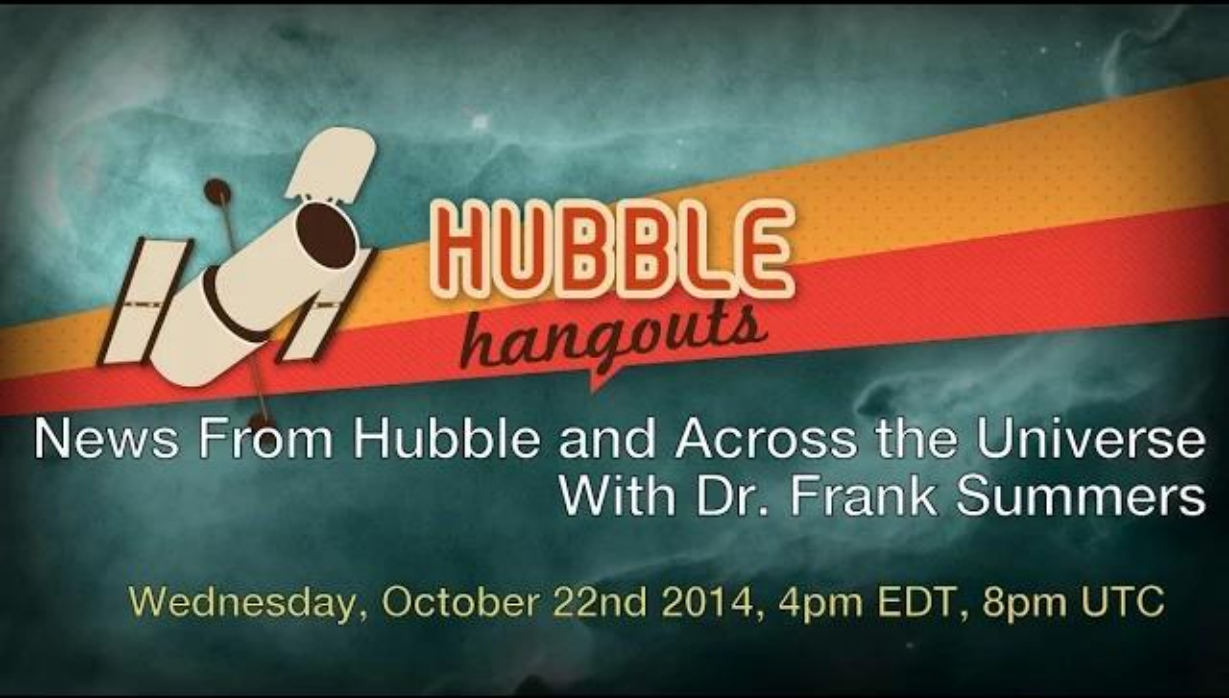
HUBBLE
hangouts
News From Hubble and Across the Universe
With Dr. Frank Summers
Wednesday, October 22nd 2014, 4pm EDT, 8pm UTC

1
00:00:07,010 --> 00:00:05,120
okay hello everybody welcome to this

2
00:00:08,839 --> 00:00:07,020
month's installment of news from Hubble

3
00:00:11,180 --> 00:00:08,849
and across the universe my name is Tony

4
00:00:13,310 --> 00:00:11,190
Darnell and joining me this month as he

5
00:00:16,250 --> 00:00:13,320
does every month is dr. Frank summers

6
00:00:17,689 --> 00:00:16,260
hey telly ain't good to say again thank

7
00:00:19,880 --> 00:00:17,699
you welcome Frank it's good talk to you

8
00:00:21,410 --> 00:00:19,890
again welcome before we get started let

9
00:00:23,480 --> 00:00:21,420
me just tell you guys that you can

10
00:00:24,740 --> 00:00:23,490
interact with us by what we're hoping

11
00:00:27,140 --> 00:00:24,750
you'll believe us some comments and

12
00:00:28,910 --> 00:00:27,150
questions as the Hangout progresses you

13
00:00:31,310 --> 00:00:28,920

can do that with the Hubble hang out

14
00:00:33,590 --> 00:00:31,320
hashtag on twitter you can also use the

15
00:00:34,880 --> 00:00:33,600
Q&A app on YouTube and G+ as well as the

16
00:00:38,840 --> 00:00:34,890
comment sections on both of those areas

17
00:00:39,860 --> 00:00:38,850
and so we're hoping that you will ask us

18
00:00:41,869 --> 00:00:39,870
some questions and leave us some

19
00:00:45,979 --> 00:00:41,879
comments will read read them and get to

20
00:00:47,569 --> 00:00:45,989
him as the Hangout progresses also I

21
00:00:49,430 --> 00:00:47,579
wanted to kind of give a shout out and

22
00:00:52,520 --> 00:00:49,440
Frank as you know this word get we're

23
00:00:55,220 --> 00:00:52,530
gearing up for Hubble's 25th anniversary

24
00:00:57,590 --> 00:00:55,230
25 years being his face can you believe

25
00:01:00,139 --> 00:00:57,600
it you know Tony I was just out of lunch

26
00:01:03,500 --> 00:01:00,149
with somebody today and she was born in

27
00:01:05,690 --> 00:01:03,510
nineteen ninety I mean she she has never

28
00:01:08,870 --> 00:01:05,700
known a time when there wasn't a Hubble

29
00:01:11,990 --> 00:01:08,880
Space Telescope haha those of us who now

30
00:01:14,870 --> 00:01:12,000
feel like old guys uh yeah the idea that

31
00:01:17,270 --> 00:01:14,880
you know Hubble is as long as a lifetime

32
00:01:20,149 --> 00:01:17,280
for these these youngsters these

33
00:01:21,560 --> 00:01:20,159
20-somethings is really impressive yeah

34
00:01:22,760 --> 00:01:21,570
work I'm kind of calling it the Hubble

35
00:01:25,130 --> 00:01:22,770
generation and we're going to have some

36
00:01:26,990 --> 00:01:25,140
social media campaigns are geared toward

37
00:01:28,760 --> 00:01:27,000
that in the coming year so look for

38
00:01:32,270 --> 00:01:28,770

those but i wanted to mention too i

39
00:01:34,130 --> 00:01:32,280
think tomorrow uh the intrepid museum if

40
00:01:37,399 --> 00:01:34,140
you're in New York the intrepid museum

41
00:01:39,469 --> 00:01:37,409
is opening their Hubble at 25 exhibit so

42
00:01:42,469 --> 00:01:39,479
I would encourage you guys if you're in

43
00:01:43,730 --> 00:01:42,479
the area or throughout the time when the

44
00:01:45,050 --> 00:01:43,740
exhibit is on and I think it's going to

45
00:01:47,840 --> 00:01:45,060
be up for the whole year right you know

46
00:01:49,789 --> 00:01:47,850
Frank I know it's at least six months so

47
00:01:51,590 --> 00:01:49,799
yeah try to get down there and see it's

48
00:01:56,120 --> 00:01:51,600
at the intrepid museum and you could go

49
00:01:58,249 --> 00:01:56,130
to attribute intrepid museum org to uh

50
00:01:59,359 --> 00:01:58,259
to learn more about it and get

51
00:02:00,770 --> 00:01:59,369
directions and all that kinda stuff I

52
00:02:03,139 --> 00:02:00,780
just wanted to get a shout out that

53
00:02:05,120 --> 00:02:03,149
opens tomorrow so I will also say that

54
00:02:07,370 --> 00:02:05,130
IP I assisted a little bit on the

55
00:02:09,260 --> 00:02:07,380
exhibits there the exhibit designer

56
00:02:11,630 --> 00:02:09,270
called me for various pieces of

57
00:02:13,460 --> 00:02:11,640
information and things and he even used

58
00:02:14,210 --> 00:02:13,470
a quote of mine oh good what so I

59
00:02:16,160 --> 00:02:14,220
understand

60
00:02:18,080 --> 00:02:16,170
haven't seen the exhibit but the the

61
00:02:19,390 --> 00:02:18,090
exhibit ends with actually a quote about

62
00:02:22,310 --> 00:02:19,400
the James Webb Space Telescope

63
00:02:24,380 --> 00:02:22,320

attributed to me oh good Willie right

64
00:02:25,910 --> 00:02:24,390
awesome so yeah we've got a hand just

65
00:02:28,790 --> 00:02:25,920
about everything have all the seams and

66
00:02:30,050 --> 00:02:28,800
that's that's as it should be so okay

67
00:02:32,030 --> 00:02:30,060
Frank I guess we'll go ahead and get

68
00:02:33,680 --> 00:02:32,040
started you've got some cool stories for

69
00:02:35,090 --> 00:02:33,690
us in case you don't know what we're

70
00:02:37,370 --> 00:02:35,100
doing folks this is something Frank and

71
00:02:39,110 --> 00:02:37,380
I do each month and Frank it gathers up

72
00:02:40,850 --> 00:02:39,120
some really interesting stories that are

73
00:02:42,620 --> 00:02:40,860
both related to Hubble and sometimes

74
00:02:46,090 --> 00:02:42,630
they're not but their depth are

75
00:02:49,520 --> 00:02:46,100
definitely topical areas in astronomy so

76
00:02:51,199 --> 00:02:49,530
what do you got for us Frank ok so as I

77
00:02:53,449 --> 00:02:51,209
said we usually I try to do the news

78
00:02:55,460 --> 00:02:53,459
from Hubble but there's always lots of

79
00:02:57,920 --> 00:02:55,470
cool stuff out there so we end up going

80
00:03:01,400 --> 00:02:57,930
we ended it extended it to and across

81
00:03:05,449 --> 00:03:01,410
the universe ok so our first story

82
00:03:07,790 --> 00:03:05,459
tonight hidden by a super nova all right

83
00:03:12,080 --> 00:03:07,800
so we're going to talk about this galaxy

84
00:03:14,780 --> 00:03:12,090
this is the galaxy m83 & M 83 is this

85
00:03:16,820 --> 00:03:14,790
beautiful spiral galaxies out there um

86
00:03:18,500 --> 00:03:16,830
it's actually relatively nearby it's

87
00:03:22,009 --> 00:03:18,510
only about 10 million light-years away

88
00:03:24,259 --> 00:03:22,019

so it's a relatively nearby galaxies and

89
00:03:28,360 --> 00:03:24,269
one of the famous things that happened

90
00:03:32,930 --> 00:03:28,370
in m83 was the observation of supernovae

91
00:03:35,270 --> 00:03:32,940
1993 J now you might say well I would

92
00:03:37,850 --> 00:03:35,280
1990 3 j.b of any real importance it's

93
00:03:40,910 --> 00:03:37,860
just another supernova well because it's

94
00:03:44,180 --> 00:03:40,920
relatively nearby supernova one can

95
00:03:46,030 --> 00:03:44,190
actually study it in in more detail but

96
00:03:48,650 --> 00:03:46,040
can actually see the details of it okay

97
00:03:50,330 --> 00:03:48,660
and when we look at our supernova I

98
00:03:52,460 --> 00:03:50,340
guess I should explain the on this image

99
00:03:54,350 --> 00:03:52,470
on the left hand side you can see an

100
00:03:56,360 --> 00:03:54,360
image before the supernova occurred and

101
00:03:57,860 --> 00:03:56,370
on the right-hand side you can see the

102
00:03:59,090 --> 00:03:57,870
image when the supernova occurred with

103
00:04:02,210 --> 00:03:59,100
the along with the arrow the arrow

104
00:04:03,949 --> 00:04:02,220
occurred 10 then to se yes it's

105
00:04:06,050 --> 00:04:03,959
wonderful when we look out into space

106
00:04:07,550 --> 00:04:06,060
that somebody puts these big arrows

107
00:04:10,070 --> 00:04:07,560
pointing towards what we should look at

108
00:04:13,520 --> 00:04:10,080
its I'm know it's a turtle drove but I

109
00:04:17,479 --> 00:04:13,530
gotta do it okay so that's super nova

110
00:04:21,320 --> 00:04:17,489
1993 chain um and we classify supernova

111
00:04:24,050 --> 00:04:21,330
based upon their light curve okay so

112
00:04:26,330 --> 00:04:24,060
this is a kind of complex diagram but

113
00:04:28,320 --> 00:04:26,340

what you're getting colors lots of

114
00:04:32,010 --> 00:04:28,330
different colors okay so on the x

115
00:04:34,770 --> 00:04:32,020
we have is measured in days okay and the

116
00:04:37,709 --> 00:04:34,780
peak luminosity is considered day zero

117
00:04:39,809 --> 00:04:37,719
alright so there are days before the

118
00:04:42,240 --> 00:04:39,819
peak luminosity in days after the peak

119
00:04:43,980 --> 00:04:42,250
luminosity and you can see by the legend

120
00:04:45,300 --> 00:04:43,990
at the very top that they're all these

121
00:04:47,760 --> 00:04:45,310
different types of supernovas and

122
00:04:50,520 --> 00:04:47,770
actually that the two highest curves are

123
00:04:52,469 --> 00:04:50,530
for hyper Nova's okay so I didn't know

124
00:04:54,629 --> 00:04:52,479
that why do they why is it the bright

125
00:04:58,529 --> 00:04:54,639
why is it when the supernova actually

126
00:05:00,689 --> 00:04:58,539
occurred day 0 um just because we don't

127
00:05:03,809 --> 00:05:00,699
have we can't tell the exact day it

128
00:05:05,730 --> 00:05:03,819
occurs we never catch it oh yeah yeah

129
00:05:07,409 --> 00:05:05,740
that makes perfect and so the brightness

130
00:05:09,390 --> 00:05:07,419
of the supernova gets brighter and

131
00:05:11,129 --> 00:05:09,400
brighter and brighter and the only point

132
00:05:13,709 --> 00:05:11,139
that we can say ah here's here's a

133
00:05:16,709 --> 00:05:13,719
fiducial point2 to sync everything to is

134
00:05:18,180 --> 00:05:16,719
the peak luminosity day okay look at

135
00:05:21,089 --> 00:05:18,190
those hypernova those are really bright

136
00:05:23,820 --> 00:05:21,099
yeah almost one-and-a-half to two

137
00:05:26,999 --> 00:05:23,830
magnitudes brighter than the type 1 a's

138
00:05:29,879 --> 00:05:27,009

hmm okay so there are two basic types of

139
00:05:33,839 --> 00:05:29,889
supernovae do you know them Tony here is

140
00:05:36,930 --> 00:05:33,849
it there are type 1 and type 2 yes of

141
00:05:41,219 --> 00:05:36,940
course mr. I win what do I we ordered

142
00:05:43,709 --> 00:05:41,229
that and the idea is that type 1a

143
00:05:46,829 --> 00:05:43,719
supernovae come from the explosion of a

144
00:05:48,480 --> 00:05:46,839
white dwarf star and type 2 supernovae

145
00:05:50,700 --> 00:05:48,490
come from the explosion of a massive

146
00:05:53,219 --> 00:05:50,710
star a very massive star near the end of

147
00:05:57,269 --> 00:05:53,229
its life but it's not that simple is it

148
00:05:59,969 --> 00:05:57,279
it's never that okay and used to be that

149
00:06:02,279 --> 00:05:59,979
okay well a white dwarf has had all its

150
00:06:04,649 --> 00:06:02,289
hydrogen burned into helium and carbon

151
00:06:07,589 --> 00:06:04,659
and nitrogen oxygen so it doesn't have

152
00:06:09,480 --> 00:06:07,599
any hydrogen lines in it ok so just

153
00:06:11,969 --> 00:06:09,490
spectroscopically the type ones have no

154
00:06:16,260 --> 00:06:11,979
hydrogen lines the type to have hydrogen

155
00:06:20,300 --> 00:06:16,270
lines now type 2 b's of which supernova

156
00:06:23,939 --> 00:06:20,310
1993 j is one of the classic examples

157
00:06:26,040 --> 00:06:23,949
they are this pink line here okay and

158
00:06:29,100 --> 00:06:26,050
they have two interesting factors about

159
00:06:31,980 --> 00:06:29,110
them one the hydrogen lines are weak

160
00:06:33,480 --> 00:06:31,990
okay there's not much hydrogen in that

161
00:06:35,999 --> 00:06:33,490
initial spectrum their present so

162
00:06:39,510 --> 00:06:36,009
they're hordes of type 2 but they aren't

163
00:06:41,250 --> 00:06:39,520

very strong and eventually they go away

164
00:06:43,170 --> 00:06:41,260
and

165
00:06:46,440 --> 00:06:43,180
crazy thing as you can see in this pink

166
00:06:48,510 --> 00:06:46,450
line is that there's a second peak in

167
00:06:50,100 --> 00:06:48,520
the supernova light curve you look at

168
00:06:52,260 --> 00:06:50,110
all the others there are bumps and

169
00:06:54,330 --> 00:06:52,270
Wiggles but there's no second peak in

170
00:06:57,690 --> 00:06:54,340
any of the light curve hmmm well the two

171
00:06:59,670 --> 00:06:57,700
supernova type to be must have hydrogen

172
00:07:02,340 --> 00:06:59,680
out there right there's some hydrogen

173
00:07:04,740 --> 00:07:02,350
out there but it goes away pretty

174
00:07:07,590 --> 00:07:04,750
quickly so what's the explanation for

175
00:07:11,340 --> 00:07:07,600
this type to be supernova all right well

176
00:07:13,650 --> 00:07:11,350
here is our our idea for so the scenario

177
00:07:15,480 --> 00:07:13,660
is that you have two massive stars

178
00:07:18,600 --> 00:07:15,490
orbiting around each other you know

179
00:07:20,670 --> 00:07:18,610
binary stars are very common if you look

180
00:07:23,220 --> 00:07:20,680
up the night sky half the stars you see

181
00:07:25,460 --> 00:07:23,230
in the night sky are in multiple star

182
00:07:28,320 --> 00:07:25,470
systems binaries or triples or even more

183
00:07:32,400 --> 00:07:28,330
okay and these are really really close

184
00:07:34,770 --> 00:07:32,410
and as the first star the more massive

185
00:07:37,620 --> 00:07:34,780
star evolves to become a red giant or

186
00:07:40,050 --> 00:07:37,630
red supergiant some of the material is

187
00:07:44,280 --> 00:07:40,060
sucked off that star and onto the

188
00:07:47,610 --> 00:07:44,290

companion star okay mm-hmm that leaves

189
00:07:49,610 --> 00:07:47,620
much less hydrogen in the envelope to

190
00:07:52,290 --> 00:07:49,620
appear when that star goes supernova

191
00:07:55,700 --> 00:07:52,300
okay so that explains the weak hydrogen

192
00:08:00,210 --> 00:07:55,710
lines in the supernova explosion right

193
00:08:02,460 --> 00:08:00,220
plus as that hydrogen material expands

194
00:08:05,370 --> 00:08:02,470
away you start to see deeper into the

195
00:08:07,770 --> 00:08:05,380
star you start to see hotter regions of

196
00:08:10,710 --> 00:08:07,780
of the stuff of us of the supernova and

197
00:08:13,650 --> 00:08:10,720
therefore you can get that extra like

198
00:08:16,020 --> 00:08:13,660
bump in the light curve okay so that's

199
00:08:18,210 --> 00:08:16,030
supernova explosion if you pull off

200
00:08:20,580 --> 00:08:18,220
material off of the outer part of the

201
00:08:22,830 --> 00:08:20,590
start before it goes supernova then

202
00:08:25,340 --> 00:08:22,840
you'll get weak hydrogen lines and as

203
00:08:27,450 --> 00:08:25,350
you as you look through the opacity

204
00:08:29,370 --> 00:08:27,460
decreases you look through and see the

205
00:08:32,400 --> 00:08:29,380
hotter regions and you can get a second

206
00:08:36,089 --> 00:08:32,410
bump a peak in the light curve all right

207
00:08:40,170 --> 00:08:36,099
but the interesting thing is this will

208
00:08:43,020 --> 00:08:40,180
leave behind another massive star that

209
00:08:45,210 --> 00:08:43,030
has had a fresh helping of hydrogen

210
00:08:47,910 --> 00:08:45,220
given to it okay and hydrogen is what

211
00:08:49,530 --> 00:08:47,920
them what powers does the first nuclear

212
00:08:51,930 --> 00:08:49,540
fusion that powers the star which

213
00:08:54,840 --> 00:08:51,940

actually if as it mixes in will

214
00:08:56,639 --> 00:08:54,850
regenerate the star well so it doesn't

215
00:08:59,460 --> 00:08:56,649
blow away with with the explosion the

216
00:09:01,949 --> 00:08:59,470
first one that we found that stars are

217
00:09:03,660 --> 00:09:01,959
so compact that even a supernova

218
00:09:06,809 --> 00:09:03,670
explosion going off relatively nearby

219
00:09:08,939 --> 00:09:06,819
doesn't blow the star away Wow all right

220
00:09:11,370 --> 00:09:08,949
so it's got this fresh hydrogen on to it

221
00:09:14,249 --> 00:09:11,380
and it should be rejuvenated and become

222
00:09:16,590 --> 00:09:14,259
a bluer star again so maybe that star

223
00:09:18,840 --> 00:09:16,600
was getting old and was it was starting

224
00:09:20,730 --> 00:09:18,850
towards the red giant track I starting

225
00:09:23,040 --> 00:09:20,740
to become old but it's got this fresh

226
00:09:24,420 --> 00:09:23,050
helping of hydrogen and it had it's

227
00:09:27,840 --> 00:09:24,430
become rejuvenating it should be blue

228
00:09:29,639 --> 00:09:27,850
right okay you know and what's left

229
00:09:30,960 --> 00:09:29,649
behind there that red dot that's with

230
00:09:32,519 --> 00:09:30,970
that's just the remnant that's supposed

231
00:09:36,689 --> 00:09:32,529
to be a supernova remnant hey I'm Keri

232
00:09:40,309 --> 00:09:36,699
diagram okay okay all right so we want

233
00:09:43,710 --> 00:09:40,319
to be able to look for this companion as

234
00:09:45,470 --> 00:09:43,720
evidence that the site to be supernovas

235
00:09:48,809 --> 00:09:45,480
go the way that we think they should

236
00:09:54,439 --> 00:09:48,819
okay so I mean we're going to look at

237
00:10:00,179 --> 00:09:54,449
his m83 image but Hubble's m83 image is

238
00:10:02,370 --> 00:10:00,189

384 megapixels hey I I know I know their

239
00:10:05,280 --> 00:10:02,380
money evers have lots of pixels but this

240
00:10:08,220 --> 00:10:05,290
is even bigger than not that many okay

241
00:10:12,929 --> 00:10:08,230
Oh 20,000 by 15 down I think my phone

242
00:10:15,600 --> 00:10:12,939
has 10 I still got an old phone it's

243
00:10:18,389 --> 00:10:15,610
only got like three or four ah Wow good

244
00:10:23,309 --> 00:10:18,399
so if we look into that region where

245
00:10:24,840 --> 00:10:23,319
supernova 1993 J exists existed if we

246
00:10:26,850 --> 00:10:24,850
look at it today we don't see that

247
00:10:28,290 --> 00:10:26,860
bright star or that yellow arrow you

248
00:10:32,610 --> 00:10:28,300
know somebody erased that yellow arrow

249
00:10:34,920 --> 00:10:32,620
for darn but with all this resolution

250
00:10:37,650 --> 00:10:34,930
from Hubble we can actually look in and

251
00:10:40,650 --> 00:10:37,660
follow and try and see can we see that

252
00:10:43,079 --> 00:10:40,660
companion star and this is what we found

253
00:10:46,230 --> 00:10:43,089
boom that yellow arrow pops back out and

254
00:10:48,660 --> 00:10:46,240
it is a tiny little dot and one of these

255
00:10:52,199 --> 00:10:48,670
blue little dots in this image it wasn't

256
00:10:53,999 --> 00:10:52,209
actually specified to my certainty which

257
00:10:55,860 --> 00:10:54,009
one it was but yeah cuz I like the arrow

258
00:10:58,110 --> 00:10:55,870
to be in that smoking at both of their

259
00:11:00,569 --> 00:10:58,120
wonder which one it is and and I wanted

260
00:11:02,009 --> 00:11:00,579
to put that arrow in there but the press

261
00:11:03,750 --> 00:11:02,019
release I couldn't figure out exactly

262
00:11:05,879 --> 00:11:03,760
which one it was so it's one of those

263
00:11:06,860 --> 00:11:05,889

being the blue one right near the center

264
00:11:09,200 --> 00:11:06,870
yeah

265
00:11:12,590 --> 00:11:09,210
this is what we find at the site of

266
00:11:17,060 --> 00:11:12,600
super non over 1993 Jay today you do

267
00:11:19,220 --> 00:11:17,070
find a blue star right we see that same

268
00:11:21,980 --> 00:11:19,230
in the exact same spot where we saw the

269
00:11:24,470 --> 00:11:21,990
supernova goes this is very juvenile in

270
00:11:26,660 --> 00:11:24,480
star with hmm this is I'm sorry that's

271
00:11:29,120 --> 00:11:26,670
this is that rejuvenated star the one

272
00:11:31,790 --> 00:11:29,130
that's done or GOP a star and it's blue

273
00:11:34,550 --> 00:11:31,800
okay like I should be right it should be

274
00:11:36,920 --> 00:11:34,560
if it's if it's rejuvenated okay so we

275
00:11:41,090 --> 00:11:36,930
have finally answered the question to be

276
00:11:45,350 --> 00:11:41,100
or not to be a heavenly supernova 1983

277
00:11:51,470 --> 00:11:45,360
oh god this is gonna be one of those

278
00:11:54,710 --> 00:11:51,480
days isn't it Frank supernova 1983 jay

279
00:11:56,150 --> 00:11:54,720
is a to be super nova and it has the

280
00:11:57,290 --> 00:11:56,160
companion that we've been looking for

281
00:11:59,000 --> 00:11:57,300
this is the first time we've ever been

282
00:12:04,250 --> 00:11:59,010
able to confirm that any idea of its

283
00:12:06,650 --> 00:12:04,260
mass no I come here I was just curious

284
00:12:08,360 --> 00:12:06,660
my recollection was and I'm not sure

285
00:12:11,630 --> 00:12:08,370
about that both of them were meant to be

286
00:12:14,000 --> 00:12:11,640
very massive stars or so on order 10

287
00:12:15,920 --> 00:12:14,010
solar masses and possibility at this

288
00:12:19,130 --> 00:12:15,930

star will go supernova itself in the

289
00:12:21,710 --> 00:12:19,140
future that was my impression but I

290
00:12:23,390 --> 00:12:21,720
can't remember exactly that's really

291
00:12:25,250 --> 00:12:23,400
cool though i do these these so these

292
00:12:26,449 --> 00:12:25,260
stars can feed off of each other and I

293
00:12:28,160 --> 00:12:26,459
guess ways we're only just now

294
00:12:30,320 --> 00:12:28,170
discovering that's really a cool theory

295
00:12:33,350 --> 00:12:30,330
though are a good good confirmation of a

296
00:12:36,230 --> 00:12:33,360
theory and so a to be super nova is is

297
00:12:38,840 --> 00:12:36,240
like a you know 1a supernova in that a

298
00:12:42,199 --> 00:12:38,850
white dwarf in a 1a supernova feeds off

299
00:12:44,240 --> 00:12:42,209
of a giant star to to undergo with

300
00:12:45,949 --> 00:12:44,250
supernova explosion but here you're

301
00:12:49,280 --> 00:12:45,959
actually pulling star off the star that

302
00:12:50,870 --> 00:12:49,290
goes supernova what guys think okay yeah

303
00:12:52,550 --> 00:12:50,880
before you go to your next door you

304
00:12:54,710 --> 00:12:52,560
about to go to your next story sure go

305
00:12:56,600 --> 00:12:54,720
ahead I just want to give you a question

306
00:12:58,519 --> 00:12:56,610
from Adam synergy he's asking and I'm

307
00:13:00,740 --> 00:12:58,529
not highlighted here on the Q&A app I

308
00:13:02,269 --> 00:13:00,750
recently entered into a discussion with

309
00:13:04,610 --> 00:13:02,279
someone who argued that computer

310
00:13:07,280 --> 00:13:04,620
simulations of this of the large-scale

311
00:13:10,040 --> 00:13:07,290
universe are meaningless because quote

312
00:13:13,040 --> 00:13:10,050
they're only simulations uncool what

313
00:13:14,870 --> 00:13:13,050

does dr. summers think have the biggest

314
00:13:17,150 --> 00:13:14,880
contributions from this area of research

315
00:13:18,889 --> 00:13:17,160
and I'm actually that are the Hubble

316
00:13:21,139 --> 00:13:18,899
public like I would say

317
00:13:26,900 --> 00:13:21,149
yeah yeah and I would say of course my

318
00:13:28,100 --> 00:13:26,910
PhD thesis okay yes oh yeah only

319
00:13:30,859 --> 00:13:28,110
something you're interested in a good

320
00:13:33,739 --> 00:13:30,869
question too I my PhD thesis was in

321
00:13:35,900 --> 00:13:33,749
computer simulations I did hydrodynamics

322
00:13:40,790 --> 00:13:35,910
simulations of the formation of galaxies

323
00:13:43,879 --> 00:13:40,800
Oh about 20 years ago or so and what

324
00:13:46,449 --> 00:13:43,889
computer simulations do for you is they

325
00:13:49,609 --> 00:13:46,459
allow you to explore a range of ideas

326
00:13:52,249 --> 00:13:49,619
okay one of the things I often say is

327
00:13:55,759 --> 00:13:52,259
that astronomy is not a laboratory

328
00:13:57,829 --> 00:13:55,769
science you can't go out and grab a star

329
00:14:00,230 --> 00:13:57,839
or nebula bring it into your lab slice

330
00:14:03,379 --> 00:14:00,240
it dice it look under the hood see what

331
00:14:05,749 --> 00:14:03,389
it's made of but we do know the

332
00:14:08,329 --> 00:14:05,759
equations of physics and we can program

333
00:14:10,340 --> 00:14:08,339
them accurately into a computer and we

334
00:14:12,350 --> 00:14:10,350
can simulate the behavior of matter

335
00:14:16,519 --> 00:14:12,360
according to those equations of physics

336
00:14:17,929 --> 00:14:16,529
and what the simulations have done for

337
00:14:20,660 --> 00:14:17,939
us over the years especially in terms of

338
00:14:23,299 --> 00:14:20,670

cosmology is they have narrowed down our

339
00:14:26,840 --> 00:14:23,309
range of options in terms of the

340
00:14:29,720 --> 00:14:26,850
cosmology when the 1980s when I started

341
00:14:31,579 --> 00:14:29,730
working in this field the main results

342
00:14:33,739 --> 00:14:31,589
were that well first of all you could

343
00:14:37,639 --> 00:14:33,749
collapse material to get you know

344
00:14:39,110 --> 00:14:37,649
structures and you have a range of

345
00:14:41,629 --> 00:14:39,120
dainik see perturbations in the early

346
00:14:43,249 --> 00:14:41,639
universe and how do they do they

347
00:14:46,460 --> 00:14:43,259
collapse to form the galaxy distribution

348
00:14:50,059 --> 00:14:46,470
we see today so this focused on the cold

349
00:14:52,759 --> 00:14:50,069
dark matter scenario and able to see how

350
00:14:56,030 --> 00:14:52,769
the dark matter forms the seeds from

351
00:14:59,119 --> 00:14:56,040
which the normal matter could collapse

352
00:15:02,989 --> 00:14:59,129
to form galaxies and so we've been able

353
00:15:05,090 --> 00:15:02,999
to really refine and constrain how the

354
00:15:07,519 --> 00:15:05,100
large-scale galaxy distribution are

355
00:15:09,710 --> 00:15:07,529
formed as well as what Greg Snyder

356
00:15:11,559 --> 00:15:09,720
showed just a few weeks ago was that

357
00:15:14,179 --> 00:15:11,569
we're getting down to really making

358
00:15:16,669 --> 00:15:14,189
individual galaxies that look somewhat

359
00:15:18,199 --> 00:15:16,679
realistic you know my PhD thesis

360
00:15:20,179 --> 00:15:18,209
simulation we got galaxies and they had

361
00:15:22,009 --> 00:15:20,189
disks but you really couldn't see any

362
00:15:25,220 --> 00:15:22,019
spiral arms or anything and the stuff

363
00:15:27,799 --> 00:15:25,230

Greg was showing was definitely several

364
00:15:29,539 --> 00:15:27,809
quantum levels above it quantum advances

365
00:15:31,699 --> 00:15:29,549
over it because you really could see

366
00:15:32,420 --> 00:15:31,709
galaxies that look like other galaxies

367
00:15:35,780 --> 00:15:32,430
and then you could

368
00:15:39,410 --> 00:15:35,790
test out ideas about how galaxies formed

369
00:15:41,630 --> 00:15:39,420
with these simulations and then and then

370
00:15:43,550 --> 00:15:41,640
an answer to that person who said oh

371
00:15:46,130 --> 00:15:43,560
they're only simulations you must

372
00:15:48,769 --> 00:15:46,140
compare them against observations in

373
00:15:50,690 --> 00:15:48,779
order to make a valid point that's right

374
00:15:52,340 --> 00:15:50,700
and once you've got these models sort of

375
00:15:54,050 --> 00:15:52,350
constrained a little bit and you know

376
00:15:56,780 --> 00:15:54,060
what makes sense in which doesn't make

377
00:15:59,660 --> 00:15:56,790
sense you can you can more intelligently

378
00:16:01,970 --> 00:15:59,670
plan for those observation is it's like

379
00:16:04,760 --> 00:16:01,980
you said it with dear previous story if

380
00:16:06,949 --> 00:16:04,770
they're right about the theories of what

381
00:16:08,810 --> 00:16:06,959
this what the supernovae are like then

382
00:16:11,150 --> 00:16:08,820
we should see the following thing and so

383
00:16:12,980 --> 00:16:11,160
when Hubble got good enough to get the

384
00:16:14,540 --> 00:16:12,990
resolution they were they looked at it

385
00:16:15,980 --> 00:16:14,550
and they were able to confirm things

386
00:16:17,150 --> 00:16:15,990
they thought in the past now i don't

387
00:16:20,660 --> 00:16:17,160
know if that particular thing was ever

388
00:16:22,070 --> 00:16:20,670

simulated but but it's an example so

389
00:16:24,380 --> 00:16:22,080
that was a good question Adam and I have

390
00:16:26,810 --> 00:16:24,390
one more question it's from I was

391
00:16:29,780 --> 00:16:26,820
related to the story that you just you

392
00:16:32,030 --> 00:16:29,790
just did Hans milling on QA is going as

393
00:16:36,949 --> 00:16:32,040
asking what is the green dot in the

394
00:16:38,030 --> 00:16:36,959
upper right Krypton yeah so so he's

395
00:16:40,730 --> 00:16:38,040
talking about I don't know if you can

396
00:16:42,290 --> 00:16:40,740
see the mouse on this Yeah right there

397
00:16:44,980 --> 00:16:42,300
there so it's a green dot there's also a

398
00:16:47,780 --> 00:16:44,990
red dot above that and some yellow dots

399
00:16:50,510 --> 00:16:47,790
since I don't know the man passes that

400
00:16:54,650 --> 00:16:50,520
these were observed in I'm going to

401
00:16:57,410 --> 00:16:54,660
assume that the green dot is is either a

402
00:17:02,990 --> 00:16:57,420
cosmic ray hit that came only in the

403
00:17:05,960 --> 00:17:03,000
green the green observation it wouldn't

404
00:17:07,669 --> 00:17:05,970
be a there are no things that are small

405
00:17:09,919 --> 00:17:07,679
discreet and completely green like that

406
00:17:12,590 --> 00:17:09,929
yeah it's pretty weird looking all right

407
00:17:14,720 --> 00:17:12,600
nebulae things that we found if you

408
00:17:17,150 --> 00:17:14,730
remember Hani's for me from a few years

409
00:17:19,460 --> 00:17:17,160
ago oh yeah yeah nebula type things that

410
00:17:21,620 --> 00:17:19,470
show up mostly in green light but not

411
00:17:24,439 --> 00:17:21,630
small discreet things so I would assume

412
00:17:26,510 --> 00:17:24,449
that's just a cosmic very hit for

413
00:17:27,799 --> 00:17:26,520

something like that cool all right yep

414
00:17:28,910 --> 00:17:27,809
Thank You Hans and I'll get to your

415
00:17:31,850 --> 00:17:28,920
other question in just a bit but I

416
00:17:35,450 --> 00:17:31,860
Monell that Franco or the next story all

417
00:17:37,700 --> 00:17:35,460
right to Pluto and beyond part two

418
00:17:41,120 --> 00:17:37,710
because Tony you remember we talked

419
00:17:43,400 --> 00:17:41,130
about this in July right mm-hmm yep are

420
00:17:44,930 --> 00:17:43,410
the New Horizons mission it were aizen's

421
00:17:46,010 --> 00:17:44,940
mission which I want us to remind

422
00:17:48,560 --> 00:17:46,020
everybody what we talked about

423
00:17:52,700 --> 00:17:48,570
they're just little tiny bit launched in

424
00:17:56,150 --> 00:17:52,710
January nineteenth of 2006 okay and that

425
00:18:01,130 --> 00:17:56,160
was just before Hubble found the two

426
00:18:02,840 --> 00:18:01,140
other moons of Pluto Nix and Hydra ok so

427
00:18:06,770 --> 00:18:02,850
this image you can see Pluto Charon Nix

428
00:18:08,330 --> 00:18:06,780
and Hydra notice NH New Horizons they

429
00:18:12,410 --> 00:18:08,340
worked very hard to make sure they could

430
00:18:17,900 --> 00:18:12,420
name these moons and an H it is it so

431
00:18:20,420 --> 00:18:17,910
important to you and of course that was

432
00:18:22,340 --> 00:18:20,430
good because now that new verizon has

433
00:18:24,050 --> 00:18:22,350
launched we astronomers were okay to

434
00:18:26,270 --> 00:18:24,060
kick pluto out of the solar system or

435
00:18:28,190 --> 00:18:26,280
demoted to a dwarf planet because hey

436
00:18:32,650 --> 00:18:28,200
once the mission to Pluto was launched

437
00:18:38,210 --> 00:18:35,270
that's not the real reason I want to say

438
00:18:40,280 --> 00:18:38,220

I'm joking before this comes after you

439
00:18:45,200 --> 00:18:40,290
without yo yo here comes out here Nassif

440
00:18:48,290 --> 00:18:45,210
calling now anyway um but that occurred

441
00:18:51,230 --> 00:18:48,300
that summer that Pluto was demoted from

442
00:18:53,900 --> 00:18:51,240
its planetary status all right Hubble

443
00:18:56,420 --> 00:18:53,910
also played a role in 2010 and 2012

444
00:18:58,430 --> 00:18:56,430
looking for other possible things in the

445
00:19:01,310 --> 00:18:58,440
Pluto system before numerous ins got

446
00:19:04,190 --> 00:19:01,320
there and we discovered sticks and

447
00:19:07,370 --> 00:19:04,200
kerberos ok so now we've got this system

448
00:19:10,160 --> 00:19:07,380
with sort of a planet and five moons or

449
00:19:12,410 --> 00:19:10,170
a binary planet and four moons whatever

450
00:19:13,670 --> 00:19:12,420
you want to do it well Pluto doesn't

451
00:19:16,760 --> 00:19:13,680
need us it's got its own solar system

452
00:19:19,340 --> 00:19:16,770
it's got quite a system should be a

453
00:19:21,860 --> 00:19:19,350
really cool interest system to study so

454
00:19:23,930 --> 00:19:21,870
here is the overview of this new horizon

455
00:19:28,670 --> 00:19:23,940
mission in 10 years and 3 billion miles

456
00:19:32,810 --> 00:19:28,680
as they say launched in 2006 we're here

457
00:19:36,140 --> 00:19:32,820
in fall 2014 next next summer will be

458
00:19:37,760 --> 00:19:36,150
the encounter ok then a real it's a long

459
00:19:40,060 --> 00:19:37,770
way to go what's out in the middle of

460
00:19:42,470 --> 00:19:40,070
bloody nowhere in the solar system ok

461
00:19:44,450 --> 00:19:42,480
that's going to be zooming when it goes

462
00:19:46,940 --> 00:19:44,460
to gets to Pluto it can be very much

463
00:19:50,000 --> 00:19:46,950

assuming but here's important ideas for

464
00:19:52,010 --> 00:19:50,010
you in January 2015 we will finally be

465
00:19:55,060 --> 00:19:52,020
able to improve on these pictures right

466
00:19:57,410 --> 00:19:55,070
these are Hubble images of Pluto they're

467
00:19:59,270 --> 00:19:57,420
essentially the best we can do we can

468
00:19:59,610 --> 00:19:59,280
computer process them to try and you

469
00:20:01,830 --> 00:19:59,620
know

470
00:20:04,770 --> 00:20:01,840
look for better things and create maps

471
00:20:07,230 --> 00:20:04,780
but these are the actual pixels and will

472
00:20:09,450 --> 00:20:07,240
get better starting in January so every

473
00:20:11,760 --> 00:20:09,460
pixel from january to december of next

474
00:20:14,070 --> 00:20:11,770
year is precious because that will be

475
00:20:15,600 --> 00:20:14,080
the only time we'll ever get better than

476
00:20:17,430 --> 00:20:15,610
Hubble that's interesting point because

477
00:20:20,280 --> 00:20:17,440
of yet these are the best images of

478
00:20:23,340 --> 00:20:20,290
Pluto so far and we can ever hope to do

479
00:20:24,600 --> 00:20:23,350
yeah after this when Jaso in January New

480
00:20:27,480 --> 00:20:24,610
Horizons will be close enough to do a

481
00:20:30,030 --> 00:20:27,490
better job yep and so what's the plan

482
00:20:33,660 --> 00:20:30,040
are they gonna be like okay they will be

483
00:20:35,430 --> 00:20:33,670
x dot action picture taking and hey I'm

484
00:20:36,990 --> 00:20:35,440
sure they have a complete schedule think

485
00:20:40,230 --> 00:20:37,000
that 10 years to plan the schedule yeah

486
00:20:42,210 --> 00:20:40,240
yeah so they have a complete schedule

487
00:20:45,299 --> 00:20:42,220
the most important date is July

488
00:20:48,630 --> 00:20:45,309

fourteenth Bastille Day next summer at

489
00:20:51,330 --> 00:20:48,640
749 and 59 seconds a.m. it will have its

490
00:20:54,060 --> 00:20:51,340
close to sproates Newtonian physics I

491
00:20:56,310 --> 00:20:54,070
get alone so I took this from their

492
00:20:58,260 --> 00:20:56,320
website that's I haven't checked it's

493
00:21:01,470 --> 00:20:58,270
been updated but that's the current plan

494
00:21:03,180 --> 00:21:01,480
okay so that is when we will have our

495
00:21:05,669 --> 00:21:03,190
closest approach that's the midpoint it

496
00:21:07,250 --> 00:21:05,679
will continue to be able to take data of

497
00:21:09,180 --> 00:21:07,260
the Pluto system all the way through

498
00:21:11,910 --> 00:21:09,190
December of next year and still have

499
00:21:13,950 --> 00:21:11,920
better views and Hubble would get all

500
00:21:17,130 --> 00:21:13,960
right but the question we asked last

501
00:21:19,650 --> 00:21:17,140
time was what happens afterwards okay

502
00:21:21,330 --> 00:21:19,660
we've been to Pluto now what we just

503
00:21:23,250 --> 00:21:21,340
sort of fly out like voyagers throughout

504
00:21:28,730 --> 00:21:23,260
the solar system I'm going to Disney

505
00:21:31,350 --> 00:21:28,740
World and see goofy right right yeah

506
00:21:34,070 --> 00:21:31,360
buddy so New Horizons you've just been

507
00:21:37,830 --> 00:21:34,080
to puto what are you gonna do next I am

508
00:21:40,080 --> 00:21:37,840
okay so the idea is that we want to try

509
00:21:45,020 --> 00:21:40,090
and explore another object in the Kuiper

510
00:21:48,600 --> 00:21:45,030
belt okay here's a plot from the summer

511
00:21:50,490 --> 00:21:48,610
1274 Kuiper belt objects out there let's

512
00:21:52,560 --> 00:21:50,500
see the blue eyes here starting at the

513
00:21:54,720 --> 00:21:52,570

inner one is Jupiter Saturn Uranus and

514
00:21:57,810 --> 00:21:54,730
Neptune you can see those blue circles

515
00:21:59,640 --> 00:21:57,820
are the orbits of the giant planets and

516
00:22:01,350 --> 00:21:59,650
all of these red and white dots out

517
00:22:02,700 --> 00:22:01,360
there are Kuiper belt objects that have

518
00:22:06,810 --> 00:22:02,710
been discovered in the last 20 years

519
00:22:08,220 --> 00:22:06,820
okay and of course this family here is

520
00:22:10,590 --> 00:22:08,230
the reason why I Pluto is no longer a

521
00:22:11,790 --> 00:22:10,600
planet because hey it's now part that's

522
00:22:12,630 --> 00:22:11,800
one of the largest objects in the Kuiper

523
00:22:15,150 --> 00:22:12,640
belt now

524
00:22:19,080 --> 00:22:15,160
there's a lot of them too all right so

525
00:22:20,250 --> 00:22:19,090
Hubble has what we announced in july was

526
00:22:23,250 --> 00:22:20,260
that Hubble had been given the go-ahead

527
00:22:25,650 --> 00:22:23,260
to do a comprehensive search for other

528
00:22:27,420 --> 00:22:25,660
Kuiper belt objects to look for and so

529
00:22:32,100 --> 00:22:27,430
here's an example here's what we did we

530
00:22:34,530 --> 00:22:32,110
did 83 hovell with see three fields okay

531
00:22:37,170 --> 00:22:34,540
wide field camera 3 wipeouts I yeah

532
00:22:38,790 --> 00:22:37,180
thank you why field camera 3 and so in

533
00:22:41,550 --> 00:22:38,800
the lower left you can see the full moon

534
00:22:43,410 --> 00:22:41,560
at to scale alright so we're we're

535
00:22:45,930 --> 00:22:43,420
actually covering an area almost as

536
00:22:48,060 --> 00:22:45,940
large as the entire full moon those blue

537
00:22:50,160 --> 00:22:48,070
squares are all the places Hubble looked

538
00:22:52,410 --> 00:22:50,170

the squares are all the places that

539
00:22:54,840 --> 00:22:52,420
Hubble looked and Hubble opened its

540
00:22:58,470 --> 00:22:54,850
camera all right and took multiple

541
00:23:01,080 --> 00:22:58,480
exposures of the same region ok so these

542
00:23:03,000 --> 00:23:01,090
ones is just a few multiple exposures it

543
00:23:04,890 --> 00:23:03,010
was still only one orbit basically but

544
00:23:07,680 --> 00:23:04,900
they got 83 it looks like they got 83

545
00:23:11,970 --> 00:23:07,690
orbits a bubble 83 pointings to try and

546
00:23:14,670 --> 00:23:11,980
look for these kb oats and so in the

547
00:23:17,220 --> 00:23:14,680
center we have a single whip whip c3

548
00:23:18,780 --> 00:23:17,230
filled with a camera three field ok and

549
00:23:22,080 --> 00:23:18,790
then there's a blow-up of the region

550
00:23:24,930 --> 00:23:22,090
containing what's called PT 1 which is a

551
00:23:27,510 --> 00:23:24,940
potential target number one oh I love it

552
00:23:29,850 --> 00:23:27,520
potential target ok and so you can see

553
00:23:32,820 --> 00:23:29,860
that this is actually a compendium of

554
00:23:34,440 --> 00:23:32,830
five exposures right and that inside

555
00:23:36,990 --> 00:23:34,450
that little blue circle are five

556
00:23:39,330 --> 00:23:37,000
different images of the same Kuiper belt

557
00:23:40,800 --> 00:23:39,340
object okay because the Kuiper belt

558
00:23:43,380 --> 00:23:40,810
object being within the solar system

559
00:23:45,000 --> 00:23:43,390
moves quickly across the frame whereas

560
00:23:48,690 --> 00:23:45,010
of course the distant stars don't move

561
00:23:51,450 --> 00:23:48,700
right so if we blow that up on the next

562
00:23:54,740 --> 00:23:51,460
image you can see this Kuiper belt

563
00:23:59,580 --> 00:23:54,750

object is normal number is 1 million

564
00:24:02,010 --> 00:23:59,590
10,000 113 why and of course why means

565
00:24:05,820 --> 00:24:02,020
why would you ever call it that way to

566
00:24:08,730 --> 00:24:05,830
view this as kb opt one potential target

567
00:24:10,680 --> 00:24:08,740
number one all right and so this you can

568
00:24:13,350 --> 00:24:10,690
see that left the five different images

569
00:24:15,630 --> 00:24:13,360
of it and so they went through this you

570
00:24:18,540 --> 00:24:15,640
can see a tiny region of one exposure

571
00:24:20,460 --> 00:24:18,550
and there are 83 different exposures so

572
00:24:23,220 --> 00:24:20,470
you can imagine the computer processing

573
00:24:24,540 --> 00:24:23,230
necessary to find these objects so let

574
00:24:26,019 --> 00:24:24,550
me just interject real quick nicholas

575
00:24:27,849 --> 00:24:26,029
grader is asking a question on the q

576
00:24:30,070 --> 00:24:27,859
if it's relevant how how long does it

577
00:24:32,560 --> 00:24:30,080
take to look at all those eighty three

578
00:24:33,940 --> 00:24:32,570
areas for Hubble how it so you want each

579
00:24:36,669 --> 00:24:33,950
one was in orbit right or at least

580
00:24:40,779 --> 00:24:36,679
generally when we do a pointings we

581
00:24:42,310 --> 00:24:40,789
don't slew in between pointings so i

582
00:24:44,320 --> 00:24:42,320
would say that i'd say they probably had

583
00:24:46,149 --> 00:24:44,330
to get eighty three orbits unless they

584
00:24:48,639 --> 00:24:46,159
could do some some sub swing within

585
00:24:49,839 --> 00:24:48,649
within an orbit okay thank you thanks

586
00:24:52,839 --> 00:24:49,849
Nicholas house a good question right

587
00:24:56,649 --> 00:24:52,849
yeah okay and so each orbit is like 96

588
00:24:59,019 --> 00:24:56,659

97 minutes and only half the orbit is

589
00:25:00,519 --> 00:24:59,029
general usable but depending upon how

590
00:25:02,889 --> 00:25:00,529
quickly they can slew between them if

591
00:25:05,320 --> 00:25:02,899
they could do multiple pointings in 11

592
00:25:08,200 --> 00:25:05,330
in one orbit that would be that would be

593
00:25:11,709 --> 00:25:08,210
cool I'm not observer so i don't know if

594
00:25:13,930 --> 00:25:11,719
that's possible okay okay so we got this

595
00:25:17,229 --> 00:25:13,940
stuff here and that's really nice all

596
00:25:19,299 --> 00:25:17,239
right um and so Hubble the kbo

597
00:25:22,269 --> 00:25:19,309
candidates that we found our three

598
00:25:24,039 --> 00:25:22,279
potential targets PT 1 PT 2 and PT 3

599
00:25:26,169 --> 00:25:24,049
again we astronomers are pretty

600
00:25:29,769 --> 00:25:26,179
straightforward were this yeah I met you

601
00:25:33,579 --> 00:25:29,779
two bunch the size estimates are from 25

602
00:25:35,799 --> 00:25:33,589
to 55 kilometers or 15 to 35 miles for

603
00:25:42,399 --> 00:25:35,809
those of you and the point is as bad as

604
00:25:45,930 --> 00:25:42,409
of you miles for those people whatever I

605
00:25:49,329 --> 00:25:45,940
i think in kilometers you're right

606
00:25:51,839 --> 00:25:49,339
anyway so this is really really small

607
00:25:54,159 --> 00:25:51,849
like most Kuiper belt objects are okay

608
00:25:59,139 --> 00:25:54,169
Pluto is around two thousand kilometers

609
00:26:01,389 --> 00:25:59,149
in diameter and PT 1 is quote according

610
00:26:04,329 --> 00:26:01,399
to one guy definitely reachable ok and

611
00:26:06,279 --> 00:26:04,339
reachable is constraint in terms of the

612
00:26:07,839 --> 00:26:06,289
amount of fuel they have onboard the

613
00:26:09,729 --> 00:26:07,849

spacecraft no good i was gonna ask you

614
00:26:11,829 --> 00:26:09,739
about that so ok so it's already going

615
00:26:13,690 --> 00:26:11,839
in a third direction after it leaves

616
00:26:16,119 --> 00:26:13,700
pluto and it's going to be able to do

617
00:26:18,579 --> 00:26:16,129
some moving around but small amount of

618
00:26:20,200 --> 00:26:18,589
maneuverability to make sure that it

619
00:26:22,930 --> 00:26:20,210
passes close by and as you said

620
00:26:26,019 --> 00:26:22,940
Newtonian dynamics we can figure out the

621
00:26:29,109 --> 00:26:26,029
exact orbit no problem ok Newton was

622
00:26:30,909 --> 00:26:29,119
pretty much right and you know actually

623
00:26:32,709 --> 00:26:30,919
there was a question we got in a

624
00:26:34,869 --> 00:26:32,719
workshop I gave recently is do we need

625
00:26:37,960 --> 00:26:34,879
the general relativistic Corrections for

626
00:26:39,730 --> 00:26:37,970
this and generally know there's very

627
00:26:41,350 --> 00:26:39,740
very very very few times

628
00:26:44,590 --> 00:26:41,360
the source software we need gr

629
00:26:46,419 --> 00:26:44,600
corrections I remember JPL saying well

630
00:26:50,410 --> 00:26:46,429
we include them but they're actually not

631
00:26:52,390 --> 00:26:50,420
really relevant ok and then the other

632
00:26:54,669 --> 00:26:52,400
two are considered potentially

633
00:26:57,280 --> 00:26:54,679
accessible and they will require some

634
00:26:59,200 --> 00:26:57,290
study to make sure that if they are

635
00:27:01,140 --> 00:26:59,210
chosen that they are molten resin is the

636
00:27:04,750 --> 00:27:01,150
most interesting one to go visit that

637
00:27:06,310 --> 00:27:04,760
just the the rough calculations say yes

638
00:27:09,610 --> 00:27:06,320

we can get there they of course have to

639
00:27:12,790 --> 00:27:09,620
go through it in detail ok however I

640
00:27:14,410 --> 00:27:12,800
must note okay that this extension of

641
00:27:16,299 --> 00:27:14,420
the new horizons mission to visit

642
00:27:19,390 --> 00:27:16,309
another Kuiper belt object while it's

643
00:27:20,890 --> 00:27:19,400
been as an idea since the beginning of

644
00:27:24,370 --> 00:27:20,900
New Horizons mission it's not been

645
00:27:27,549 --> 00:27:24,380
funded by NASA okay so what will happen

646
00:27:29,350 --> 00:27:27,559
is that the new horizons team sometime

647
00:27:31,360 --> 00:27:29,360
next year the year after I think

648
00:27:34,900 --> 00:27:31,370
probably in 2016 will submit an

649
00:27:38,860 --> 00:27:34,910
application to NASA for extension

650
00:27:42,040 --> 00:27:38,870
funding to do a flyby of one of these

651
00:27:44,080 --> 00:27:42,050
kbos and then NASA depending upon

652
00:27:46,180 --> 00:27:44,090
budgetary situations and whatever's

653
00:27:48,730 --> 00:27:46,190
going on within the agency at the time

654
00:27:50,080 --> 00:27:48,740
will then approve or disapprove that so

655
00:27:52,900 --> 00:27:50,090
I suppose it'll be based a lot on the

656
00:27:54,940 --> 00:27:52,910
science case to be made and the pay the

657
00:27:56,770 --> 00:27:54,950
trade the payoffs versus you know what

658
00:27:58,810 --> 00:27:56,780
it's going to cost to get there as an

659
00:28:00,910 --> 00:27:58,820
astronomer you're already there okay

660
00:28:02,860 --> 00:28:00,920
yeah oh yeah I know the guy he's in

661
00:28:05,470 --> 00:28:02,870
charge right now so there's no extra

662
00:28:07,350 --> 00:28:05,480
money to be put into the spacecraft but

663
00:28:09,820 --> 00:28:07,360

the money is actually for the

664
00:28:11,590 --> 00:28:09,830
astronomers and the technicians to run

665
00:28:14,410 --> 00:28:11,600
the spacecraft and do all the planning

666
00:28:16,780 --> 00:28:14,420
etc so it sets more salary work and as

667
00:28:18,160 --> 00:28:16,790
an astronomer I mean this is our really

668
00:28:22,000 --> 00:28:18,170
the only opportunity we're going to get

669
00:28:24,100 --> 00:28:22,010
from my lifetime tooks to examine Kuiper

670
00:28:27,280 --> 00:28:24,110
belt objects in detail so I of course

671
00:28:29,380 --> 00:28:27,290
would approve it because it's really a

672
00:28:32,200 --> 00:28:29,390
unique opportunity I'll see why we I

673
00:28:33,010 --> 00:28:32,210
can't imagine why we wouldn't the amount

674
00:28:35,110 --> 00:28:33,020
the amount of money's gonna be

675
00:28:36,730 --> 00:28:35,120
relatively small compared to you know

676
00:28:38,590 --> 00:28:36,740
the money it took to get it there right

677
00:28:40,630 --> 00:28:38,600
run Arella exactly yeah it just seems

678
00:28:41,740 --> 00:28:40,640
like a smart thing to do i I don't you

679
00:28:44,049 --> 00:28:41,750
may have said it when i was looking at

680
00:28:46,750 --> 00:28:44,059
four egg comments and stuff but uh did

681
00:28:49,510 --> 00:28:46,760
you say how much these three targets how

682
00:28:54,269 --> 00:28:49,520
long after it passes pluto will it take

683
00:29:00,159 --> 00:28:54,279
to reach a i got there yet Oh

684
00:29:03,429 --> 00:29:00,169
III get get there okay so so here but

685
00:29:07,239 --> 00:29:03,439
for example is a good good diagram that

686
00:29:09,939 --> 00:29:07,249
was on the APL website where so here is

687
00:29:11,889 --> 00:29:09,949
the idea of the PT 1 size and they've

688
00:29:14,069 --> 00:29:11,899

estimated thirty five thirty to forty

689
00:29:18,369 --> 00:29:14,079
five kilometers in diameter okay

690
00:29:21,639 --> 00:29:18,379
asteroid eros which near shoemaker of

691
00:29:24,519 --> 00:29:21,649
which point x is 35 by 12 kilometers and

692
00:29:27,279 --> 00:29:24,529
of course the other comet that's in the

693
00:29:31,569 --> 00:29:27,289
news comment rubber ducky or cheerio

694
00:29:33,849 --> 00:29:31,579
mall Jeremy Semenko rubber ducky which

695
00:29:36,669 --> 00:29:33,859
will be landing on in December so we'll

696
00:29:37,899 --> 00:29:36,679
talk about that next month right you can

697
00:29:40,479 --> 00:29:37,909
see how small that is only four

698
00:29:43,179 --> 00:29:40,489
kilometers in diameter right yep so

699
00:29:45,389 --> 00:29:43,189
they're already been destroyed and their

700
00:29:48,939 --> 00:29:45,399
asteroid asteroid and comet nuclei size

701
00:29:52,449 --> 00:29:48,949
they're not of small moon sizes or even

702
00:29:54,939 --> 00:29:52,459
small planet sizes good all right so

703
00:29:58,449 --> 00:29:54,949
finally it will take several years to

704
00:30:00,129 --> 00:29:58,459
get there the take taken ten years to

705
00:30:04,119 --> 00:30:00,139
get to Pluto take another couple years

706
00:30:07,449 --> 00:30:04,129
to travel further and this is a diagram

707
00:30:09,339 --> 00:30:07,459
showing a possible artist conception of

708
00:30:12,849 --> 00:30:09,349
what it might look like looking back on

709
00:30:14,619 --> 00:30:12,859
the Sun however those bright dots there

710
00:30:17,589 --> 00:30:14,629
are not stars they are supposed to be

711
00:30:20,709 --> 00:30:17,599
the planets okay so Jupiter Saturn

712
00:30:24,729 --> 00:30:20,719
Uranus Neptune and Pluto are shown in

713
00:30:26,439 --> 00:30:24,739

this diagram no ever as somebody who

714
00:30:30,629 --> 00:30:26,449
does astronomers realizations I have to

715
00:30:33,579 --> 00:30:30,639
say the position of the kbo is wrong

716
00:30:35,829 --> 00:30:33,589
okay because first of all New Horizons

717
00:30:39,309 --> 00:30:35,839
is flying past Pluto almost directly on

718
00:30:41,469 --> 00:30:39,319
up from the Sun and it can't change

719
00:30:45,699 --> 00:30:41,479
course it can't take a huge left like

720
00:30:48,819 --> 00:30:45,709
this would be furthermore Pluto is about

721
00:30:51,279 --> 00:30:48,829
3 billion miles from the Sun right this

722
00:30:53,049 --> 00:30:51,289
object is another billion miles farther

723
00:30:55,479 --> 00:30:53,059
that's why it's going to take another

724
00:30:57,399 --> 00:30:55,489
couple years to get there you know

725
00:31:00,549 --> 00:30:57,409
because it's another billion miles that

726
00:31:02,199 --> 00:31:00,559
has got to travel and so if you take a

727
00:31:04,749 --> 00:31:02,209
straight line from the Sun through Pluto

728
00:31:06,490 --> 00:31:04,759
if you can adding in for shortening of

729
00:31:08,560 --> 00:31:06,500
this because of

730
00:31:11,710 --> 00:31:08,570
active this object would have to be way

731
00:31:13,630 --> 00:31:11,720
over there and a lot closer in put it

732
00:31:15,100 --> 00:31:13,640
would be right along with along the site

733
00:31:17,200 --> 00:31:15,110
between the subject and Pluto so you

734
00:31:22,090 --> 00:31:17,210
have you have problems with the artist

735
00:31:24,250 --> 00:31:22,100
liberties then um nice drawing but this

736
00:31:27,610 --> 00:31:24,260
object is way too hot too far away to be

737
00:31:29,290 --> 00:31:27,620
one of the capsule targets okay I just

738
00:31:31,450 --> 00:31:29,300

don't I just thought i would show people

739
00:31:32,980 --> 00:31:31,460
that you know even as an astronomer i

740
00:31:36,100 --> 00:31:32,990
look at these diagrams that's a nice

741
00:31:37,540 --> 00:31:36,110
diagram but I immediately flash on whoa

742
00:31:39,820 --> 00:31:37,550
wait a minute it should be here and

743
00:31:41,410 --> 00:31:39,830
there and the perspective it's very very

744
00:31:44,320 --> 00:31:41,420
hard to get that kind of thing correct

745
00:31:46,150 --> 00:31:44,330
yeah okay okay ya know a couple years

746
00:31:47,830 --> 00:31:46,160
from New Horizons it's gonna be out

747
00:31:50,080 --> 00:31:47,840
there blunt phone off the universe and

748
00:31:51,400 --> 00:31:50,090
it's not gonna be singing 100 bottles of

749
00:31:54,070 --> 00:31:51,410
beer on the wall as it travels across

750
00:31:59,140 --> 00:31:54,080
there god you're was gonna see Tony I'm

751
00:32:01,900 --> 00:31:59,150
I'd lemon I told you are you using I'm

752
00:32:05,500 --> 00:32:01,910
gonna be song from The Pretenders and I

753
00:32:09,520 --> 00:32:05,510
would fly three billion rounds and I

754
00:32:13,030 --> 00:32:09,530
would fly up billion you just to be the

755
00:32:18,250 --> 00:32:13,040
mission that flew for feeling get miles

756
00:32:20,620 --> 00:32:18,260
on a Kuiper belt hey I gotta hand a

757
00:32:23,170 --> 00:32:20,630
change you did it I go the way I was

758
00:32:24,670 --> 00:32:23,180
gonna do it oh that's great okay and i

759
00:32:26,500 --> 00:32:24,680
like i like how you did it you did a

760
00:32:29,830 --> 00:32:26,510
good job with the words and stuff so it

761
00:32:31,540 --> 00:32:29,840
really fits nice it was just you know

762
00:32:33,100 --> 00:32:31,550
listening to the whole thing about it's

763
00:32:35,350 --> 00:32:33,110

going 3 billion miles I was asked to

764
00:32:37,300 --> 00:32:35,360
play a billion more and just subtly that

765
00:32:38,950 --> 00:32:37,310
hit my head feels like it stuck in my

766
00:32:40,900 --> 00:32:38,960
head all right I gotta use that for the

767
00:32:43,900 --> 00:32:40,910
Hangout can I just say though Frank um

768
00:32:49,570 --> 00:32:43,910
let's go glad you're an astronomer stick

769
00:32:51,130 --> 00:32:49,580
to stick to your day job there was great

770
00:32:54,040 --> 00:32:51,140
thanks alright said you've got any

771
00:32:56,760 --> 00:32:54,050
questions let's see here's one from Hans

772
00:32:59,590 --> 00:32:56,770
milling on the Q&A app giggling will

773
00:33:02,740 --> 00:32:59,600
jwst be able to make better pictures of

774
00:33:04,540 --> 00:33:02,750
Pluto uh j ust will have a similar

775
00:33:07,540 --> 00:33:04,550
resolution to Hubble but in the infrared

776
00:33:10,360 --> 00:33:07,550
and Pluto will be brighter in the

777
00:33:13,240 --> 00:33:10,370
infrared than it is in visible light so

778
00:33:16,030 --> 00:33:13,250
yes James T will be able to see it

779
00:33:19,180 --> 00:33:16,040
better but will not get higher

780
00:33:20,450 --> 00:33:19,190
resolution alright so Hubble has about

781
00:33:23,120 --> 00:33:20,460
20 pixels across

782
00:33:25,160 --> 00:33:23,130
Pluto's disk Jada's T will also have

783
00:33:28,730 --> 00:33:25,170
about 20 pixels across those discs in

784
00:33:31,190 --> 00:33:28,740
the infrared pack and Michael jobin is

785
00:33:34,670 --> 00:33:31,200
asking on the Q&A app so will the

786
00:33:36,680 --> 00:33:34,680
sensors work in that way uh in that way

787
00:33:38,870 --> 00:33:36,690
out low light for the new horizons in

788
00:33:41,720 --> 00:33:38,880

other words will be bright enough out

789
00:33:44,720 --> 00:33:41,730
that far out for okay that is a valid

790
00:33:47,390 --> 00:33:44,730
question because the object four billion

791
00:33:50,990 --> 00:33:47,400
miles out there is going to receive you

792
00:33:53,570 --> 00:33:51,000
know less light and it's only tens of

793
00:33:56,420 --> 00:33:53,580
kilometers across so it's not going to

794
00:33:58,610 --> 00:33:56,430
reflect that much light also most Kuiper

795
00:34:02,390 --> 00:33:58,620
belt objects are pretty much pitch black

796
00:34:03,860 --> 00:34:02,400
I'm serious the surface of them they've

797
00:34:06,050 --> 00:34:03,870
been flying around the solar system for

798
00:34:07,990 --> 00:34:06,060
four billion years they hit tiny little

799
00:34:10,610 --> 00:34:08,000
particles the solar wind hits them etc

800
00:34:14,480 --> 00:34:10,620
their surfaces all of the bright stuff

801
00:34:16,490 --> 00:34:14,490
on the surfaces has been pushed away and

802
00:34:18,830 --> 00:34:16,500
you have sort of a at are like colored

803
00:34:20,450 --> 00:34:18,840
service every time we see a comment it

804
00:34:25,610 --> 00:34:20,460
ends up having a coal-black surface

805
00:34:30,020 --> 00:34:25,620
right so the the brightness of the

806
00:34:31,880 --> 00:34:30,030
object will be is in question however we

807
00:34:33,590 --> 00:34:31,890
are going through the Pluto system where

808
00:34:37,940 --> 00:34:33,600
we're kind of pre trying to look at Nix

809
00:34:39,860 --> 00:34:37,950
and Hydra and the other two every 30

810
00:34:42,440 --> 00:34:39,870
days blanking on their names right now

811
00:34:44,600 --> 00:34:42,450
but anyways we're looking those moments

812
00:34:48,050 --> 00:34:44,610
which aren't much bigger if at all

813
00:34:50,390 --> 00:34:48,060

bigger than these in this object so we

814
00:34:52,100 --> 00:34:50,400
will have experience with the numerals

815
00:34:55,550 --> 00:34:52,110
and sensors in looking at those types of

816
00:34:58,100 --> 00:34:55,560
objects and I don't and we can also do

817
00:34:59,630 --> 00:34:58,110
this take longer exposures this is the

818
00:35:01,700 --> 00:34:59,640
one of the things we have to do is

819
00:35:03,680 --> 00:35:01,710
calibrate and so we can use our

820
00:35:06,740 --> 00:35:03,690
long-range one I think it's called New

821
00:35:09,500 --> 00:35:06,750
Horizons called Laurie lor RI is the

822
00:35:11,600 --> 00:35:09,510
long-range imager to look at it in

823
00:35:13,490 --> 00:35:11,610
advance and then we get a close that

824
00:35:15,890 --> 00:35:13,500
will calibrate the exposures will need

825
00:35:17,540 --> 00:35:15,900
for the up-close cameras ok awesome good

826
00:35:18,950 --> 00:35:17,550
question ok thank you and i think that's

827
00:35:20,780 --> 00:35:18,960
it for this particular story i have some

828
00:35:21,860 --> 00:35:20,790
other questions i'll get to after your

829
00:35:25,510 --> 00:35:21,870
after you were able to get through the

830
00:35:27,590 --> 00:35:25,520
stories so ok now I want to switch gears

831
00:35:29,300 --> 00:35:27,600
and tell you guys something that you

832
00:35:31,010 --> 00:35:29,310
usually don't get to hear all right

833
00:35:33,110 --> 00:35:31,020
because Tony and I working at Space

834
00:35:33,920 --> 00:35:33,120
Telescope we get these me emails every

835
00:35:36,049 --> 00:35:33,930
now and then say

836
00:35:39,829 --> 00:35:36,059
okay there's been there's been a hiccup

837
00:35:41,720 --> 00:35:39,839
okay and this happened this week where

838
00:35:43,940 --> 00:35:41,730

we had a hiccup in the science

839
00:35:48,980 --> 00:35:43,950
instrument control and data handling

840
00:35:52,670 --> 00:35:48,990
unit or the SI C and D H so this is the

841
00:35:55,130 --> 00:35:52,680
SI c and d h and actually this is a

842
00:35:56,809 --> 00:35:55,140
ground base unit this is a picture of it

843
00:35:59,089 --> 00:35:56,819
from Goddard Space Flight Center the

844
00:36:02,089 --> 00:35:59,099
ground base unit in outer space by

845
00:36:05,329 --> 00:36:02,099
center but there is a version of this up

846
00:36:08,420 --> 00:36:05,339
on the hubble space telescope and the SI

847
00:36:12,049 --> 00:36:08,430
c and d h was actually very famous about

848
00:36:15,230 --> 00:36:12,059
five years ago because here is the image

849
00:36:17,650 --> 00:36:15,240
of the space shuttles on the launch pad

850
00:36:22,819 --> 00:36:17,660
getting ready for servicing mission for

851
00:36:25,130 --> 00:36:22,829
this was in September of 2008 and you

852
00:36:27,680 --> 00:36:25,140
may remember that the servicing mission

853
00:36:31,460 --> 00:36:27,690
for didn't actually go until may of 2009

854
00:36:33,620 --> 00:36:31,470
he's right it was at this point with the

855
00:36:36,710 --> 00:36:33,630
two shuttles on the launch pads down at

856
00:36:39,980 --> 00:36:36,720
Kennedy that we had a problem in the SI

857
00:36:42,230 --> 00:36:39,990
c and d h on hon board help the a-side

858
00:36:45,589 --> 00:36:42,240
electronics failed and we had to switch

859
00:36:48,200 --> 00:36:45,599
to the b-side electronics and that was

860
00:36:49,940 --> 00:36:48,210
fine because we have backup electronics

861
00:36:52,250 --> 00:36:49,950
but we realized this is the last

862
00:36:55,940 --> 00:36:52,260
servicing mission to Hubble we want to

863
00:36:59,420 --> 00:36:55,950

leave Hubble in the best possible shape

864
00:37:02,000 --> 00:36:59,430
and to have the SI casi C and D H

865
00:37:03,980 --> 00:37:02,010
science instrument control right it

866
00:37:07,010 --> 00:37:03,990
controls all of the science instruments

867
00:37:08,569 --> 00:37:07,020
d h data handling all of the data from

868
00:37:10,640 --> 00:37:08,579
those scientists then route through this

869
00:37:13,849 --> 00:37:10,650
yeah the best cameras in the world if

870
00:37:15,859 --> 00:37:13,859
that stuff doesn't work critical hit p

871
00:37:18,710 --> 00:37:15,869
it is in the critical path of getting

872
00:37:21,380 --> 00:37:18,720
the science data back home okay without

873
00:37:23,089 --> 00:37:21,390
the si si in th we can't get any science

874
00:37:24,890 --> 00:37:23,099
data back okay we can't tell the cameras

875
00:37:26,990 --> 00:37:24,900
what to do we can't get the data off the

876
00:37:29,329 --> 00:37:27,000
camera so it's a really crucial piece of

877
00:37:31,940 --> 00:37:29,339
equipment and it had been up there and

878
00:37:34,220 --> 00:37:31,950
worked fine for 18 years but they

879
00:37:36,770 --> 00:37:34,230
decided all right we're going to take

880
00:37:38,700 --> 00:37:36,780
the time to take the ground spare which

881
00:37:42,750 --> 00:37:38,710
is the picture I showed you in there

882
00:37:45,420 --> 00:37:42,760
and make it flight ready and replace the

883
00:37:49,079 --> 00:37:45,430
SI c and d h at the same time in

884
00:37:51,089 --> 00:37:49,089
servicing mission for so they did they

885
00:37:53,609 --> 00:37:51,099
did that they took the SI c and d h they

886
00:37:56,190 --> 00:37:53,619
made it flight ready and we took an

887
00:37:58,500 --> 00:37:56,200
extra six months or so before servicing

888
00:38:03,720 --> 00:37:58,510

mission for and it finally went in May

889
00:38:06,300 --> 00:38:03,730
of 2009 well this week there was a what

890
00:38:08,520 --> 00:38:06,310
we call a lock-up and the SI c and d h

891
00:38:11,790 --> 00:38:08,530
and i hadn't heard of this before head

892
00:38:13,800 --> 00:38:11,800
you Tony mm-hmm no yeah but apparently

893
00:38:16,440 --> 00:38:13,810
it's a known issue and a known thing it

894
00:38:18,120 --> 00:38:16,450
does according to exactly her since this

895
00:38:19,740 --> 00:38:18,130
SI c and d h was installed during

896
00:38:22,620 --> 00:38:19,750
servicing mission for there have been

897
00:38:24,089 --> 00:38:22,630
five lockups yeah now they say oh it's

898
00:38:27,660 --> 00:38:24,099
on average one or two once or twice a

899
00:38:29,010 --> 00:38:27,670
year and it seems like you know well you

900
00:38:31,230 --> 00:38:29,020
know how your computer gets gets gets

901
00:38:36,270 --> 00:38:31,240
all hey wiring you have to reboot right

902
00:38:38,070 --> 00:38:36,280
oh no my it never happens oh it sounded

903
00:38:41,339 --> 00:38:38,080
like that and the way to describe it it

904
00:38:44,190 --> 00:38:41,349
just get left gets locked up gets if you

905
00:38:46,980 --> 00:38:44,200
reboot it boom everything's okay and so

906
00:38:49,829 --> 00:38:46,990
that happened on let's see what is today

907
00:38:52,020 --> 00:38:49,839
wednesday so it happened on monday yeah

908
00:38:54,120 --> 00:38:52,030
ternoon and what's fixer look at a cup

909
00:38:55,710 --> 00:38:54,130
on tuesday ryan geo so tuesday morning

910
00:38:57,870 --> 00:38:55,720
we got an email saying hey the SI c and

911
00:38:59,849 --> 00:38:57,880
d h has had a lock up we're on it

912
00:39:01,740 --> 00:38:59,859
everything nothing nothing looks out of

913
00:39:03,870 --> 00:39:01,750

ordinary except for the anomaly and the

914
00:39:05,520 --> 00:39:03,880
SI c and d h and this morning we got

915
00:39:07,740 --> 00:39:05,530
another email saying hey everything's

916
00:39:09,750 --> 00:39:07,750
good we're back toward science stuff and

917
00:39:13,290 --> 00:39:09,760
i just want to give you an example of

918
00:39:15,839 --> 00:39:13,300
how the folks who work on hubble here in

919
00:39:19,349 --> 00:39:15,849
our building along with folks at goddard

920
00:39:20,490 --> 00:39:19,359
space flight center are really there on

921
00:39:23,130 --> 00:39:20,500
it then they can take care of these

922
00:39:25,290 --> 00:39:23,140
things really well and we do have these

923
00:39:27,570 --> 00:39:25,300
anomalies we do have these small breaks

924
00:39:29,130 --> 00:39:27,580
in the Hubble observing schedule matter

925
00:39:30,810 --> 00:39:29,140
of fact I think that small break in the

926
00:39:32,370 --> 00:39:30,820
Hubble observable has had a little

927
00:39:37,440 --> 00:39:32,380
problem in getting the comet siding

928
00:39:38,670 --> 00:39:37,450
spring observations back so no yeah well

929
00:39:40,470 --> 00:39:38,680
that's what sort of the Hubble

930
00:39:44,609 --> 00:39:40,480
equivalent of a spinning beachball I

931
00:39:45,960 --> 00:39:44,619
guess yes there you go they're trying to

932
00:39:47,040 --> 00:39:45,970
download the siding Springs of inches

933
00:39:48,100 --> 00:39:47,050
and all they got was this spinning

934
00:39:53,620 --> 00:39:48,110
beachball

935
00:39:55,570 --> 00:39:53,630
I hate that thing anyway so but Hubble

936
00:39:57,640 --> 00:39:55,580
is back it's working it's doing science

937
00:39:59,080 --> 00:39:57,650
again just want to let you know hey

938
00:40:01,090 --> 00:39:59,090

small little hiccup occurred this week

939
00:40:03,220 --> 00:40:01,100
it's nothing out of the ordinary but

940
00:40:05,020 --> 00:40:03,230
it's it's fun to let you guys in on

941
00:40:06,970 --> 00:40:05,030
what's happening behind the scenes yeah

942
00:40:08,500 --> 00:40:06,980
thanks Franken Michael jobin is

943
00:40:11,080 --> 00:40:08,510
commenting I still think we could have

944
00:40:13,930 --> 00:40:11,090
done one more HST rehab using the soft

945
00:40:15,460 --> 00:40:13,940
docking ring yeah maybe but it's a

946
00:40:17,080 --> 00:40:15,470
little unlikely i think that would ever

947
00:40:20,890 --> 00:40:17,090
happen but it might I mean I hold out

948
00:40:23,680 --> 00:40:20,900
hope but um you know what it is possible

949
00:40:24,910 --> 00:40:23,690
yeah what a lot of people I and a lot of

950
00:40:27,130 --> 00:40:24,920
people at NASA would have loved to have

951
00:40:29,740 --> 00:40:27,140
seen is trying to use that as an excuse

952
00:40:31,960 --> 00:40:29,750
to develop robotic servicing yeah

953
00:40:33,880 --> 00:40:31,970
there's a lot of interest all across

954
00:40:36,460 --> 00:40:33,890
NASA not just for Hubble I mean all

955
00:40:38,910 --> 00:40:36,470
across NASA about trying to do robotic

956
00:40:42,040 --> 00:40:38,920
servicing robotic missions in space and

957
00:40:44,710 --> 00:40:42,050
advancing that and that one of the

958
00:40:48,130 --> 00:40:44,720
possible uses of that docking ring okay

959
00:40:51,160 --> 00:40:48,140
so yeah all right I'm gonna finish up

960
00:40:56,860 --> 00:40:51,170
with a close encounter of the fourth

961
00:40:59,320 --> 00:40:56,870
planet kind oh boy yeah your titles Tony

962
00:41:01,870 --> 00:40:59,330
you should be used to this but I don't

963
00:41:04,180 --> 00:41:01,880

think I'll ever get used to it is that

964
00:41:07,090 --> 00:41:04,190
all or summer comet siding spring for

965
00:41:10,420 --> 00:41:07,100
planet Mars and comet siding spring and

966
00:41:12,240 --> 00:41:10,430
this is a picture I a I don't know if I

967
00:41:14,980 --> 00:41:12,250
talk about siding spring and a hangouts

968
00:41:16,840 --> 00:41:14,990
mmm I don't believe so no I think we

969
00:41:19,150 --> 00:41:16,850
might have alluded to it than the last

970
00:41:21,490 --> 00:41:19,160
ones I okay well this is uh Damien

971
00:41:25,060 --> 00:41:21,500
peaches and Damien peach got some of the

972
00:41:26,830 --> 00:41:25,070
really best images of Comet Ison he's

973
00:41:29,620 --> 00:41:26,840
coming through again showing really cool

974
00:41:32,080 --> 00:41:29,630
images of Comet sightings beautiful as

975
00:41:33,340 --> 00:41:32,090
from februari of earlier this year you

976
00:41:35,140 --> 00:41:33,350
can see the cluster of galaxies in the

977
00:41:37,030 --> 00:41:35,150
background it isn't that a great

978
00:41:38,770 --> 00:41:37,040
composition on it's beautiful house

979
00:41:40,180 --> 00:41:38,780
losing it any people just sort of

980
00:41:42,790 --> 00:41:40,190
noticing that look at the comment but

981
00:41:44,380 --> 00:41:42,800
look at the GALEX night now oh yeah as a

982
00:41:48,160 --> 00:41:44,390
comic can you move that come out of the

983
00:41:50,200 --> 00:41:48,170
way on alright so and of course I think

984
00:41:53,080 --> 00:41:50,210
spring the major thing about it is that

985
00:41:56,920 --> 00:41:53,090
it was going to pass very close to Mars

986
00:41:58,510 --> 00:41:56,930
on october 19th of this year how close

987
00:42:00,790 --> 00:41:58,520
tomorrow I mean this is actually kind of

988
00:42:01,290 --> 00:42:00,800

crazy because siding spring is coming in

989
00:42:03,690 --> 00:42:01,300
from

990
00:42:06,570 --> 00:42:03,700
cloud right it's got this incredibly

991
00:42:08,700 --> 00:42:06,580
long orbit the estimate is that it would

992
00:42:12,210 --> 00:42:08,710
take like two or three million years to

993
00:42:16,440 --> 00:42:12,220
complete an orbit okay so its perihelion

994
00:42:18,990 --> 00:42:16,450
and the inclination is it's inclined to

995
00:42:21,170 --> 00:42:19,000
the plane so it's not in the plane it's

996
00:42:24,240 --> 00:42:21,180
actually heavily inclined to the plane

997
00:42:27,000 --> 00:42:24,250
but it actually is going to be passing

998
00:42:29,070 --> 00:42:27,010
very close to Mars this is an amazing

999
00:42:30,810 --> 00:42:29,080
coincidence but we discovered it well in

1000
00:42:34,650 --> 00:42:30,820
advance in order to be able to prepare

1001
00:42:36,990 --> 00:42:34,660
for it just to talk about how close it

1002
00:42:38,310 --> 00:42:37,000
is I put together this scale diagram

1003
00:42:40,310 --> 00:42:38,320
that it's going to be one hundred

1004
00:42:44,780 --> 00:42:40,320
thirty-five thousand kilometers or

1005
00:42:50,730 --> 00:42:44,790
86,000 miles but the ease of you people

1006
00:42:52,350 --> 00:42:50,740
for you people oh anyways but easy

1007
00:42:56,040 --> 00:42:52,360
before you understand that is that it's

1008
00:42:59,310 --> 00:42:56,050
20 Mars diameters okay so 20 times the

1009
00:43:01,710 --> 00:42:59,320
diameter of Mars is the true scale and I

1010
00:43:03,930 --> 00:43:01,720
like to give that because well you've

1011
00:43:05,660 --> 00:43:03,940
seen a lot of visualizations of comet

1012
00:43:08,640 --> 00:43:05,670
siding Springs on Mars this week and

1013
00:43:11,130 --> 00:43:08,650

none of them have actually got the comet

1014
00:43:13,050 --> 00:43:11,140
and Mars at the proper scale relative to

1015
00:43:14,340 --> 00:43:13,060
one another right they always have the

1016
00:43:18,150 --> 00:43:14,350
comet looking like it's going to brush

1017
00:43:20,580 --> 00:43:18,160
across the brush across the atmosphere

1018
00:43:22,950 --> 00:43:20,590
of Mars but it's really going to be it's

1019
00:43:25,710 --> 00:43:22,960
going to be 20 Mars diners cross away

1020
00:43:28,320 --> 00:43:25,720
from and so the question is how large

1021
00:43:31,350 --> 00:43:28,330
was its coma going to be with the coma

1022
00:43:33,330 --> 00:43:31,360
of a comet be hundreds of thousands of

1023
00:43:35,490 --> 00:43:33,340
kilometers across so that it would sweep

1024
00:43:38,010 --> 00:43:35,500
across Mars and we might have an

1025
00:43:40,710 --> 00:43:38,020
interesting interaction all right so

1026
00:43:42,540 --> 00:43:40,720
Hubble looked at it Hubble has the fine

1027
00:43:44,730 --> 00:43:42,550
resolution still can't see the nucleus a

1028
00:43:46,680 --> 00:43:44,740
comma then accommodate yourself is only

1029
00:43:48,480 --> 00:43:46,690
a few kilometers across this was less

1030
00:43:52,140 --> 00:43:48,490
per me so we're just seeing that the

1031
00:43:54,240 --> 00:43:52,150
coma but on the Left we see the image

1032
00:43:56,630 --> 00:43:54,250
and on the right we see a processed

1033
00:44:00,060 --> 00:43:56,640
version of it where we subtracted off a

1034
00:44:02,310 --> 00:44:00,070
roughly symmetrical model of gamma

1035
00:44:04,740 --> 00:44:02,320
emission so the material coming off of

1036
00:44:07,590 --> 00:44:04,750
the nucleus to form the coma if it comes

1037
00:44:10,230 --> 00:44:07,600
off smoothly you know it would be

1038
00:44:11,760 --> 00:44:10,240

roughly spherical okay so subtract that

1039
00:44:14,220 --> 00:44:11,770
off and what do you get on the right

1040
00:44:14,940 --> 00:44:14,230
hand side it looks like there are twin

1041
00:44:17,700 --> 00:44:14,950
to

1042
00:44:19,740 --> 00:44:17,710
oppositely directed jets okay you can

1043
00:44:22,230 --> 00:44:19,750
see that try to look for sub structure

1044
00:44:24,210 --> 00:44:22,240
in the emission of the coma and it

1045
00:44:26,220 --> 00:44:24,220
appears there are some Jetson Hubble has

1046
00:44:30,290 --> 00:44:26,230
been monitoring that over the course of

1047
00:44:32,400 --> 00:44:30,300
months to try from from a year ago on

1048
00:44:34,620 --> 00:44:32,410
through the spring to try and

1049
00:44:36,810 --> 00:44:34,630
characterize you know what's going on is

1050
00:44:39,329 --> 00:44:36,820
there lots of Jets of material is it

1051
00:44:41,310 --> 00:44:39,339
generally smooth is it you know might it

1052
00:44:43,200 --> 00:44:41,320
be breaking up how will can actually see

1053
00:44:46,319 --> 00:44:43,210
it if it does break up I things like

1054
00:44:50,810 --> 00:44:46,329
that so it's been monitored and here is

1055
00:44:53,760 --> 00:44:50,820
a image from September of 2014 and

1056
00:44:55,530 --> 00:44:53,770
unfortunately as we got through the late

1057
00:44:57,780 --> 00:44:55,540
summer and into September we expected it

1058
00:45:01,650 --> 00:44:57,790
to dim a little bit but it actually

1059
00:45:05,970 --> 00:45:01,660
dimmed a lot more than we expected as if

1060
00:45:09,300 --> 00:45:05,980
as if Idzik it as it came in and so I

1061
00:45:11,880 --> 00:45:09,310
honestly wasn't expecting much okay just

1062
00:45:13,770 --> 00:45:11,890
because the coma wasn't this hundreds

1063
00:45:16,220 --> 00:45:13,780

hundred thousand kilometer across comma

1064
00:45:19,050 --> 00:45:16,230
comas maybe 10,000 kilometers across

1065
00:45:23,099 --> 00:45:19,060
didn't see they're going to be a huge

1066
00:45:25,980 --> 00:45:23,109
interaction okay but we have missions at

1067
00:45:28,319 --> 00:45:25,990
Mars and this is the Maven mission which

1068
00:45:29,819 --> 00:45:28,329
just arrived at cars okay so it arrives

1069
00:45:35,849 --> 00:45:29,829
at Mars and first thing that's got to do

1070
00:45:39,599 --> 00:45:35,859
is go oh oh so head I'm not making this

1071
00:45:45,420 --> 00:45:39,609
up NASA called for what they call a duck

1072
00:45:47,579 --> 00:45:45,430
and cover like from the 50s yes Becca so

1073
00:45:51,089 --> 00:45:47,589
there are three orbiting missions around

1074
00:45:53,880 --> 00:45:51,099
Mars and they adjusted the orbits so

1075
00:45:56,849 --> 00:45:53,890
that when siding spring came by they

1076
00:45:58,050 --> 00:45:56,859
would be on the far side of Mars as much

1077
00:46:00,660 --> 00:45:58,060
as possible and of course they're

1078
00:46:02,430 --> 00:46:00,670
orbiting around Mars continuously so I

1079
00:46:04,980 --> 00:46:02,440
can't stay over there it's not like they

1080
00:46:08,069 --> 00:46:04,990
can park them over there but during the

1081
00:46:12,420 --> 00:46:08,079
what they presumed would be the maximum

1082
00:46:13,500 --> 00:46:12,430
chance of danger they had made sure that

1083
00:46:17,400 --> 00:46:13,510
the missions were on the far side of

1084
00:46:19,319 --> 00:46:17,410
Mars and after this weekend they the

1085
00:46:23,069 --> 00:46:19,329
post comments spacecraft status is that

1086
00:46:25,950 --> 00:46:23,079
everybody's in good health Oh fuels yes

1087
00:46:28,260 --> 00:46:25,960
you not that I was terribly worried

1088
00:46:28,920 --> 00:46:28,270

you right up to you do have to put these

1089
00:46:30,540 --> 00:46:28,930
things and say

1090
00:46:32,790 --> 00:46:30,550
mode intent and take care of just in

1091
00:46:34,410 --> 00:46:32,800
case right right there's no reason that

1092
00:46:37,799 --> 00:46:34,420
there's something couldn't dispute out

1093
00:46:40,290 --> 00:46:37,809
and and you get a 1 good serious hit on

1094
00:46:44,040 --> 00:46:40,300
these things could really damage them

1095
00:46:46,740 --> 00:46:44,050
and may even just got there so no maven

1096
00:46:49,109 --> 00:46:46,750
needs to start doing it's a it's science

1097
00:46:51,540 --> 00:46:49,119
okay you know talk about bad timing your

1098
00:46:52,829 --> 00:46:51,550
dad got nailed by that thing the

1099
00:46:55,530 --> 00:46:52,839
previous image that's Mars

1100
00:46:57,960 --> 00:46:55,540
Reconnaissance Orbiter I was wrong ok I

1101
00:46:59,760 --> 00:46:57,970
wanna check check that I realized that

1102
00:47:02,579 --> 00:46:59,770
you know maven I remember has this

1103
00:47:05,309 --> 00:47:02,589
really funky shape and that was mro not

1104
00:47:08,640 --> 00:47:05,319
me then I know trans okay all right

1105
00:47:11,640 --> 00:47:08,650
refrigerants we have the Mars missions

1106
00:47:13,170 --> 00:47:11,650
on the ground and so what are they going

1107
00:47:15,660 --> 00:47:13,180
to see if there's all this debris

1108
00:47:16,859 --> 00:47:15,670
hitting the Martian atmosphere well what

1109
00:47:19,950 --> 00:47:16,869
happens when comet debris hits the

1110
00:47:23,640 --> 00:47:19,960
Earth's atmosphere we get a meteor

1111
00:47:26,790 --> 00:47:23,650
shower all right could we see a meteor

1112
00:47:29,849 --> 00:47:26,800
shower on Mars that would be really cool

1113
00:47:32,579 --> 00:47:29,859

could we see a comet from the surface of

1114
00:47:35,130 --> 00:47:32,589
another planet that would be cool what'd

1115
00:47:39,870 --> 00:47:35,140
be cool what have been cool we didn't

1116
00:47:41,940 --> 00:47:39,880
see a meteor shower from oh we did get

1117
00:47:45,150 --> 00:47:41,950
this image this is from the opportunity

1118
00:47:46,559 --> 00:47:45,160
rover and you can see pointed out in

1119
00:47:47,880 --> 00:47:46,569
this image are stars that have been

1120
00:47:50,700 --> 00:47:47,890
trailed a little bit because it's a

1121
00:47:52,970 --> 00:47:50,710
longer exposure and a few cosmic rays

1122
00:47:56,280 --> 00:47:52,980
which are just you know detector hits

1123
00:47:59,370 --> 00:47:56,290
but right in the center there is a

1124
00:48:02,250 --> 00:47:59,380
picture of comet siding Springs from the

1125
00:48:04,349 --> 00:48:02,260
surface of Mars alright still awesome

1126
00:48:07,530 --> 00:48:04,359
it's still awesome it's still kind of

1127
00:48:10,170 --> 00:48:07,540
awesome with yeah it was awesome when we

1128
00:48:12,690 --> 00:48:10,180
saw the solar eclipse for Mars it's

1129
00:48:14,549 --> 00:48:12,700
awesome to see a comet from Mars it's

1130
00:48:16,829 --> 00:48:14,559
just nice to sort of think about doing

1131
00:48:19,230 --> 00:48:16,839
astronomy from the surface of another

1132
00:48:21,299 --> 00:48:19,240
planet yeah it's also important to note

1133
00:48:23,010 --> 00:48:21,309
that the camera is on these Rovers are

1134
00:48:24,480 --> 00:48:23,020
not optimally suited for looking up at

1135
00:48:26,579 --> 00:48:24,490
the sky like this so that's a pretty

1136
00:48:28,650 --> 00:48:26,589
nice a nice image given what it was

1137
00:48:32,089 --> 00:48:28,660
designed to do so my takeaway from the

1138
00:48:34,620 --> 00:48:32,099

weekend is that didn't really do much

1139
00:48:35,849 --> 00:48:34,630
wasn't as big an interaction I'm sure

1140
00:48:38,130 --> 00:48:35,859
there are some science that's going to

1141
00:48:40,289 --> 00:48:38,140
be get come out of it I haven't heard

1142
00:48:43,150 --> 00:48:40,299
any details of it but maybe we'll hear

1143
00:48:45,140 --> 00:48:43,160
some tomorrow or in the coming weeks

1144
00:48:48,500 --> 00:48:45,150
but if you really want a good picture

1145
00:48:51,650 --> 00:48:48,510
where do we go we go back to the peach

1146
00:48:53,780 --> 00:48:51,660
of a picture from Damien peach and this

1147
00:48:57,980 --> 00:48:53,790
is one of the cool images i found out on

1148
00:49:00,980 --> 00:48:57,990
the net very nice that is Mars Mars of

1149
00:49:03,230 --> 00:49:00,990
course is blown out right but he's been

1150
00:49:05,360 --> 00:49:03,240
able to control Mars's blow out a little

1151
00:49:07,130 --> 00:49:05,370
bit and you can see comet siding spring

1152
00:49:10,040 --> 00:49:07,140
yeah you can see how much fainter it is

1153
00:49:12,170 --> 00:49:10,050
too yeah all of the in the normal

1154
00:49:13,760 --> 00:49:12,180
pictures you know have Mars blown out

1155
00:49:15,440 --> 00:49:13,770
and the detector noise is all over the

1156
00:49:18,410 --> 00:49:15,450
place they're just a few of these that

1157
00:49:21,140 --> 00:49:18,420
are able to keep that dynamic range and

1158
00:49:23,240 --> 00:49:21,150
control it and not have Mars blow all

1159
00:49:26,540 --> 00:49:23,250
over the place I'll still be in common

1160
00:49:29,360 --> 00:49:26,550
so uh on the QA app sev dust bunny is

1161
00:49:30,650 --> 00:49:29,370
this is comment they are asking Frank's

1162
00:49:31,850 --> 00:49:30,660
just kind of answered your question but

1163
00:49:34,310 --> 00:49:31,860

I'll read it out has there been any

1164
00:49:36,650 --> 00:49:34,320
fallout from the comet's tail into the

1165
00:49:40,250 --> 00:49:36,660
Mars atmosphere creating things like

1166
00:49:41,570 --> 00:49:40,260
Aurora and you but you said most of that

1167
00:49:43,970 --> 00:49:41,580
and not I don't think they've noticed

1168
00:49:46,070 --> 00:49:43,980
much going on right I know that they

1169
00:49:48,440 --> 00:49:46,080
were looking at ultraviolet to see if

1170
00:49:51,320 --> 00:49:48,450
there was Aurora on Mars now how can

1171
00:49:53,600 --> 00:49:51,330
there be Aurora if that is charged

1172
00:49:56,300 --> 00:49:53,610
particles in a magnetosphere and Mars

1173
00:49:59,030 --> 00:49:56,310
doesn't have one ah well simply

1174
00:50:03,020 --> 00:49:59,040
Augustine molecules streaming through an

1175
00:50:05,810 --> 00:50:03,030
atmosphere okay as they slow down will

1176
00:50:07,490 --> 00:50:05,820
give off a green glow okay okay sure

1177
00:50:10,220 --> 00:50:07,500
sure so it's not a magnetic phenomenon

1178
00:50:12,380 --> 00:50:10,230
it's a it's a particle hitting the

1179
00:50:15,200 --> 00:50:12,390
atmosphere kind of thought on earth that

1180
00:50:16,910 --> 00:50:15,210
it the magnetic field funnels those

1181
00:50:19,400 --> 00:50:16,920
particles towards North Pole and South

1182
00:50:21,440 --> 00:50:19,410
Poles right and that's why the Aurora

1183
00:50:23,540 --> 00:50:21,450
occurred the North and South Poles but

1184
00:50:26,180 --> 00:50:23,550
if those particles had hit anywhere on

1185
00:50:28,040 --> 00:50:26,190
her on ours on Earth's atmosphere they

1186
00:50:31,010 --> 00:50:28,050
would give off that glow but okay

1187
00:50:32,600 --> 00:50:31,020
they're concentrated right now cuz my

1188
00:50:36,190 --> 00:50:32,610

that was microphone oh that's why you

1189
00:50:39,200 --> 00:50:36,200
get this continued at this this Aurora

1190
00:50:42,530 --> 00:50:39,210
phenomenon there I haven't heard of any

1191
00:50:46,210 --> 00:50:42,540
Aurora stories yet yeah okay alright

1192
00:50:50,300 --> 00:50:46,220
cool and can we do a plug for tomorrow

1193
00:50:51,920 --> 00:50:50,310
we can you okay so so we're going to

1194
00:50:54,589 --> 00:50:51,930
follow up on this a little bit more guys

1195
00:50:58,700 --> 00:50:54,599
Hubble as Frank mentioned with uh with

1196
00:51:01,969 --> 00:50:58,710
the issues with Hubble earlier in the

1197
00:51:03,920 --> 00:51:01,979
week we it did observe siding spring

1198
00:51:06,529 --> 00:51:03,930
comet' siding spring over the weekend

1199
00:51:08,779 --> 00:51:06,539
and we we are hopefully going to have

1200
00:51:10,130 --> 00:51:08,789
those pictures out and release tomorrow

1201
00:51:12,469 --> 00:51:10,140
we're going to have a hangout on it

1202
00:51:14,749 --> 00:51:12,479
we're going to have John yang Lee as

1203
00:51:16,700 --> 00:51:14,759
well as Max Mutchler and result of the

1204
00:51:18,079 --> 00:51:16,710
soul of a and others and a hangout to

1205
00:51:19,579 --> 00:51:18,089
talk about this observation so that's

1206
00:51:24,099 --> 00:51:19,589
tomorrow at three we hope you will join

1207
00:51:26,450 --> 00:51:24,109
us as we talk more about this then okay

1208
00:51:28,700 --> 00:51:26,460
and while we're in the process of

1209
00:51:31,579 --> 00:51:28,710
advertising can I'll advertise the

1210
00:51:33,650 --> 00:51:31,589
upcoming public lectures we mentioned

1211
00:51:37,160 --> 00:51:33,660
them on our Google+ accounts as our

1212
00:51:38,450 --> 00:51:37,170
Facebook account but the Space Telescope

1213
00:51:41,420 --> 00:51:38,460

Science Institute has a public lecture

1214
00:51:42,469 --> 00:51:41,430
series that I run and next month we're

1215
00:51:44,660 --> 00:51:42,479
going to do it on the second tuesday

1216
00:51:47,299 --> 00:51:44,670
because election day is the first

1217
00:51:50,299 --> 00:51:47,309
tuesday so we're doing the second

1218
00:51:52,579 --> 00:51:50,309
tuesday and the topic is a telegram from

1219
00:51:55,579 --> 00:51:52,589
the early universe speakers mark a

1220
00:51:58,999 --> 00:51:55,589
Minkowski of johns hopkins mark is one

1221
00:52:01,519 --> 00:51:59,009
of the v-world experts on the Cosmic

1222
00:52:03,019 --> 00:52:01,529
Microwave Background I was a postdoc

1223
00:52:06,529 --> 00:52:03,029
with Mark kamionkowski epic Columbia

1224
00:52:10,609 --> 00:52:06,539
University Oh 15-20 years ago something

1225
00:52:12,890 --> 00:52:10,619
like that he's really great and he's

1226
00:52:16,579 --> 00:52:12,900
going to come talk to us and also about

1227
00:52:20,180 --> 00:52:16,589
the CMB polarization results that were

1228
00:52:22,279 --> 00:52:20,190
claimed to in as proof of income in the

1229
00:52:24,019 --> 00:52:22,289
inflationary epoch of the universe yeah

1230
00:52:25,489 --> 00:52:24,029
that was yeah that was big it was a big

1231
00:52:28,999 --> 00:52:25,499
deal early on and it was highly

1232
00:52:30,200 --> 00:52:29,009
contested and disputed and so this is

1233
00:52:31,759 --> 00:52:30,210
the guy who's gonna be able to tell you

1234
00:52:33,979 --> 00:52:31,769
the full deal on it okay you have

1235
00:52:35,299 --> 00:52:33,989
definitely worth going to I'm looked at

1236
00:52:36,650 --> 00:52:35,309
saying we there and of course we're

1237
00:52:39,380 --> 00:52:36,660
gonna record that and put that up on

1238
00:52:41,420 --> 00:52:39,390

YouTube up that yellow and I mean like

1239
00:52:42,890 --> 00:52:41,430
Frank and I also monitor the comments

1240
00:52:44,569 --> 00:52:42,900
during that too so if you guys want to

1241
00:52:47,359 --> 00:52:44,579
comment during that will be there and

1242
00:52:49,430 --> 00:52:47,369
then just an upcoming idea in December

1243
00:52:50,959 --> 00:52:49,440
Joshua peak said he was talking about

1244
00:52:54,019 --> 00:52:50,969
the interstellar medium but he didn't

1245
00:52:56,599 --> 00:52:54,029
give me a full title yet okay great just

1246
00:52:59,599 --> 00:52:56,609
other things all right okay finish by

1247
00:53:03,259 --> 00:52:59,609
putting up my contacts if you want to if

1248
00:53:04,670 --> 00:53:03,269
anybody wants to ask me questions or

1249
00:53:07,690 --> 00:53:04,680
other things here's what I do okay

1250
00:53:10,240 --> 00:53:07,700
awesome and hopefully so after the

1251
00:53:12,160 --> 00:53:10,250
next month's public lecture series in

1252
00:53:14,470 --> 00:53:12,170
the second week we will also be back

1253
00:53:15,760 --> 00:53:14,480
with news from Hubble and across the

1254
00:53:18,579 --> 00:53:15,770
universe so we'll have we'll be back

1255
00:53:20,380 --> 00:53:18,589
doing our thing then too here's a couple

1256
00:53:21,640 --> 00:53:20,390
of want to get to a few of these

1257
00:53:23,380 --> 00:53:21,650
questions because we're starting to

1258
00:53:26,079 --> 00:53:23,390
stack we've got a lot of them Hans mills

1259
00:53:28,240 --> 00:53:26,089
milling is asked asked early on I wanted

1260
00:53:30,130 --> 00:53:28,250
to answer this one I always wanted to

1261
00:53:32,620 --> 00:53:30,140
ask both of you if you have your own

1262
00:53:34,750 --> 00:53:32,630
backyard telescope you have a backyard

1263
00:53:38,170 --> 00:53:34,760

telescope Frank I do not I own

1264
00:53:40,630 --> 00:53:38,180
binoculars so I have never been an

1265
00:53:41,800 --> 00:53:40,640
observational astronomer people think

1266
00:53:43,359 --> 00:53:41,810
that you know if you grow up to me

1267
00:53:44,500 --> 00:53:43,369
astronomer you had a telescope and you

1268
00:53:47,410 --> 00:53:44,510
were kidding you really love looking the

1269
00:53:48,940 --> 00:53:47,420
stars I was really into Napa like some

1270
00:53:51,339 --> 00:53:48,950
problem-solving and puzzles and stuff

1271
00:53:52,839 --> 00:53:51,349
like that you had a trs-80 computer you

1272
00:53:56,349 --> 00:53:52,849
were running simulations on it you know

1273
00:53:59,020 --> 00:53:56,359
it yeah I was doing I was into computers

1274
00:54:02,410 --> 00:53:59,030
and they like I'm not interested on me

1275
00:54:04,480 --> 00:54:02,420
growing up it was as I got to advanced

1276
00:54:06,069 --> 00:54:04,490
math and the word problems the best word

1277
00:54:07,930 --> 00:54:06,079
problems were in physics and the best

1278
00:54:10,569 --> 00:54:07,940
physics problems weren't astronomy that

1279
00:54:13,990 --> 00:54:10,579
I ended up in astronomy but i do have

1280
00:54:16,030 --> 00:54:14,000
binoculars are fantastic for per se

1281
00:54:17,890 --> 00:54:16,040
surveying the night sky yeah i agree i

1282
00:54:19,450 --> 00:54:17,900
have a pair of those i have always been

1283
00:54:20,920 --> 00:54:19,460
an amateur astronomer I've always had

1284
00:54:23,620 --> 00:54:20,930
telescopes I started out with a

1285
00:54:26,710 --> 00:54:23,630
criterion 6-inch Newtonian reflector

1286
00:54:31,030 --> 00:54:26,720
which I have kept for many many years

1287
00:54:34,270 --> 00:54:31,040
and I've I might I speak with a lx200

1288
00:54:36,790 --> 00:54:34,280

go-to telescope in the 90s I sold that

1289
00:54:40,150 --> 00:54:36,800
and now really all I have is my Astro

1290
00:54:41,890 --> 00:54:40,160
scan two thousand and a hof a telescope

1291
00:54:44,309 --> 00:54:41,900
that I used to look at the solar disk

1292
00:54:48,460 --> 00:54:44,319
with and it's one of those up corona

1293
00:54:51,819 --> 00:54:48,470
Coronado PST's personal solar telescopes

1294
00:54:53,829 --> 00:54:51,829
are really nice h alpha used to be

1295
00:54:55,839 --> 00:54:53,839
expensive he used to cost four thousand

1296
00:54:58,569 --> 00:54:55,849
dollars to get an H off of filter now

1297
00:55:01,900 --> 00:54:58,579
one of those four five hundred dollars i

1298
00:55:03,250 --> 00:55:01,910
mean including the telescope so that's

1299
00:55:05,440 --> 00:55:03,260
what i currently have and i highly

1300
00:55:07,750 --> 00:55:05,450
recommend all of those telescopes and

1301
00:55:11,069 --> 00:55:07,760
course celestron i had a c8 in the 80s

1302
00:55:13,930 --> 00:55:11,079
which i sold because i needed money so

1303
00:55:15,010 --> 00:55:13,940
but I've had I've had a lot of I've had

1304
00:55:16,540 --> 00:55:15,020
a lot of tells while doing my

1305
00:55:19,569 --> 00:55:16,550
undergraduate at Virginia Tech I took

1306
00:55:20,400 --> 00:55:19,579
care of the c16 up at the Virginia Tech

1307
00:55:23,579 --> 00:55:20,410
observant

1308
00:55:25,779 --> 00:55:23,589
okay here's a good question from lyosha

1309
00:55:28,510 --> 00:55:25,789
shooting I think from the queue and I am

1310
00:55:31,720 --> 00:55:28,520
could Pluto's gravity be used to change

1311
00:55:35,260 --> 00:55:31,730
course like Voyager did with Saturn to

1312
00:55:37,480 --> 00:55:35,270
my new horizons the answer is no Pluto

1313
00:55:42,880 --> 00:55:37,490

doesn't have much of gravity the NASA

1314
00:55:45,609 --> 00:55:42,890
Pluto is point two percent of points or

1315
00:55:47,799 --> 00:55:45,619
0.02 percent of the mass of Earth it's

1316
00:55:50,410 --> 00:55:47,809
really it's it's significantly smaller

1317
00:55:54,849 --> 00:55:50,420
than our Moon smash okay so there's not

1318
00:55:56,980 --> 00:55:54,859
a ton of mass to play off of also New

1319
00:56:00,460 --> 00:55:56,990
Horizons is moving at a tremendous rate

1320
00:56:03,430 --> 00:56:00,470
it's covered three billion miles in 10

1321
00:56:05,500 --> 00:56:03,440
years I'm using miles hi billion

1322
00:56:08,319 --> 00:56:05,510
kilometers one of those people I can't

1323
00:56:11,500 --> 00:56:08,329
believe it well that's because for the

1324
00:56:14,740 --> 00:56:11,510
story had to do the three Billy you

1325
00:56:16,960 --> 00:56:14,750
people I don't know about you anyway um

1326
00:56:19,029 --> 00:56:16,970
since it's moving at such a tremendous

1327
00:56:21,549 --> 00:56:19,039
velocity and there's time only a tiny

1328
00:56:23,589 --> 00:56:21,559
bit of mass it will of course change the

1329
00:56:25,930 --> 00:56:23,599
orbit by a tiny tiny tiny tiny amount

1330
00:56:29,710 --> 00:56:25,940
but nothing like when Voyager went past

1331
00:56:32,319 --> 00:56:29,720
Jupiter Jupiter is 317 times the mass of

1332
00:56:34,569 --> 00:56:32,329
Earth so it has a lot of mass to change

1333
00:56:36,089 --> 00:56:34,579
the orbit awesome okay good question and

1334
00:56:39,460 --> 00:56:36,099
here's one directly for you Frank

1335
00:56:41,650 --> 00:56:39,470
Nicholas greater is asking will there be

1336
00:56:45,130 --> 00:56:41,660
another and we ask this question often

1337
00:56:49,630 --> 00:56:45,140
will there be another episode and if so

1338
00:56:54,099 --> 00:56:49,640

when Thank You Nicholas is going to our

1339
00:56:58,000 --> 00:56:54,109
meetings Nicholas yes it's been a while

1340
00:57:00,460 --> 00:56:58,010
and we got some new technology and such

1341
00:57:02,950 --> 00:57:00,470
and we tested out the new technology on

1342
00:57:05,799 --> 00:57:02,960
three videos that I did for educators so

1343
00:57:08,680 --> 00:57:05,809
everything's working we got what we need

1344
00:57:10,990 --> 00:57:08,690
to do it's just finding my time to do it

1345
00:57:12,760 --> 00:57:11,000
I can do these hangouts more easily

1346
00:57:14,380 --> 00:57:12,770
because I don't have to actually know

1347
00:57:17,650 --> 00:57:14,390
what I'm going to say if I stumble over

1348
00:57:21,460 --> 00:57:17,660
my words on a hangout it's okay i do

1349
00:57:22,900 --> 00:57:21,470
think Mike I appreciate that yeah you

1350
00:57:24,609 --> 00:57:22,910
would I keep me I'm advantage of that

1351
00:57:26,829 --> 00:57:24,619
yeah yeah I know I was just giving her

1352
00:57:28,170 --> 00:57:26,839
time okay good well thank you

1353
00:57:32,859 --> 00:57:28,180
I'm glad you're giving him a hard time

1354
00:57:33,920 --> 00:57:32,869
okay we did we do to Lucien again as was

1355
00:57:36,140 --> 00:57:33,930
asking earlier when

1356
00:57:38,180 --> 00:57:36,150
companion star steals maths from a star

1357
00:57:40,790 --> 00:57:38,190
what would be the actual trigger for the

1358
00:57:42,950 --> 00:57:40,800
star to go Nova mass is taken away from

1359
00:57:45,170 --> 00:57:42,960
the so the pressure from the core gets

1360
00:57:48,589 --> 00:57:45,180
the chance to wreak havoc no longer

1361
00:57:50,960 --> 00:57:48,599
constrained by gravity okay so would

1362
00:57:53,390 --> 00:57:50,970
that be the actual trigger no all right

1363
00:57:55,849 --> 00:57:53,400

so really good question leo okay first

1364
00:57:57,799 --> 00:57:55,859
of all the what we're talking about is

1365
00:58:00,710 --> 00:57:57,809
really massive stars these are stars

1366
00:58:02,780 --> 00:58:00,720
greater than eight solar masses and the

1367
00:58:05,299 --> 00:58:02,790
supernova trigger is in the core and

1368
00:58:07,490 --> 00:58:05,309
what happens is hydrogen gets burned to

1369
00:58:10,520 --> 00:58:07,500
helium and when runs out of helium

1370
00:58:12,530 --> 00:58:10,530
helium gets burned to carbon and then to

1371
00:58:14,960 --> 00:58:12,540
nitrogen and then to oxygen and

1372
00:58:18,049 --> 00:58:14,970
magnesium and phosphorus and so on all

1373
00:58:21,770 --> 00:58:18,059
the way up to iron okay so you're you're

1374
00:58:23,210 --> 00:58:21,780
doing a nuclear fusion to build heavier

1375
00:58:26,809 --> 00:58:23,220
and heavier elements in the core and

1376
00:58:29,690 --> 00:58:26,819
when you get to iron you can't do a

1377
00:58:33,740 --> 00:58:29,700
fusion and create energy okay it's

1378
00:58:36,559 --> 00:58:33,750
endothermic not exothermic it brings in

1379
00:58:38,900 --> 00:58:36,569
energy rather than releasing energy so

1380
00:58:40,849 --> 00:58:38,910
when you get to iron you build up what's

1381
00:58:43,640 --> 00:58:40,859
called a Chandrasekhar mass of iron in

1382
00:58:46,250 --> 00:58:43,650
the core and that when you have that

1383
00:58:49,630 --> 00:58:46,260
much mass at that high density and

1384
00:58:52,220 --> 00:58:49,640
pressure the atomic structure collapses

1385
00:58:54,109 --> 00:58:52,230
protons and electrons combine to form

1386
00:58:56,059 --> 00:58:54,119
neutrons the whole thing goes into a

1387
00:58:58,430 --> 00:58:56,069
freefall collapse and then explodes

1388
00:59:01,940 --> 00:58:58,440

apart with by releasing this flood of

1389
00:59:03,530 --> 00:59:01,950
neutrinos okay that is relatively

1390
00:59:05,539 --> 00:59:03,540
independent of what's happening on the

1391
00:59:07,250 --> 00:59:05,549
outer layers because by this time the

1392
00:59:09,559 --> 00:59:07,260
Stars bloated and it's become the

1393
00:59:11,470 --> 00:59:09,569
supergiant star and you can steal

1394
00:59:14,270 --> 00:59:11,480
hydrogen from the outer layers and

1395
00:59:17,480 --> 00:59:14,280
deposited onto another star without

1396
00:59:19,730 --> 00:59:17,490
really affecting the nuclear catastrophe

1397
00:59:21,020 --> 00:59:19,740
that's going on in the core okay so

1398
00:59:24,109 --> 00:59:21,030
you've got this runaway nuclear

1399
00:59:25,609 --> 00:59:24,119
catastrophe going on the core and but

1400
00:59:27,049 --> 00:59:25,619
the outer layers are being pulled off

1401
00:59:29,660 --> 00:59:27,059
onto another star that doesn't really

1402
00:59:31,430 --> 00:59:29,670
affect it that much okay awesome thank

1403
00:59:32,599 --> 00:59:31,440
you Frank okay we're out of time but I'm

1404
00:59:35,030 --> 00:59:32,609
going to end it with this comment from

1405
00:59:39,309 --> 00:59:35,040
Michael jobin who says I think he should

1406
00:59:41,690 --> 00:59:39,319
record that song do not encourage him I

1407
00:59:43,849 --> 00:59:41,700
go all the rest of my life without

1408
00:59:46,609 --> 00:59:43,859
hearing that song again I bof be odd you

1409
00:59:47,370 --> 00:59:46,619
just all right guys well Islands stern

1410
00:59:50,220 --> 00:59:47,380
would appreciate it

1411
00:59:52,620 --> 00:59:50,230
how about that avoided me for kicking

1412
00:59:53,819 --> 00:59:52,630
Pluto at the Hayden Planetarium at least

1413
00:59:57,059 --> 00:59:53,829

I could get back in his good graces with

1414
00:59:58,799 --> 00:59:57,069
a song like that how about that oh by

1415
01:00:00,380 --> 00:59:58,809
the way Alan Stern is the principal

1416
01:00:03,029 --> 01:00:00,390
investigator of the New Horizons mission

1417
01:00:04,319 --> 01:00:03,039
okay so folks I guess that'll we're

1418
01:00:06,240 --> 01:00:04,329
going to if it's been an hour we're

1419
01:00:07,470 --> 01:00:06,250
going to stop there thank you Frank this

1420
01:00:08,819 --> 01:00:07,480
has been a lot of fun i love doing these

1421
01:00:11,460 --> 01:00:08,829
with you so it look forward to doing it

1422
01:00:14,339 --> 01:00:11,470
next month middle of some time around

1423
01:00:16,200 --> 01:00:14,349
middle of november about november 15th

1424
01:00:18,299 --> 01:00:16,210
the Ides of November okay sounds great

1425
01:00:20,009 --> 01:00:18,309
Todd all right that's it that's it