:10,420
problem and so their various outcomes of

1033
00:43:14,670 --> 00:43:12,280
this problem depending on what the

1034
00:43:16,349 --> 00:43:14,680
initial mass of the star was and we're

1035
00:43:19,140 --> 00:43:16,359
talking here about the relatively low

1036
00:43:21,930 --> 00:43:19,150
mass stars with initial mass is less

1037
00:43:25,050 --> 00:43:21,940
than about eight solar masses and they

1038
00:43:29,430 --> 00:43:25,060

have a solution which is fairly quiet

1039
00:43:31,770 --> 00:43:29,440
sent they can lose enough mass from

1040
00:43:34,740 --> 00:43:31,780
their outer layers to get down to or

1041
00:43:38,040 --> 00:43:34,750
below this one point for solar mass

1042
00:43:39,960 --> 00:43:38,050
limit in the core and form a white dwarf

1043
00:43:43,410 --> 00:43:39,970
and that's a stable configuration that

1044
00:43:45,300 --> 00:43:43,420
will never do anything else if nothing

1045
00:43:47,820 --> 00:43:45,310
else happens to it it will just cool off

1046
00:43:51,599 --> 00:43:47,830
and sit there forever and become a cold

1047
00:43:52,770 --> 00:43:51,609
dark cinder in in space right it's

1048
00:43:54,359 --> 00:43:52,780
important to point up in a point not

1049
00:43:56,450 --> 00:43:54,369
burning your not shining in any way

1050
00:43:59,099 --> 00:43:56,460
other than der the energy from the

1051
00:44:01,050 --> 00:43:59,109
compression I guess right no there there

1052
00:44:02,570 --> 00:44:01,060
shining the way that we see there the

1053
00:44:05,400 --> 00:44:02,580
shiny because they're still hot from the

1054
00:44:06,750 --> 00:44:05,410
the nuclear burning phase and there but

1055
00:44:09,270 --> 00:44:06,760
they're just cooling down so they're

1056
00:44:14,130 --> 00:44:09,280
cooling curves and all of this is pretty

1057
00:44:17,250 --> 00:44:14,140
well understood so they're they're just

1058
00:44:19,560 --> 00:44:17,260
shining by releasing the the heat the

1059
00:44:21,210 --> 00:44:19,570
thermal energy that heated them up in

1060
00:44:22,980 --> 00:44:21,220
the first place and they don't have any

1061
00:44:23,350 --> 00:44:22,990
way to produce any more energy so that's

1062
00:44:25,930 --> 00:44:23,360
why

1063
00:44:28,480 --> 00:44:25,940

just become cold dead cinders now

1064
00:44:32,620 --> 00:44:28,490
electron degeneracy is a very

1065
00:44:36,490 --> 00:44:32,630
interesting physical phenomenon that was

1066
00:44:38,740 --> 00:44:36,500
discovered by chandrasekhara there's

1067
00:44:41,110 --> 00:44:38,750
that we have a very nearby star Sirius

1068
00:44:43,540 --> 00:44:41,120
the brightest star in the sky and it has

1069
00:44:44,830 --> 00:44:43,550
a white dwarf companion and it's far

1070
00:44:46,750 --> 00:44:44,840
enough away and the stars close enough

1071
00:44:49,600 --> 00:44:46,760
we can actually resolve them visually

1072
00:44:53,920 --> 00:44:49,610
and he was concerned about what this

1073
00:44:56,590 --> 00:44:53,930
very hot dim star was it was a companion

1074
00:44:59,410 --> 00:44:56,600
to Sirius as a normal a star big bright

1075
00:45:02,770 --> 00:44:59,420
thing but here's this little a hot thing

1076
00:45:04,240 --> 00:45:02,780
and which is much hotter than serious

1077
00:45:05,800 --> 00:45:04,250
and at the time John just like our work

1078
00:45:08,440 --> 00:45:05,810
there was no explanation for such an

1079
00:45:11,350 --> 00:45:08,450
object it seemed impossible and he

1080
00:45:14,170 --> 00:45:11,360
derived this solution that the thing has

1081
00:45:19,470 --> 00:45:14,180
become as the core has condensed and

1082
00:45:22,780 --> 00:45:19,480
become so dense the a white dwarf as

1083
00:45:24,100 --> 00:45:22,790
Boris said is a massive sixty percent

1084
00:45:26,230 --> 00:45:24,110
eighty percent up to the Chandrasekhar

1085
00:45:28,840 --> 00:45:26,240
limit of the Sun but in a volume equal

1086
00:45:31,150 --> 00:45:28,850
to the size of the earth so the density

1087
00:45:33,630 --> 00:45:31,160
inside is huge and at these densities

1088
00:45:36,490 --> 00:45:33,640

what changes sake I realized is that

1089
00:45:39,420 --> 00:45:36,500
electrons no longer belong to individual

1090
00:45:43,210 --> 00:45:39,430
nuclei there's just a sea of electrons

1091
00:45:44,980 --> 00:45:43,220
in this object and the nuclei are all

1092
00:45:47,170 --> 00:45:44,990
separate the new the electrons were kind

1093
00:45:49,900 --> 00:45:47,180
of all shared and that's what electron

1094
00:45:53,800 --> 00:45:49,910
degeneracy means and there is this is a

1095
00:45:56,110 --> 00:45:53,810
stable quasi like solid or quasi

1096
00:45:58,420 --> 00:45:56,120
crystalline state they will hold up the

1097
00:46:00,570 --> 00:45:58,430
the remnants of this star this core

1098
00:46:02,440 --> 00:46:00,580
forever against the force of gravity

1099
00:46:04,690 --> 00:46:02,450
yeah I've always I've always

1100
00:46:06,430 --> 00:46:04,700
oversimplified it by imagining this star

1101
00:46:08,890 --> 00:46:06,440
where the all of the electrons are

1102
00:46:10,330 --> 00:46:08,900
squished so tightly together that

1103
00:46:11,890 --> 00:46:10,340
they're not like you say they're not

1104
00:46:13,630 --> 00:46:11,900
part of an individual atom anymore

1105
00:46:15,310 --> 00:46:13,640
they're just there's just no more space

1106
00:46:17,440 --> 00:46:15,320
there and they're all kind of tightly

1107
00:46:20,890 --> 00:46:17,450
packed into this sort way as you said

1108
00:46:22,750 --> 00:46:20,900
maybe a crystal and kind of structure

1109
00:46:24,340 --> 00:46:22,760
not really but and just kind of wrap

1110
00:46:25,930 --> 00:46:24,350
that up so there we have this white Dorf

1111
00:46:27,640 --> 00:46:25,940
then so to just sit there forever but if

1112
00:46:29,920 --> 00:46:27,650
you have some mechanism of dumping more

1113
00:46:31,570 --> 00:46:29,930

material onto it or merging two of them

1114
00:46:33,190 --> 00:46:31,580
such that you exceed that one point four

1115
00:46:35,089 --> 00:46:33,200
solar mass limit then you're going to

1116
00:46:37,309 --> 00:46:35,099
get a 1a supernova

1117
00:46:38,599 --> 00:46:37,319
and there you go so thank good quite

1118
00:46:41,059 --> 00:46:38,609
good job that was that was a tough

1119
00:46:43,370 --> 00:46:41,069
concept so I hope that made a lot of

1120
00:46:45,469 --> 00:46:43,380
sense i find that these my favorite

1121
00:46:47,690 --> 00:46:45,479
thing about it is you can you can you

1122
00:46:49,039 --> 00:46:47,700
can always use the word degenerate now

1123
00:46:53,599 --> 00:46:49,049
in astronomy and have it have been

1124
00:46:57,799 --> 00:46:53,609
something good and now that's also true

1125
00:46:59,989 --> 00:46:57,809
/ GG generous II so um okay so there was

1126
00:47:01,819 --> 00:46:59,999
a question here I wanted to get to a

1127
00:47:03,259 --> 00:47:01,829
little a comment from Russell Bateman

1128
00:47:06,049 --> 00:47:03,269
this was to you Carol this is off topic

1129
00:47:08,870 --> 00:47:06,059
he says but is that 3d printing going on

1130
00:47:11,120 --> 00:47:08,880
in the background yes it's 3d printing

1131
00:47:14,120 --> 00:47:11,130
going on in the background we have a

1132
00:47:15,769 --> 00:47:14,130
project to create objects with a 3d

1133
00:47:19,940 --> 00:47:15,779
printer actually for the visually

1134
00:47:22,880 --> 00:47:19,950
impaired and unfortunately because the

1135
00:47:25,219 --> 00:47:22,890
printers in my office the intern sets up

1136
00:47:28,460 --> 00:47:25,229
the job and it runs for seven hours and

1137
00:47:30,890 --> 00:47:28,470
there's nothing I can help you with that

1138
00:47:33,589 --> 00:47:30,900

send it on over my way and I'll take

1139
00:47:36,079 --> 00:47:33,599
care of it it's trying to make a galaxy

1140
00:47:38,960 --> 00:47:36,089
only a really big one in fluorescent

1141
00:47:41,630 --> 00:47:38,970
orange and we put textures on them so

1142
00:47:44,209 --> 00:47:41,640
they can feel what it feels like since

1143
00:47:46,219 --> 00:47:44,219
they can't see the images we haven't

1144
00:47:48,640 --> 00:47:46,229
figured out how to make a white dwarf or

1145
00:47:51,950 --> 00:47:48,650
a cosmic Cataclysm prepared oh boy yeah

1146
00:47:57,709 --> 00:47:51,960
because one of the spheres would would

1147
00:47:59,299 --> 00:47:57,719
do the surrogate for what yeah well

1148
00:48:02,299 --> 00:47:59,309
there you go that's really cool printer

1149
00:48:04,910 --> 00:48:02,309
to either so many apologies for the

1150
00:48:06,529 --> 00:48:04,920
noise no it's great it's a we knew I

1151
00:48:08,959 --> 00:48:06,539
should have a can hang out on that as a

1152
00:48:12,289 --> 00:48:08,969
3d printing and used as an astronomy so

1153
00:48:14,599 --> 00:48:12,299
a manual conceal I believe is how you

1154
00:48:16,789 --> 00:48:14,609
pronounce his last name was pointing out

1155
00:48:19,069 --> 00:48:16,799
that observation campaigns past and

1156
00:48:21,739 --> 00:48:19,079
current for pro-am collaboration are

1157
00:48:24,079 --> 00:48:21,749
available on the absa website and he

1158
00:48:26,329 --> 00:48:24,089
says it said ave so org slash observing

1159
00:48:30,499 --> 00:48:26,339
dash campaigns so you can get a sense of

1160
00:48:32,569 --> 00:48:30,509
what's going on already uh right Arnie

1161
00:48:34,249 --> 00:48:32,579
so you can kind of already get an

1162
00:48:39,319 --> 00:48:34,259
overview of what's what's being done

1163
00:48:40,910 --> 00:48:39,329

with in-app so maybe so okay so I have

1164
00:48:43,009 --> 00:48:40,920
well that brings up a point I had a

1165
00:48:45,650 --> 00:48:43,019
question about the observation that were

1166
00:48:48,349 --> 00:48:45,660
they were taking the art oh and Gordon

1167
00:48:49,430 --> 00:48:48,359
were doing for Boris was there a lot of

1168
00:48:52,640 --> 00:48:49,440
communication

1169
00:48:55,700 --> 00:48:52,650
among you like oh I observed it in its

1170
00:48:58,490 --> 00:48:55,710
blah blah you know magnitude and report

1171
00:49:02,630 --> 00:48:58,500
or do you use basically send things to

1172
00:49:04,760 --> 00:49:02,640
Boris and to the aavso for further

1173
00:49:06,950 --> 00:49:04,770
processing so how much communication in

1174
00:49:10,430 --> 00:49:06,960
these companion campaigns goes on

1175
00:49:13,430 --> 00:49:10,440
between the APS all members yeah maybe

1176
00:49:16,339 --> 00:49:13,440
report and then our token could explain

1177
00:49:18,770 --> 00:49:16,349
that yeah primarily it was by submitting

1178
00:49:20,210 --> 00:49:18,780
the data to the aavso website so it was

1179
00:49:22,280 --> 00:49:20,220
kind of an indirect communication like

1180
00:49:24,950 --> 00:49:22,290
with our tow and others now when things

1181
00:49:26,809 --> 00:49:24,960
got really kind of critical the last 24

1182
00:49:28,579 --> 00:49:26,819
hours then there were occasional emails

1183
00:49:30,440 --> 00:49:28,589
going back and forth between us directly

1184
00:49:35,089 --> 00:49:30,450
is that everybody was trying to get the

1185
00:49:39,440 --> 00:49:35,099
app duration that the HST needed yeah

1186
00:49:44,660 --> 00:49:39,450
that's on top of it and and do you do

1187
00:49:46,849 --> 00:49:44,670
you both join campaigns regularly yeah I

1188
00:49:48,500 --> 00:49:46,859

mean I in my case yeah I do mean to me

1189
00:49:50,540 --> 00:49:48,510
that's the enjoyment of the amateur

1190
00:49:52,370 --> 00:49:50,550
astronomy I think people go one of two

1191
00:49:55,370 --> 00:49:52,380
ways in amateur astronomy the beautiful

1192
00:49:56,660 --> 00:49:55,380
photographs or science support and my

1193
00:50:00,559 --> 00:49:56,670
particular Vance working with the

1194
00:50:06,170 --> 00:50:00,569
scientists and how are you are tell you

1195
00:50:08,180 --> 00:50:06,180
is that the staple simple me great thank

1196
00:50:10,160 --> 00:50:08,190
you all right so christian alexander we

1197
00:50:13,339 --> 00:50:10,170
durer is asking where in this maybe

1198
00:50:15,829 --> 00:50:13,349
maybe Nolan you know or Carol where can

1199
00:50:19,490 --> 00:50:15,839
I find an overview about all HST

1200
00:50:21,470 --> 00:50:19,500
observation orders or any statistics

1201
00:50:23,599 --> 00:50:21,480
about the observations and also about

1202
00:50:25,040 --> 00:50:23,609
the usage of color filters things like

1203
00:50:28,609 --> 00:50:25,050
that is there a place people can go to

1204
00:50:32,839 --> 00:50:28,619
see where HST is about to observe yes

1205
00:50:36,140 --> 00:50:32,849
actually I just looked it up and you can

1206
00:50:38,349 --> 00:50:36,150
go to the website which i will tell you

1207
00:50:42,980 --> 00:50:38,359
but you can also do a google search on

1208
00:50:45,800 --> 00:50:42,990
HST observing programs and there is a

1209
00:50:48,200 --> 00:50:45,810
page that talks about the programs that

1210
00:50:49,880 --> 00:50:48,210
are in the queue for the week nolan

1211
00:50:52,059 --> 00:50:49,890
talked about that there's a queue built

1212
00:50:56,480 --> 00:50:52,069
for week so you can actually look at the

1213
00:51:00,230 --> 00:50:56,490

observations for week and then we we

1214
00:51:02,910 --> 00:51:00,240
have this process where every year we

1215
00:51:06,210 --> 00:51:02,920
have proposals like boris and others

1216
00:51:08,549 --> 00:51:06,220
put in a proposal to get time on HST and

1217
00:51:11,579 --> 00:51:08,559
then their peer reviewed and the

1218
00:51:14,280 --> 00:51:11,589
calendar then those proposals that one

1219
00:51:16,069 --> 00:51:14,290
are published as well and all of those

1220
00:51:19,740 --> 00:51:16,079
are through the Hubble Space Telescope

1221
00:51:22,349 --> 00:51:19,750
mission office web page which is from

1222
00:51:28,380 --> 00:51:22,359
the Space Telescope page so i will say

1223
00:51:30,960 --> 00:51:28,390
it slowly and it's ww course got stsci

1224
00:51:34,829 --> 00:51:30,970
which stands for Space Telescope Science

1225
00:51:37,109 --> 00:51:34,839
Institute edu and if you go to that page

1226
00:51:39,480 --> 00:51:37,119
and you look under missions there's a

1227
00:51:43,109 --> 00:51:39,490
chesty mission and all the things about

1228
00:51:46,740 --> 00:51:43,119
this the observations in what's called

1229
00:51:49,230 --> 00:51:46,750
cycle 21 cycle 22 was just peer reviewed

1230
00:51:51,000 --> 00:51:49,240
and that will be published soon all the

1231
00:51:54,359 --> 00:51:51,010
previous cycles of things that have been

1232
00:51:56,220 --> 00:51:54,369
observed um we of course have our press

1233
00:51:58,319 --> 00:51:56,230
releases that highlight some of the

1234
00:52:01,319 --> 00:51:58,329
discoveries and then there is the

1235
00:52:03,180 --> 00:52:01,329
schedule that says HST program for the

1236
00:52:06,870 --> 00:52:03,190
week post or you can see what's

1237
00:52:09,150 --> 00:52:06,880
happening or back where the week so all

1238
00:52:11,940 --> 00:52:09,160

that information is out there for you to

1239
00:52:15,569 --> 00:52:11,950
peruse youngest on over there yeah

1240
00:52:17,160 --> 00:52:15,579
fighting an astronomer okay so I want to

1241
00:52:18,780 --> 00:52:17,170
respond to one comment I'm staying on

1242
00:52:20,700 --> 00:52:18,790
here about that there aren't any there

1243
00:52:22,260 --> 00:52:20,710
aren't any answered questions showing up

1244
00:52:24,930 --> 00:52:22,270
under the Q&A app and the reason for

1245
00:52:27,870 --> 00:52:24,940
that is I have I don't have the ability

1246
00:52:30,000 --> 00:52:27,880
to select them i am not running the

1247
00:52:31,680 --> 00:52:30,010
running the Hangout so i don't get the

1248
00:52:33,299 --> 00:52:31,690
ability to actually choose which

1249
00:52:35,670 --> 00:52:33,309
questions but we are answering questions

1250
00:52:37,109 --> 00:52:35,680
right now I just can't select them and

1251
00:52:38,789 --> 00:52:37,119
have them be highlighted now I'm going

1252
00:52:41,490 --> 00:52:38,799
to work with Elena on fixing that next

1253
00:52:44,670 --> 00:52:41,500
week so I just want to let people know

1254
00:52:49,130 --> 00:52:44,680
that that is we are answering questions

1255
00:52:52,140 --> 00:52:49,140
so so that was good so let's see um

1256
00:52:53,910 --> 00:52:52,150
let's see well finally we'll take let me

1257
00:52:57,319 --> 00:52:53,920
Scott am I missing any on do you have

1258
00:52:59,220 --> 00:52:57,329
you been looking by any chance at the

1259
00:53:02,220 --> 00:52:59,230
comment tracker I've been looking

1260
00:53:04,589 --> 00:53:02,230
primarily at the and a lot of our stuff

1261
00:53:05,940 --> 00:53:04,599
is in the Q&A app oh there I am blowing

1262
00:53:12,780 --> 00:53:05,950
up the Hubble hanging out twitter feed

1263
00:53:14,819 --> 00:53:12,790

so go Twitter awesome great so let me

1264
00:53:16,080 --> 00:53:14,829
check that real quick and oh you are

1265
00:53:18,680 --> 00:53:16,090
look at all that great job

1266
00:53:22,860 --> 00:53:18,690
um so Q and a nap has been fantastic

1267
00:53:24,000 --> 00:53:22,870
yeah using it yeah so that's been the

1268
00:53:27,480 --> 00:53:24,010
primary way people have been interacting

1269
00:53:29,700 --> 00:53:27,490
with us so thank you guys for that is so

1270
00:53:33,030 --> 00:53:29,710
where are we going for here what's next

1271
00:53:35,400 --> 00:53:33,040
Oh Morris left um hmm okay I'm staying

1272
00:53:37,320 --> 00:53:35,410
here well you're their own thing I

1273
00:53:39,240 --> 00:53:37,330
thought you dropped out yeah I dropped

1274
00:53:41,670 --> 00:53:39,250
off but I joined again oh good good so

1275
00:53:43,230 --> 00:53:41,680
what's next where are you just going to

1276
00:53:48,030 --> 00:53:43,240
keep analyzing data or do you have any

1277
00:53:50,130 --> 00:53:48,040
what we tell us what to look for uh well

1278
00:53:54,060 --> 00:53:50,140
so so will be will be busy with that

1279
00:53:56,160 --> 00:53:54,070
data set for a while um I've got I've

1280
00:53:58,260 --> 00:53:56,170
got some other agency programs but

1281
00:53:59,490 --> 00:53:58,270
nothing on nothing on exploding white

1282
00:54:03,090 --> 00:53:59,500
dwarfs oh that's that's a completely

1283
00:54:05,280 --> 00:54:03,100
different story there okay Morris is one

1284
00:54:09,090 --> 00:54:05,290
of our most successful Hubble proposal

1285
00:54:10,830 --> 00:54:09,100
proposers and he's every cycle he's on

1286
00:54:12,630 --> 00:54:10,840
multiple proposals I don't know how many

1287
00:54:15,150 --> 00:54:12,640
for this cycle but I know it's more than

1288
00:54:16,830 --> 00:54:15,160

if more than two or three that's a good

1289
00:54:18,300 --> 00:54:16,840
point I mean he got a hundred and twenty

1290
00:54:20,160 --> 00:54:18,310
two orbits for this particular that's a

1291
00:54:23,550 --> 00:54:20,170
lot of time that's a long got another

1292
00:54:27,840 --> 00:54:23,560
ones as well so how many are you on the

1293
00:54:32,190 --> 00:54:27,850
cycle Boris I think six so so long one

1294
00:54:33,600 --> 00:54:32,200
is a pinc and five SS class nice good

1295
00:54:38,070 --> 00:54:33,610
we'll have you back I can see that

1296
00:54:40,560 --> 00:54:38,080
that's busy yeah yeah so Eric charland

1297
00:54:42,510 --> 00:54:40,570
has commented that great idea Tony I'd

1298
00:54:44,280 --> 00:54:42,520
watch for sure living in a big city no

1299
00:54:47,420 --> 00:54:44,290
point in buying a big telescope you know

1300
00:54:51,390 --> 00:54:47,430
these virtual telescope idea really is

1301
00:54:53,850 --> 00:54:51,400
it's fantastic yeah i love the ID the

1302
00:54:55,320 --> 00:54:53,860
possibilities for it you can use a

1303
00:54:57,750 --> 00:54:55,330
telescope on the other side of the world

1304
00:55:00,690 --> 00:54:57,760
get your data and contribute to science

1305
00:55:02,250 --> 00:55:00,700
I mean that's um I love seeing it being

1306
00:55:03,630 --> 00:55:02,260
used this way because we use them

1307
00:55:05,250 --> 00:55:03,640
everyone smile for the virtual star

1308
00:55:07,320 --> 00:55:05,260
party so we have friends at I telescope

1309
00:55:10,760 --> 00:55:07,330
that do let us use them for the show

1310
00:55:13,170 --> 00:55:10,770
that's nice and so we did we get to see

1311
00:55:15,180 --> 00:55:13,180
we get to see amazing views from across

1312
00:55:16,530 --> 00:55:15,190
the world that's not initially from our

1313
00:55:18,810 --> 00:55:16,540

strong words that are in so seeing it

1314
00:55:21,360 --> 00:55:18,820
being used for for science in this way

1315
00:55:22,860 --> 00:55:21,370
and really you know supporting the

1316
00:55:25,740 --> 00:55:22,870
Hubble Space Telescope I mean it's

1317
00:55:28,170 --> 00:55:25,750
something that I think is fantastic with

1318
00:55:29,940 --> 00:55:28,180
people think that being able to do

1319
00:55:33,150 --> 00:55:29,950
science

1320
00:55:34,410 --> 00:55:33,160
with a space observatory is so far away

1321
00:55:37,740 --> 00:55:34,420
from them but it's something that you

1322
00:55:41,160 --> 00:55:37,750
can really take part in and it's not a

1323
00:55:43,710 --> 00:55:41,170
big threshold to get into you there's a

1324
00:55:46,800 --> 00:55:43,720
lot of resources available to let you

1325
00:55:49,380 --> 00:55:46,810
actively contribute to science of

1326
00:55:52,740 --> 00:55:49,390
content today well so you're likely not

1327
00:55:55,500 --> 00:55:52,750
expose yeah sounds like it's not yet

1328
00:55:58,410 --> 00:55:55,510
Carol d it sounds like it's a non zero

1329
00:56:00,810 --> 00:55:58,420
cost so there's there's still money in a

1330
00:56:02,130 --> 00:56:00,820
bowl and things like that there ma I

1331
00:56:03,930 --> 00:56:02,140
definitely it can get expensive

1332
00:56:05,099 --> 00:56:03,940
depending by that much time you observe

1333
00:56:07,170 --> 00:56:05,109
on the other hand if you're just

1334
00:56:09,000 --> 00:56:07,180
tracking you know a couple of stars and

1335
00:56:11,760 --> 00:56:09,010
measuring their magnitudes you know once

1336
00:56:13,620 --> 00:56:11,770
a day it's not that bad what we didn't

1337
00:56:15,060 --> 00:56:13,630
talk much about the processing I mean so

1338
00:56:16,290 --> 00:56:15,070

Scott you said people have used them on

1339
00:56:18,060 --> 00:56:16,300
virtual stark don't you have to process

1340
00:56:19,349 --> 00:56:18,070
these images they come back needing dark

1341
00:56:20,609 --> 00:56:19,359
subtractions and all kinds of things

1342
00:56:24,030 --> 00:56:20,619
right i mean you can't just throw them

1343
00:56:26,579 --> 00:56:24,040
up there is that true as some of them

1344
00:56:28,200 --> 00:56:26,589
that we use with I telescope have just

1345
00:56:30,030 --> 00:56:28,210
used regular color cameras so we haven't

1346
00:56:31,380 --> 00:56:30,040
used any of the scientific data coming

1347
00:56:33,599 --> 00:56:31,390
through it we're just using the

1348
00:56:35,520 --> 00:56:33,609
photographs are coming down from the

1349
00:56:37,349 --> 00:56:35,530
cameras that we've used which you know

1350
00:56:39,720 --> 00:56:37,359
we have like a half meter telescope

1351
00:56:41,579 --> 00:56:39,730
which is great to use for four beautiful

1352
00:56:44,400 --> 00:56:41,589
photography I don't know about you guys

1353
00:56:47,460 --> 00:56:44,410
with with your scientific observations

1354
00:56:49,290 --> 00:56:47,470
what what Dad are you receiving from the

1355
00:56:51,710 --> 00:56:49,300
detector how do you process that before

1356
00:56:53,670 --> 00:56:51,720
you're sending it on to the Hubble team

1357
00:56:56,339 --> 00:56:53,680
yeah we actually get you know you

1358
00:56:58,650 --> 00:56:56,349
download all the images from the scopes

1359
00:57:01,260 --> 00:56:58,660
directly onto your laptop computer right

1360
00:57:02,849 --> 00:57:01,270
and then you process all those and get

1361
00:57:05,069 --> 00:57:02,859
the magnitude measurements and uploads

1362
00:57:07,200 --> 00:57:05,079
those back to the double a BSO website

1363
00:57:11,849 --> 00:57:07,210

so yeah that's how we get the data from

1364
00:57:13,650 --> 00:57:11,859
from the remote site I want a nap I want

1365
00:57:16,140 --> 00:57:13,660
to be able to you go out and want a nap

1366
00:57:18,930 --> 00:57:16,150
i'm gonna point it up in the sky have

1367
00:57:24,569 --> 00:57:18,940
Hubble use my stuff and I'm sure our

1368
00:57:27,809 --> 00:57:24,579
knees working on okay we're gonna I got

1369
00:57:28,920 --> 00:57:27,819
one final question it's very uh it's one

1370
00:57:30,420 --> 00:57:28,930
of the older ones and it's got two

1371
00:57:33,240 --> 00:57:30,430
pluses so I want to make sure i mention

1372
00:57:35,970 --> 00:57:33,250
it's from got new raju i'm in india

1373
00:57:39,540 --> 00:57:35,980
india is in asia asia is on earth earth

1374
00:57:42,510 --> 00:57:39,550
is in the universe universes in a galaxy

1375
00:57:43,870 --> 00:57:42,520
well other way around but where is the

1376
00:57:45,339 --> 00:57:43,880
galaxy and how long

1377
00:57:47,200 --> 00:57:45,349
has it so the gal I guess the simple

1378
00:57:50,740 --> 00:57:47,210
answer might be that the galaxy is one

1379
00:57:53,680 --> 00:57:50,750
of a much larger structure of other

1380
00:57:55,660 --> 00:57:53,690
galaxies around us we have we're in

1381
00:57:57,970 --> 00:57:55,670
something called the local group and

1382
00:57:59,829 --> 00:57:57,980
those galaxies are kind of merging some

1383
00:58:01,120 --> 00:57:59,839
in fact we're on a way of colliding with

1384
00:58:02,859 --> 00:58:01,130
one of them right now the Andromeda

1385
00:58:05,920 --> 00:58:02,869
galaxy but on a much larger scale

1386
00:58:08,349 --> 00:58:05,930
universe is composed of this structure

1387
00:58:11,589 --> 00:58:08,359
of galaxies all of which are interacting

1388
00:58:13,359 --> 00:58:11,599

in a variety of complicated ways but

1389
00:58:16,990 --> 00:58:13,369
overall the universe is also expanding

1390
00:58:18,700 --> 00:58:17,000
and accelerating so it's good to point

1391
00:58:20,859 --> 00:58:18,710
out that you start in one spot and as

1392
00:58:23,079 --> 00:58:20,869
your scale gets larger the kinds of

1393
00:58:24,220 --> 00:58:23,089
things that become important change a

1394
00:58:25,359 --> 00:58:24,230
little bit with the scale that you're

1395
00:58:28,509 --> 00:58:25,369
looking at so thank you for that

1396
00:58:33,460 --> 00:58:28,519
question and I guess guys I want to

1397
00:58:36,789 --> 00:58:33,470
thank everybody Boris Nolan art oh and

1398
00:58:38,289 --> 00:58:36,799
Gordon and everybody thank you very much

1399
00:58:41,200 --> 00:58:38,299
for joining us this was a really great

1400
00:58:43,599 --> 00:58:41,210
hangout Carol Scott awesome as always a

1401
00:58:45,849 --> 00:58:43,609
lot of fun I want to thank you guys for

1402
00:58:47,230 --> 00:58:45,859
watching we're still monitor all of

1403
00:58:48,819 --> 00:58:47,240
those channels for a while to answer

1404
00:58:51,609 --> 00:58:48,829
your questions if you still have some I

1405
00:58:53,650 --> 00:58:51,619
want to thank you all for watching next

1406
00:58:56,349 --> 00:58:53,660
week we have a Hubble hang out what's up

1407
00:59:01,420 --> 00:58:56,359
next week Carol oh you would I don't

1408
00:59:04,499 --> 00:59:01,430
know keep talking purpose because I

1409
00:59:08,499 --> 00:59:04,509
didn't have the schedule in front of me

1410
00:59:12,130 --> 00:59:08,509
maybe Scott can answer I can google that

1411
00:59:15,309 --> 00:59:12,140
is will we get my calendar you meant up

1412
00:59:17,620 --> 00:59:15,319
which is why yeah I put on spot that was

1413
00:59:22,630 --> 00:59:17,630

unfair july 17 we're gonna be talking

1414
00:59:24,339 --> 00:59:22,640
about planetary let me um lemme uh yeah

1415
00:59:27,999 --> 00:59:24,349
we're going to be looking at far-uv

1416
00:59:29,440 --> 00:59:28,009
observations using HST and so we hope

1417
00:59:32,049 --> 00:59:29,450
you'll join us for that at the same

1418
00:59:34,480 --> 00:59:32,059
bat-time say no same Hubble time same

1419
00:59:37,150 --> 00:59:34,490
Hubble channel again so that's that's

1420
00:59:39,009 --> 00:59:37,160
looking at see not only earth have

1421
00:59:40,240 --> 00:59:39,019
Aurora but the other planets in the

1422
00:59:42,940 --> 00:59:40,250
solar system and we're just going to

1423
00:59:45,609 --> 00:59:42,950
talk about that we hope you'll join us

1424
00:59:47,529 --> 00:59:45,619
and we have below and bring us your

1425
00:59:49,359 --> 00:59:47,539
questions and comments that's it for