
HUBBLE
hangouts
Hubble Observes Comet Siding Spring and Mars
Thursday, October 23 2014, 3pm EDT, 7pm UTC

1
00:00:10,160 --> 00:00:07,849
hello everybody welcome to today's

2
00:00:12,890 --> 00:00:10,170
Hubble hang out my name is Tony Darnell

3
00:00:15,259 --> 00:00:12,900
and we have I think a really interesting

4
00:00:17,509 --> 00:00:15,269
topic today now you guys have been

5
00:00:19,819 --> 00:00:17,519
around Hubble hangouts long enough to

6
00:00:23,769 --> 00:00:19,829
know that Hubble has been over our heads

7
00:00:27,249 --> 00:00:23,779
for an almost 55 years circling overhead

8
00:00:30,710 --> 00:00:27,259
looking at things showing us stuff and

9
00:00:32,959 --> 00:00:30,720
today and this last Sunday was no

10
00:00:35,479 --> 00:00:32,969
exception Hubble looked at something and

11
00:00:37,880 --> 00:00:35,489
it showed us stuff specifically a

12
00:00:38,750 --> 00:00:37,890
comment that passed close by Mars and

13
00:00:41,540 --> 00:00:38,760

today we're going to be talking about

14
00:00:43,119 --> 00:00:41,550
that with the old gang of a lot of very

15
00:00:46,910 --> 00:00:43,129
familiar faces in a couple of new ones

16
00:00:50,270 --> 00:00:46,920
but and but before I get to that I want

17
00:00:53,290 --> 00:00:50,280
to make a quick announcement how today

18
00:00:56,270 --> 00:00:53,300
as I said a while ago to almost 25 years

19
00:00:57,500 --> 00:00:56,280
Hubble's been up in space and you're

20
00:00:58,489 --> 00:00:57,510
going to start to see a lot more about

21
00:01:02,239 --> 00:00:58,499
this from us we're going to be talking

22
00:01:03,229 --> 00:01:02,249
about it a lot more but the little all

23
00:01:04,850 --> 00:01:03,239
these events that are going to be coming

24
00:01:07,639 --> 00:01:04,860
up for Hubble's 25th anniversary which

25
00:01:09,620 --> 00:01:07,649
will be in April the first of those

26
00:01:13,130 --> 00:01:09,630
things are starting today so if you are

27
00:01:15,050 --> 00:01:13,140
in New York City the Big Apple you need

28
00:01:17,959 --> 00:01:15,060
to get your little booties over to the

29
00:01:21,740 --> 00:01:17,969
inter the intrepid museum and they have

30
00:01:24,980 --> 00:01:21,750
opened up the Hubble at 25 exhibit it

31
00:01:27,260 --> 00:01:24,990
opens today and it it's going to be

32
00:01:28,700 --> 00:01:27,270
going on at least through april i know

33
00:01:30,230 --> 00:01:28,710
that much because one of the events they

34
00:01:33,050 --> 00:01:30,240
have planned i'm going to be there for

35
00:01:34,310 --> 00:01:33,060
so is so we've got plenty of time but

36
00:01:37,429 --> 00:01:34,320
get over there today if you have a

37
00:01:40,100 --> 00:01:37,439
chance go to the website if you'll learn

38
00:01:42,499 --> 00:01:40,110

more about it is intrepid museum dot o

39
00:01:44,539 --> 00:01:42,509
RG you can they learn about this they

40
00:01:46,429 --> 00:01:44,549
have tickets available for events and

41
00:01:48,319 --> 00:01:46,439
stuff that are coming up so it encourage

42
00:01:51,289 --> 00:01:48,329
you if you're in the area to check it

43
00:01:53,870 --> 00:01:51,299
out hubble at 25 that's a great that's

44
00:01:55,160 --> 00:01:53,880
our new exhibit and I all we've posted

45
00:01:56,660 --> 00:01:55,170
about it on Facebook and Twitter and

46
00:01:58,399 --> 00:01:56,670
stuff like that I'm about to do it on G+

47
00:02:01,270 --> 00:01:58,409
after this event so well I'll give you

48
00:02:04,730 --> 00:02:01,280
more information as that progresses

49
00:02:08,540 --> 00:02:04,740
Carol and Scott dr. carol christian and

50
00:02:11,240 --> 00:02:08,550
scott internet the driver of the lewis

51
00:02:12,780 --> 00:02:11,250
oh wait i said i did not say that right

52
00:02:17,220 --> 00:02:12,790
did I not right

53
00:02:19,890 --> 00:02:17,230
well episode remember it watch it Scott

54
00:02:22,349 --> 00:02:19,900
Internet's a pretty cool name though and

55
00:02:23,880 --> 00:02:22,359
wait Scott will be Scott and Scott Lewis

56
00:02:26,550 --> 00:02:23,890
is helping drive the internet and this

57
00:02:28,949 --> 00:02:26,560
hangout as is dr. carol christian she is

58
00:02:31,440 --> 00:02:28,959
the outreach Hubble outreach scientists

59
00:02:33,869 --> 00:02:31,450
for the space Space Telescope Science

60
00:02:36,750 --> 00:02:33,879
Institute so today we're going to like I

61
00:02:41,369 --> 00:02:36,760
talked about Hubble on Sunday looked at

62
00:02:44,399 --> 00:02:41,379
a rare that a rather unusual close flyby

63
00:02:48,509 --> 00:02:44,409

of a comet to the planet Mars it went

64
00:02:50,670 --> 00:02:48,519
within 140,000 kilometres and about

65
00:02:53,309 --> 00:02:50,680
which is about 80 something thousand

66
00:02:55,559 --> 00:02:53,319
miles i believe which is really close

67
00:02:58,020 --> 00:02:55,569
really close and so Hubble went and

68
00:03:00,839 --> 00:02:58,030
looked at it and we took some images and

69
00:03:03,210 --> 00:03:00,849
with us to talk about this today are the

70
00:03:06,690 --> 00:03:03,220
various astronomers and people who

71
00:03:09,509 --> 00:03:06,700
helped get these images together Kari is

72
00:03:11,640 --> 00:03:09,519
it Lizzie listen list sorry thank you

73
00:03:17,219 --> 00:03:11,650
from Johns Hopkins he's an astronomer

74
00:03:19,080 --> 00:03:17,229
and a comet a comet person also john

75
00:03:20,610 --> 00:03:19,090
yang Lee you might remember him from the

76
00:03:22,469 --> 00:03:20,620
Planetary Science Institute he was

77
00:03:24,689 --> 00:03:22,479
around our hangouts when we were talking

78
00:03:27,149 --> 00:03:24,699
about comet Ison hi john yang welcome

79
00:03:29,339 --> 00:03:27,159
back also max Mutchler of the Institute

80
00:03:31,890 --> 00:03:29,349
and zola vay also of the Institute

81
00:03:34,680 --> 00:03:31,900
helped helped us put together all of

82
00:03:36,960 --> 00:03:34,690
these all of these images and so that

83
00:03:39,509 --> 00:03:36,970
we're seeing today and zol do you know

84
00:03:41,580 --> 00:03:39,519
you got a fan club wonder I don't yeah

85
00:03:43,439 --> 00:03:41,590
when I when I told people about this

86
00:03:45,360 --> 00:03:43,449
event we got some comments on Twitter

87
00:03:48,119 --> 00:03:45,370
about all zoals going to be there so I

88
00:03:51,059 --> 00:03:48,129

have to go so you gotta fake of you're

89
00:03:55,949 --> 00:03:51,069
like famous now so we can live up to the

90
00:03:57,780 --> 00:03:55,959
hype I think again okay so before we get

91
00:03:59,969 --> 00:03:57,790
going too far to be into the Hangout let

92
00:04:02,280 --> 00:03:59,979
me remind you that you can tweet at us

93
00:04:04,259 --> 00:04:02,290
using the Twitter with the Hubble

94
00:04:07,199 --> 00:04:04,269
hashtag or the Hubble hangout hashtag

95
00:04:09,509 --> 00:04:07,209
we're also looking at the Q&A app on

96
00:04:11,789 --> 00:04:09,519
YouTube and G+ as well as the comment

97
00:04:13,559 --> 00:04:11,799
section on both of those pages so we

98
00:04:15,300 --> 00:04:13,569
hope you'll comment ask questions all of

99
00:04:16,529 --> 00:04:15,310
these guys are here ready to take your

100
00:04:20,640 --> 00:04:16,539
comments and questions for you so we

101
00:04:24,420 --> 00:04:20,650
hope you will do it yesterday we talked

102
00:04:26,730 --> 00:04:24,430
about this this a little bit with Frank

103
00:04:30,480 --> 00:04:26,740
and he Frank summers

104
00:04:32,400 --> 00:04:30,490
and he was telling me that well that

105
00:04:34,370 --> 00:04:32,410
these images were a little slow in

106
00:04:38,010 --> 00:04:34,380
coming right I mean we were a little bit

107
00:04:39,450 --> 00:04:38,020
bubble looked at the flyby but because

108
00:04:44,249 --> 00:04:39,460
of something called the I think it's the

109
00:04:47,059 --> 00:04:44,259
SI sees this gets the the award for the

110
00:04:50,760 --> 00:04:47,069
worst acronym ever it's called si si and

111
00:04:53,159 --> 00:04:50,770
DP module inaudible which I guess is

112
00:04:55,320 --> 00:04:53,169
this thing that Hubble does this thing i

113
00:04:58,409 --> 00:04:55,330

did not know where it kind of does this

114
00:05:00,870 --> 00:04:58,419
equivalent of a spinning beachball where

115
00:05:03,240 --> 00:05:00,880
it this is a known thing it does and you

116
00:05:07,860 --> 00:05:03,250
just you just kind of have to wait for

117
00:05:10,980 --> 00:05:07,870
it to get done and uh uh I'm a prince

118
00:05:12,450 --> 00:05:10,990
the well that's the way it was described

119
00:05:14,219 --> 00:05:12,460
to me it i guess the hubble does this

120
00:05:15,689 --> 00:05:14,229
every one small this is for this is an

121
00:05:16,830 --> 00:05:15,699
inside behind-the-scenes look guys we

122
00:05:19,020 --> 00:05:16,840
got these emails earlier in the week

123
00:05:21,149 --> 00:05:19,030
Hubble's fine now but apparently it does

124
00:05:22,980 --> 00:05:21,159
this thing where it just kind of does a

125
00:05:24,899 --> 00:05:22,990
spinning beachball kind of thing and if

126
00:05:26,520 --> 00:05:24,909
and just like you know it's one of those

127
00:05:28,649 --> 00:05:26,530
things where if you get it on an Apple

128
00:05:29,850 --> 00:05:28,659
computer it's just you just have to wait

129
00:05:32,010 --> 00:05:29,860
for it to finish and then everything's

130
00:05:33,540 --> 00:05:32,020
fine supposedly so I'm going to this

131
00:05:35,879 --> 00:05:33,550
computer you get to please screen of

132
00:05:38,909 --> 00:05:35,889
death and sorry and that is a bigger

133
00:05:40,409 --> 00:05:38,919
problem yes so uh so I guess these

134
00:05:44,879 --> 00:05:40,419
images were a little late coming down

135
00:05:47,149 --> 00:05:44,889
isn't that right so uh I think maybe max

136
00:05:51,060 --> 00:05:47,159
can answer that a little bit better I

137
00:05:54,659 --> 00:05:51,070
yeah images that we had came down in

138
00:05:55,920 --> 00:05:54,669

good time yeah they came down over the

139
00:05:58,230 --> 00:05:55,930
weekend you know the there was a

140
00:06:00,600 --> 00:05:58,240
sequence that started I guess late on

141
00:06:03,689 --> 00:06:00,610
Saturday you know through sunday and

142
00:06:05,399 --> 00:06:03,699
monday that was all before the failure

143
00:06:07,529 --> 00:06:05,409
that you mentioned so those data came

144
00:06:09,149 --> 00:06:07,539
down there was a little problem getting

145
00:06:10,860 --> 00:06:09,159
my the archive you know so we didn't

146
00:06:13,080 --> 00:06:10,870
really get to look at them until monday

147
00:06:14,700 --> 00:06:13,090
morning even though the closest approach

148
00:06:16,200 --> 00:06:14,710
had already occurred that was really the

149
00:06:19,409 --> 00:06:16,210
first chance we had to really dive into

150
00:06:22,110 --> 00:06:19,419
the data and then it was I think a good

151
00:06:24,059 --> 00:06:22,120
day day and a half later that the there

152
00:06:27,390 --> 00:06:24,069
was the real significant you know say

153
00:06:28,950 --> 00:06:27,400
finger you know SI c and d h event which

154
00:06:30,870 --> 00:06:28,960
caused a bigger hiccup so thankfully

155
00:06:33,270 --> 00:06:30,880
most of the data from this campaign was

156
00:06:35,550 --> 00:06:33,280
already in hand before that there was a

157
00:06:36,899 --> 00:06:35,560
continuing program by john clark one of

158
00:06:39,600 --> 00:06:36,909
the investigators involved in this

159
00:06:40,650 --> 00:06:39,610
campaign that was more affected but

160
00:06:43,260 --> 00:06:40,660
fortunately for the ball

161
00:06:44,790 --> 00:06:43,270
to this campaign the timing was not too

162
00:06:45,900 --> 00:06:44,800
bad it could have been much worse if it

163
00:06:48,750 --> 00:06:45,910

landed right in the middle of our

164
00:06:50,340 --> 00:06:48,760
campaign yeah yeah I guess you know I

165
00:06:51,450 --> 00:06:50,350
wanted to bring that up just a little

166
00:06:52,860 --> 00:06:51,460
too kind of give people a little bit

167
00:06:55,260 --> 00:06:52,870
behind the scenes thing what it's like

168
00:06:56,790 --> 00:06:55,270
to you know use the Hubble and some of

169
00:06:58,560 --> 00:06:56,800
the things the Hubble goes through and I

170
00:07:00,300 --> 00:06:58,570
just learned about that recently so I

171
00:07:01,950 --> 00:07:00,310
thought I'd mention it it's not a

172
00:07:03,660 --> 00:07:01,960
serious thing that happens but we just

173
00:07:06,270 --> 00:07:03,670
have to wait for it to pass I suppose so

174
00:07:08,790 --> 00:07:06,280
ok John yang let's talk about the I like

175
00:07:12,050 --> 00:07:08,800
to ask you about this flyby what can you

176
00:07:16,410 --> 00:07:12,060
give us a an intro into what happened

177
00:07:18,210 --> 00:07:16,420
what went on last weekend well as you

178
00:07:20,160 --> 00:07:18,220
said basically the content of the comet

179
00:07:22,290 --> 00:07:20,170
is coming from far far away like the

180
00:07:25,290 --> 00:07:22,300
edge of a solar system and then you know

181
00:07:27,660 --> 00:07:25,300
it happens that it just a flyby plasmas

182
00:07:29,520 --> 00:07:27,670
from very close distance the distance is

183
00:07:31,050 --> 00:07:29,530
actually like only a third of the

184
00:07:33,660 --> 00:07:31,060
distance between the Earth and the moon

185
00:07:36,660 --> 00:07:33,670
so it's very close imagining if you have

186
00:07:38,640 --> 00:07:36,670
some kind of a comment on fly by the

187
00:07:40,260 --> 00:07:38,650
earth from that distance no that's going

188
00:07:42,360 --> 00:07:40,270

to be going to be amazing but this time

189
00:07:45,480 --> 00:07:42,370
it happened on Mars and basically the

190
00:07:46,980 --> 00:07:45,490
comet if you imagine the geometry uh you

191
00:07:48,960 --> 00:07:46,990
know the common basically comes from the

192
00:07:51,720 --> 00:07:48,970
bottom from the south you know below the

193
00:07:54,180 --> 00:07:51,730
the plan that the Mars is orbiting the

194
00:07:59,040 --> 00:07:54,190
Sun and then from the bottom and it it

195
00:08:02,610 --> 00:07:59,050
passes I think it's a slightly inside

196
00:08:04,950 --> 00:08:02,620
Mars orbit and then then cross the cross

197
00:08:08,400 --> 00:08:04,960
most Mars orbit plan to above and then

198
00:08:11,100 --> 00:08:08,410
then from there in it continues to go

199
00:08:12,930 --> 00:08:11,110
and go to his closest point to the Sun

200
00:08:14,520 --> 00:08:12,940
which is very close to Mars too and then

201
00:08:18,420 --> 00:08:14,530
leave the solar system so what happened

202
00:08:21,180 --> 00:08:18,430
last Saturday was you know the clothes

203
00:08:24,180 --> 00:08:21,190
that the comet flyby to the close is the

204
00:08:27,000 --> 00:08:24,190
distance of the of Mars and that

205
00:08:32,190 --> 00:08:27,010
happened I think on eastern time about 2

206
00:08:33,959 --> 00:08:32,200
30 saturday ok but now I carry can you

207
00:08:36,000 --> 00:08:33,969
give us some idea of what the comment

208
00:08:39,630 --> 00:08:36,010
itself was like comet siding spring what

209
00:08:41,339 --> 00:08:39,640
what was it a amazing comment was it a

210
00:08:42,779 --> 00:08:41,349
regular old just run-of-the-mill comment

211
00:08:44,790 --> 00:08:42,789
any what kind of common are we talking

212
00:08:48,840 --> 00:08:44,800
about here it was actually a very little

213
00:08:51,180 --> 00:08:48,850

overachiever common what we heard well

214
00:08:53,190 --> 00:08:51,190
god we saw this comment out almost the

215
00:08:54,420 --> 00:08:53,200
orbit of Saturn just like the comet ison

216
00:08:56,639 --> 00:08:54,430
last year

217
00:08:58,620 --> 00:08:56,649
and what we've learned now just by the

218
00:08:59,910 --> 00:08:58,630
flyby of Mars you with the emeril

219
00:09:01,860 --> 00:08:59,920
high-rise which actually image the

220
00:09:04,019 --> 00:09:01,870
nucleus is that this is a very small

221
00:09:07,320 --> 00:09:04,029
comet maybe half a kilometer radius a

222
00:09:09,630 --> 00:09:07,330
kilometer wide so there is no way we can

223
00:09:11,610 --> 00:09:09,640
ever see a body that the remember

224
00:09:13,079 --> 00:09:11,620
comments are very dark they're darker

225
00:09:14,820 --> 00:09:13,089
than asphalt they're darker than cold

226
00:09:16,800 --> 00:09:14,830
there's no way we can see a body that

227
00:09:18,329 --> 00:09:16,810
small in that dark out by Saturn the

228
00:09:19,769 --> 00:09:18,339
only way we could is if it was really

229
00:09:21,720 --> 00:09:19,779
really active it was throwing out a lot

230
00:09:23,310 --> 00:09:21,730
of material and gas and dust even where

231
00:09:26,130 --> 00:09:23,320
the local temperatures about 100 degrees

232
00:09:28,410 --> 00:09:26,140
help so it was a variant so it's very

233
00:09:30,240 --> 00:09:28,420
active then and most likely Terry active

234
00:09:32,010 --> 00:09:30,250
just as jinyang said it's been living

235
00:09:33,630 --> 00:09:32,020
for four and a half billion years the

236
00:09:35,730 --> 00:09:33,640
vast majority of the time it's been

237
00:09:37,019 --> 00:09:35,740
ordering the Sun the majority of the

238
00:09:39,600 --> 00:09:37,029

time it's orbiting the Sun on a very

239
00:09:42,120 --> 00:09:39,610
long gated orbit it's been way out away

240
00:09:43,410 --> 00:09:42,130
from the Sun and deep freeze and it was

241
00:09:44,699 --> 00:09:43,420
put together for a half billion years

242
00:09:46,740 --> 00:09:44,709
ago with the time when we were

243
00:09:49,320 --> 00:09:46,750
assembling the planets and it's a

244
00:09:50,970 --> 00:09:49,330
failure it failed miserably to actually

245
00:09:52,500 --> 00:09:50,980
become one of the giant planets instead

246
00:09:54,600 --> 00:09:52,510
he got it and had a near miss and got

247
00:09:56,579 --> 00:09:54,610
thrown out on this very elongated orbit

248
00:09:58,590 --> 00:09:56,589
possibly even half will go in elements

249
00:10:00,600 --> 00:09:58,600
to halfway to the other next star so

250
00:10:02,699 --> 00:10:00,610
it's never been in this close to the

251
00:10:05,190 --> 00:10:02,709
solar system into this to the Sun before

252
00:10:06,690 --> 00:10:05,200
it's always come in as close as may be

253
00:10:08,880 --> 00:10:06,700
one of the giant planets and go out

254
00:10:11,460 --> 00:10:08,890
again and know the clothes you called it

255
00:10:13,170 --> 00:10:11,470
a failure Walter really are called it a

256
00:10:14,430 --> 00:10:13,180
failure is a failure if it wanted to be

257
00:10:15,810 --> 00:10:14,440
part of the giant planets the great

258
00:10:18,510 --> 00:10:15,820
success because it's lived a lot longer

259
00:10:20,579 --> 00:10:18,520
than its other brothers and sisters so

260
00:10:22,500 --> 00:10:20,589
the reason why it most likely was so

261
00:10:24,269 --> 00:10:22,510
hyper active is it's never been in this

262
00:10:25,949 --> 00:10:24,279
close before and it suddenly had

263
00:10:27,870 --> 00:10:25,959

materials that have never been heated so

264
00:10:29,910 --> 00:10:27,880
much and it was boiling off furiously

265
00:10:31,500 --> 00:10:29,920
and that's why we caught it out by

266
00:10:33,810 --> 00:10:31,510
Saturn and we've been watching all the

267
00:10:35,490 --> 00:10:33,820
way in so it had a very strong ramp up

268
00:10:37,530 --> 00:10:35,500
between Saturn and maybe out to the

269
00:10:39,600 --> 00:10:37,540
orbit of Jupiter so then it kind of

270
00:10:41,040 --> 00:10:39,610
flattened out and then it actually

271
00:10:42,600 --> 00:10:41,050
started dropping just a little bit right

272
00:10:44,940 --> 00:10:42,610
before in terms of its activity right

273
00:10:46,140 --> 00:10:44,950
before it got to Mars okay let's go

274
00:10:49,040 --> 00:10:46,150
ahead and take a look at what Hubble

275
00:10:51,840 --> 00:10:49,050
image Zolt can you do you have any of

276
00:10:54,360 --> 00:10:51,850
the images that we put out a press

277
00:10:56,449 --> 00:10:54,370
release came out today on our website

278
00:10:58,620 --> 00:10:56,459
where we have some of these images now

279
00:11:01,100 --> 00:10:58,630
and I'd like to just kind of take a look

280
00:11:03,300 --> 00:11:01,110
at this now uh carry this is the kind of

281
00:11:05,819 --> 00:11:03,310
comment that's was on a similar

282
00:11:08,009 --> 00:11:05,829
trajectory as comet Ison was right it

283
00:11:09,989 --> 00:11:08,019
had a one of those really elongated

284
00:11:11,519 --> 00:11:09,999
almost perpendicular to the plane and

285
00:11:13,410 --> 00:11:11,529
solar system right there are a lot of

286
00:11:14,669 --> 00:11:13,420
very strong similarities between Ison

287
00:11:17,100 --> 00:11:14,679
and siding Springs in terms of its

288
00:11:19,799 --> 00:11:17,110

origin at orbit yes okay so here you go

289
00:11:22,619 --> 00:11:19,809
what are you showing us here's old so

290
00:11:26,160 --> 00:11:22,629
this is a picture that we put out with

291
00:11:29,669 --> 00:11:26,170
the news release today this shows Mars

292
00:11:32,699 --> 00:11:29,679
in the lower center of the image and the

293
00:11:34,859 --> 00:11:32,709
comet up to the above that and to the

294
00:11:36,479 --> 00:11:34,869
left a little bit and then the

295
00:11:38,970 --> 00:11:36,489
scattering of stars in the background

296
00:11:41,100 --> 00:11:38,980
now this is a photo composite which

297
00:11:43,499 --> 00:11:41,110
means it's been put together from three

298
00:11:45,410 --> 00:11:43,509
separate components the image of the

299
00:11:49,319 --> 00:11:45,420
comet is an actual image from Hubble

300
00:11:52,439 --> 00:11:49,329
this is actually a composite of numerous

301
00:11:56,429 --> 00:11:52,449
exposures taken with the wide field

302
00:11:58,650 --> 00:11:56,439
camera 3 that have been combined the

303
00:12:00,509 --> 00:11:58,660
common was very faint so all these

304
00:12:03,179 --> 00:12:00,519
exposures were combined and that's the

305
00:12:05,489 --> 00:12:03,189
image we see of the comet and then the

306
00:12:09,150 --> 00:12:05,499
image of Mars was a separate image also

307
00:12:10,470 --> 00:12:09,160
taken with wide field camera 3 in two

308
00:12:13,379 --> 00:12:10,480
different filters and these were

309
00:12:16,980 --> 00:12:13,389
composited to make the color image now

310
00:12:20,549 --> 00:12:16,990
these are placed on this star field at

311
00:12:22,019 --> 00:12:20,559
the positions where we would have seen

312
00:12:25,230 --> 00:12:22,029
them if we could have seen them at the

313
00:12:27,600 --> 00:12:25,240

same time so at the time of the closest

314
00:12:30,090 --> 00:12:27,610
approach so why not just get a picture

315
00:12:31,769 --> 00:12:30,100
of all of it in one in one go well not

316
00:12:33,359 --> 00:12:31,779
really that would have been really cool

317
00:12:36,449 --> 00:12:33,369
and we were kind of hoping for that and

318
00:12:38,819 --> 00:12:36,459
it turns out that at their closest

319
00:12:41,669 --> 00:12:38,829
approach technically it would have been

320
00:12:43,199 --> 00:12:41,679
possible to have the comet and Mars in

321
00:12:45,539 --> 00:12:43,209
the same field of view of the telescope

322
00:12:48,329 --> 00:12:45,549
the cameras field of view although very

323
00:12:50,039 --> 00:12:48,339
small and sky is such that they would

324
00:12:51,989 --> 00:12:50,049
have fit within that tiny field of view

325
00:12:53,970 --> 00:12:51,999
that's how close they got together in

326
00:12:55,789 --> 00:12:53,980
the sky unfortunately there's a lot of

327
00:12:58,409 --> 00:12:55,799
technical issues that get in the way

328
00:13:00,989 --> 00:12:58,419
these are both moving targets these are

329
00:13:02,789 --> 00:13:00,999
moving with respect to the stars and

330
00:13:04,590 --> 00:13:02,799
their turns out they were moving

331
00:13:06,659 --> 00:13:04,600
perpendicular to each other john yang

332
00:13:08,819 --> 00:13:06,669
mentioned that the common was cutting up

333
00:13:10,799 --> 00:13:08,829
from underneath the plane of the planets

334
00:13:13,289 --> 00:13:10,809
of the solar system and traveling up

335
00:13:15,600 --> 00:13:13,299
through that plane and above it well it

336
00:13:17,159 --> 00:13:15,610
turns out that in this view the comma

337
00:13:20,730 --> 00:13:17,169
was coming up from the bottom and

338
00:13:23,100 --> 00:13:20,740

traveling through the frame me

339
00:13:24,690 --> 00:13:23,110
while Mars was traveling also through

340
00:13:27,630 --> 00:13:24,700
the frame in the perpendicular direction

341
00:13:31,320 --> 00:13:27,640
going from right to left to this frame

342
00:13:33,600 --> 00:13:31,330
so if we were to track on the comet to

343
00:13:35,460 --> 00:13:33,610
get a good exposure of the comet Mars

344
00:13:37,980 --> 00:13:35,470
would have trailed through the exposure

345
00:13:40,440 --> 00:13:37,990
and vice versa if we would have tracked

346
00:13:42,030 --> 00:13:40,450
on Mars through the exposure the comet

347
00:13:43,800 --> 00:13:42,040
would've trail now the other

348
00:13:45,750 --> 00:13:43,810
complication the bigger complication

349
00:13:47,790 --> 00:13:45,760
really is that the brightness of these

350
00:13:50,280 --> 00:13:47,800
things and tree in reality is

351
00:13:52,800 --> 00:13:50,290
tremendously different Mars is a big

352
00:13:56,100 --> 00:13:52,810
bright planet reflecting a lot of light

353
00:13:59,490 --> 00:13:56,110
from the Sun in reality at that distance

354
00:14:03,389 --> 00:13:59,500
something like 10,000 times brighter

355
00:14:06,060 --> 00:14:03,399
than the common as carat Casey mentioned

356
00:14:08,100 --> 00:14:06,070
the comet is incredibly dark and faint

357
00:14:10,740 --> 00:14:08,110
and even the coma the material that it's

358
00:14:12,870 --> 00:14:10,750
shedding is not reflecting a very much

359
00:14:15,510 --> 00:14:12,880
sunlight so some of the amateur

360
00:14:18,269 --> 00:14:15,520
photographs that came out before this

361
00:14:20,940 --> 00:14:18,279
encounter showed that like Mars was like

362
00:14:22,650 --> 00:14:20,950
vastly overexposed and then the comet

363
00:14:25,050 --> 00:14:22,660

and it kind of looked like a star and

364
00:14:27,060 --> 00:14:25,060
have the spikes and everything from the

365
00:14:28,710 --> 00:14:27,070
camera or Mars would be fainter and you

366
00:14:30,990 --> 00:14:28,720
could barely see the comet so it's very

367
00:14:33,210 --> 00:14:31,000
hard and the other thing is that we

368
00:14:36,660 --> 00:14:33,220
couldn't get the stars the comet and

369
00:14:38,670 --> 00:14:36,670
Mars all not moving we got to point at

370
00:14:41,340 --> 00:14:38,680
something either stars or the comet or

371
00:14:42,930 --> 00:14:41,350
Mars so we did one of each and made the

372
00:14:44,610 --> 00:14:42,940
composite everything going in different

373
00:14:47,130 --> 00:14:44,620
directions and everything's going in

374
00:14:48,960 --> 00:14:47,140
different directions and I've been

375
00:14:50,699 --> 00:14:48,970
referring to it as you know in principle

376
00:14:51,870 --> 00:14:50,709
we could have taken that one shot you

377
00:14:53,250 --> 00:14:51,880
know where they're all in the same frame

378
00:14:55,319 --> 00:14:53,260
but frankly it would have just been a

379
00:14:57,060 --> 00:14:55,329
stunt you know it would have been just

380
00:14:59,310 --> 00:14:57,070
because we can because there's really no

381
00:15:00,690 --> 00:14:59,320
good scientific reason or it was all it

382
00:15:02,699 --> 00:15:00,700
was explaining it would not have made

383
00:15:05,850 --> 00:15:02,709
nice images that we could have used for

384
00:15:06,930 --> 00:15:05,860
analytical purposes so um you know

385
00:15:08,850 --> 00:15:06,940
obviously we're trying to get the best

386
00:15:10,980 --> 00:15:08,860
science out of this campaign and not

387
00:15:13,050 --> 00:15:10,990
just pull a stunt like that well let's

388
00:15:16,050 --> 00:15:13,060

talk about this image if I may can just

389
00:15:17,490 --> 00:15:16,060
add is that Mars wasn't terribly big at

390
00:15:20,190 --> 00:15:17,500
this time it was relatively far away

391
00:15:22,590 --> 00:15:20,200
from the earth so the size of Mars here

392
00:15:24,269 --> 00:15:22,600
isn't a bad approximation of how big it

393
00:15:26,160 --> 00:15:24,279
is relatively you've probably all seen

394
00:15:27,870 --> 00:15:26,170
the review t'kul pictures of Mars when

395
00:15:29,310 --> 00:15:27,880
it's you know that sound like 20 hour

396
00:15:31,740 --> 00:15:29,320
seconds across this one is as close to

397
00:15:33,269 --> 00:15:31,750
Earth as possible at this time Mars is

398
00:15:34,199 --> 00:15:33,279
about six arc seconds across because a

399
00:15:36,869 --> 00:15:34,209
lot farther away

400
00:15:39,299 --> 00:15:36,879
closest approach I want to talk a little

401
00:15:41,519 --> 00:15:39,309
bit about the science what I and I'll

402
00:15:44,009 --> 00:15:41,529
leave this to John yang or you carry

403
00:15:45,389 --> 00:15:44,019
which uh what what was the science

404
00:15:50,189 --> 00:15:45,399
driver for this what were you hoping to

405
00:15:51,869 --> 00:15:50,199
learn go ahead Jenny sure yeah so so

406
00:15:54,569 --> 00:15:51,879
this event is actually a very unique

407
00:15:56,429 --> 00:15:54,579
event in that you know this comet is a

408
00:15:58,470 --> 00:15:56,439
different category cup of comments

409
00:16:01,169 --> 00:15:58,480
comments that have been visited by

410
00:16:02,939 --> 00:16:01,179
spacecraft from close distance and we

411
00:16:05,129 --> 00:16:02,949
know you know like those those missions

412
00:16:06,929 --> 00:16:05,139
like deep impact like Stardust like

413
00:16:08,879 --> 00:16:06,939

stutters next and all those you know

414
00:16:11,519 --> 00:16:08,889
like the Rosetta mission that is ongoing

415
00:16:13,049 --> 00:16:11,529
now however this country is very very

416
00:16:16,710 --> 00:16:13,059
different from all other comments in

417
00:16:18,179 --> 00:16:16,720
that it is a this time is it's the first

418
00:16:20,970 --> 00:16:18,189
time it comes into the inner solar

419
00:16:23,400 --> 00:16:20,980
system after like forbidding 4.5

420
00:16:26,519 --> 00:16:23,410
billions billions of years updates

421
00:16:28,139 --> 00:16:26,529
formation so um so but for this kind of

422
00:16:29,879 --> 00:16:28,149
comment because it only comes into the

423
00:16:32,309 --> 00:16:29,889
inner solar system for once and then

424
00:16:34,859 --> 00:16:32,319
it's gone we only have one time one shot

425
00:16:37,470 --> 00:16:34,869
and also we only have like one year

426
00:16:40,019 --> 00:16:37,480
after this discovery 2 is perihelion the

427
00:16:42,929 --> 00:16:40,029
boys calm so that time is very short for

428
00:16:44,519 --> 00:16:42,939
us to do any space missions to look at

429
00:16:47,069 --> 00:16:44,529
the comment from caused by distance and

430
00:16:48,869 --> 00:16:47,079
then these opportunities the intensity

431
00:16:50,429 --> 00:16:48,879
in this sense this opportunity is very

432
00:16:52,650 --> 00:16:50,439
unique in that we can look at the

433
00:16:55,559 --> 00:16:52,660
comment from a close distance from the

434
00:16:58,799 --> 00:16:55,569
spacecraft on Mars so that is why we're

435
00:17:00,960 --> 00:16:58,809
doing it and then the the director

436
00:17:02,699 --> 00:17:00,970
direct scientific driver for how about

437
00:17:05,699 --> 00:17:02,709
you look at it during Mars encounter is

438
00:17:07,799 --> 00:17:05,709

because um more spacecraft will be

439
00:17:10,590 --> 00:17:07,809
looking at the comet when its flyby from

440
00:17:12,120 --> 00:17:10,600
phenyl from under the under Mars orbital

441
00:17:15,389 --> 00:17:12,130
plane and then cross it and then go

442
00:17:17,069 --> 00:17:15,399
above so but then Hubble from the other

443
00:17:19,350 --> 00:17:17,079
will look at the comment from another

444
00:17:21,779 --> 00:17:19,360
from another very different perspective

445
00:17:23,460 --> 00:17:21,789
and when you combine in image from two

446
00:17:25,769 --> 00:17:23,470
different perspectives you will be able

447
00:17:28,740 --> 00:17:25,779
to construct the 3d structure of the

448
00:17:31,529 --> 00:17:28,750
inner you know in a coma of the comment

449
00:17:34,769 --> 00:17:31,539
so basically that's one driver for these

450
00:17:37,560 --> 00:17:34,779
observations we used how about the the

451
00:17:40,260 --> 00:17:37,570
tremendous spatial resolution howl howl

452
00:17:42,990 --> 00:17:40,270
is the almost to the working can provide

453
00:17:44,700 --> 00:17:43,000
us the best right best images that you

454
00:17:48,090 --> 00:17:44,710
know we can get from all the telescopes

455
00:17:50,789 --> 00:17:48,100
on the earth so that is one thing and

456
00:17:53,340 --> 00:17:50,799
the thing I think maybe Casey can tell

457
00:17:54,950 --> 00:17:53,350
us how we can study they are the gas of

458
00:17:58,440 --> 00:17:54,960
his comment and interactions with Mars

459
00:18:00,419 --> 00:17:58,450
okay okay let's do that alright i will

460
00:18:02,940 --> 00:18:00,429
let me just add one thing to what

461
00:18:05,039 --> 00:18:02,950
jinyang said all the spacecraft visits

462
00:18:06,870 --> 00:18:05,049
to comets we've had so far have been to

463
00:18:08,460 --> 00:18:06,880

what we call Jupiter family comets that

464
00:18:10,409 --> 00:18:08,470
come from the Kuiper belt from the edge

465
00:18:11,940 --> 00:18:10,419
of the disk of our system and if you

466
00:18:14,010 --> 00:18:11,950
think of this solar system as a record

467
00:18:15,120 --> 00:18:14,020
and the comment of the planet we're out

468
00:18:17,039 --> 00:18:15,130
in the grooves and the sun's at the

469
00:18:19,350 --> 00:18:17,049
center all these comets have pretty much

470
00:18:21,180 --> 00:18:19,360
been in the plane of that record but of

471
00:18:23,100 --> 00:18:21,190
the solar system these Oort cloud comets

472
00:18:24,960 --> 00:18:23,110
that come from a different collection or

473
00:18:26,730 --> 00:18:24,970
population your clog is expands

474
00:18:28,860 --> 00:18:26,740
basically like a sphere that surrounds

475
00:18:30,240 --> 00:18:28,870
our solar system and as to the farthest

476
00:18:31,500 --> 00:18:30,250
did most distant thing we have in the

477
00:18:33,120 --> 00:18:31,510
solar system and we have never been able

478
00:18:35,640 --> 00:18:33,130
to get this close and personal to one

479
00:18:36,810 --> 00:18:35,650
before we in my rocket simply in our

480
00:18:39,060 --> 00:18:36,820
spaceships simply don't have enough

481
00:18:41,100 --> 00:18:39,070
energy to get to them so instead we have

482
00:18:42,240 --> 00:18:41,110
to wait until you come to us so that's

483
00:18:46,260 --> 00:18:42,250
why another reason this is for special

484
00:18:48,480 --> 00:18:46,270
so little blessing coming to us um yeah

485
00:18:51,090 --> 00:18:48,490
it's North normally we go to them but

486
00:18:52,830 --> 00:18:51,100
this is a wonderful example of reuse you

487
00:18:56,340 --> 00:18:52,840
can actually use NASA assets to have a

488
00:18:57,510 --> 00:18:56,350

free fly back so I jinyang wanted me to

489
00:18:59,940 --> 00:18:57,520
talk about the other things we want to

490
00:19:01,409 --> 00:18:59,950
learn from the flybot know that since

491
00:19:03,270 --> 00:19:01,419
the comment was coming to us we can

492
00:19:05,190 --> 00:19:03,280
actually watch it and watch how gas and

493
00:19:06,930 --> 00:19:05,200
dust are coming off of it and we can see

494
00:19:08,970 --> 00:19:06,940
if it varies you can see if that gas and

495
00:19:11,820 --> 00:19:08,980
that dust interacted at all with Mars

496
00:19:13,940 --> 00:19:11,830
most the the largest prediction was that

497
00:19:17,610 --> 00:19:13,950
the Martian atmosphere would heat up

498
00:19:19,289 --> 00:19:17,620
from gas molecules and tiny little bits

499
00:19:21,539 --> 00:19:19,299
of dust hitting the upper atmosphere

500
00:19:23,399 --> 00:19:21,549
there wasn't much material coming from

501
00:19:25,560 --> 00:19:23,409
the comet the Miss was close but not

502
00:19:27,210 --> 00:19:25,570
that close but on the other hand the

503
00:19:28,890 --> 00:19:27,220
comet was moving what we call retrograde

504
00:19:30,029 --> 00:19:28,900
it was actually going backwards compared

505
00:19:31,860 --> 00:19:30,039
to the way that all the planets move

506
00:19:33,990 --> 00:19:31,870
around which is counterclockwise the

507
00:19:36,600 --> 00:19:34,000
comment was coming clockwise so it was

508
00:19:39,000 --> 00:19:36,610
almost a head-on collision almost and

509
00:19:41,070 --> 00:19:39,010
the relative velocity between the comet

510
00:19:43,049 --> 00:19:41,080
and Mars is about fifty six kilometers

511
00:19:45,630 --> 00:19:43,059
per second it's about 30-some miles per

512
00:19:47,130 --> 00:19:45,640
second so each atom and each piece of

513
00:19:49,200 --> 00:19:47,140

dust that would hit Mars's atmosphere

514
00:19:51,270 --> 00:19:49,210
brought a really large amount of huge

515
00:19:52,770 --> 00:19:51,280
amount of energy so even though there

516
00:19:54,090 --> 00:19:52,780
wasn't too much material coming off the

517
00:19:56,669 --> 00:19:54,100
comment again think of the common is a

518
00:19:57,720 --> 00:19:56,679
very very small mountain if that much we

519
00:20:00,090 --> 00:19:57,730
need smaller than the average

520
00:20:01,289 --> 00:20:00,100
Appalachian mountain but and shedding a

521
00:20:02,040 --> 00:20:01,299
little bit of it's tough maybe a

522
00:20:04,470 --> 00:20:02,050
fraction of

523
00:20:06,360 --> 00:20:04,480
sent but that stuff is can actually hit

524
00:20:08,160 --> 00:20:06,370
Mars and Mars atmosphere and we were

525
00:20:10,800 --> 00:20:08,170
looking to see whether any of that would

526
00:20:12,600 --> 00:20:10,810
again heat up the atmosphere also the

527
00:20:14,880 --> 00:20:12,610
comet was up wind and the solar wind

528
00:20:16,590 --> 00:20:14,890
from Mars so I on streaming off the

529
00:20:18,330 --> 00:20:16,600
comment into the solar wind interacting

530
00:20:19,260 --> 00:20:18,340
with the comet would then hit Mars we

531
00:20:21,480 --> 00:20:19,270
were interested to see whether there's

532
00:20:23,130 --> 00:20:21,490
any interaction and possible roar a or

533
00:20:25,770 --> 00:20:23,140
just kind of puffing up of the Martian

534
00:20:27,510 --> 00:20:25,780
ionosphere well was there any did did

535
00:20:29,400 --> 00:20:27,520
you see any interaction with the

536
00:20:31,680 --> 00:20:29,410
atmosphere we don't know yet Oh another

537
00:20:34,320 --> 00:20:31,690
problem we had a problem with the orbits

538
00:20:36,390 --> 00:20:34,330

it'll Thursday this happened like this

539
00:20:38,040 --> 00:20:36,400
happened like over the weekend we lost

540
00:20:39,780 --> 00:20:38,050
our background measurement we actually

541
00:20:42,000 --> 00:20:39,790
have to get that back real soon we don't

542
00:20:43,460 --> 00:20:42,010
have a measure of what 0 is there was

543
00:20:46,350 --> 00:20:43,470
there was a problem with its spacecraft

544
00:20:50,760 --> 00:20:46,360
so what happens we'll hear more is that

545
00:20:52,710 --> 00:20:50,770
Max's job is not gonna get that max back

546
00:20:54,330 --> 00:20:52,720
with you know we get a background to

547
00:20:56,220 --> 00:20:54,340
sleep in the spacecraft had problem no

548
00:20:58,710 --> 00:20:56,230
the spacecraft there's a wonderful

549
00:20:59,820 --> 00:20:58,720
instrument morning for now 25 years you

550
00:21:01,890 --> 00:20:59,830
point out but just like every other

551
00:21:04,290 --> 00:21:01,900
machine or a robot ever built by man

552
00:21:07,920 --> 00:21:04,300
every now and then it has a hiccup ok

553
00:21:10,650 --> 00:21:07,930
i'm afraid i will let you image dave i'm

554
00:21:12,960 --> 00:21:10,660
sorry i can't open the cover the cover

555
00:21:14,730 --> 00:21:12,970
they don't actually move that anymore a

556
00:21:19,170 --> 00:21:14,740
Charles Bell has a good question let me

557
00:21:23,010 --> 00:21:19,180
ask this one before mro high-rise image

558
00:21:25,350 --> 00:21:23,020
of comment see 20 31 a 1 which is siding

559
00:21:28,350 --> 00:21:25,360
spring at close approach what did you

560
00:21:31,110 --> 00:21:28,360
think the size of the comet nucleus was

561
00:21:32,760 --> 00:21:31,120
and what did you base that on I think

562
00:21:34,170 --> 00:21:32,770
that depends on who you ask I'll give my

563
00:21:37,980 --> 00:21:34,180

opinion than shiney I should give his

564
00:21:39,510 --> 00:21:37,990
okay should be close I hope well the

565
00:21:41,550 --> 00:21:39,520
lowest limit we had was somewhere around

566
00:21:43,080 --> 00:21:41,560
point 3.5 kilometers and that came

567
00:21:45,270 --> 00:21:43,090
typically from just seeing how much gas

568
00:21:47,580 --> 00:21:45,280
was coming off being evolved the gas

569
00:21:49,140 --> 00:21:47,590
production rate we call it and assuming

570
00:21:51,030 --> 00:21:49,150
that all of that was coming from a

571
00:21:52,860 --> 00:21:51,040
nucleus so just imagine a spherical

572
00:21:54,780 --> 00:21:52,870
nucleus to make life simple you can

573
00:21:56,520 --> 00:21:54,790
figure out what 4 PI R squared has to be

574
00:21:58,950 --> 00:21:56,530
and because we know how fast water I

575
00:22:01,260 --> 00:21:58,960
spoils off at one and a half a you from

576
00:22:02,700 --> 00:22:01,270
the Sun for example the upper limit came

577
00:22:04,530 --> 00:22:02,710
from some of our earlier Hubble

578
00:22:06,330 --> 00:22:04,540
observations and we couldn't say very

579
00:22:07,860 --> 00:22:06,340
strenuously what that was if you wanted

580
00:22:10,110 --> 00:22:07,870
to be extremely conservative it was

581
00:22:11,610 --> 00:22:10,120
about 5 kilometers most likely the

582
00:22:13,980 --> 00:22:11,620
analysis had shown it couldn't even

583
00:22:15,270 --> 00:22:13,990
bigger than do two kilometers radius but

584
00:22:15,800 --> 00:22:15,280
we knew almost immediately from the

585
00:22:18,050 --> 00:22:15,810
first hub

586
00:22:19,820 --> 00:22:18,060
servations it wasn't a ginormous nucleus

587
00:22:21,410 --> 00:22:19,830
because that's the other possibility you

588
00:22:23,690 --> 00:22:21,420

can see it out by Saturn just because it

589
00:22:26,330 --> 00:22:23,700
is just big big big and we will that out

590
00:22:28,310 --> 00:22:26,340
pretty fast ginormous is that mess is

591
00:22:31,130 --> 00:22:28,320
another technical yeah that's a unit

592
00:22:35,150 --> 00:22:31,140
yeah so is actually tweeting that right

593
00:22:36,320 --> 00:22:35,160
now so yeah epi so's old Leia I don't

594
00:22:38,450 --> 00:22:36,330
know if you can show us this or not but

595
00:22:40,970 --> 00:22:38,460
let he were talking about the first

596
00:22:42,500 --> 00:22:40,980
observations of Hubble can we see the

597
00:22:44,150 --> 00:22:42,510
progression of Hubble images you happen

598
00:22:46,850 --> 00:22:44,160
to have that handy when some of the

599
00:22:50,270 --> 00:22:46,860
first observations back in September

600
00:22:53,200 --> 00:22:50,280
versus the ones that were closer or is

601
00:22:56,060 --> 00:22:53,210
that wanna sleep I can bring that up

602
00:22:57,860 --> 00:22:56,070
well I don't mean I don't mean to throw

603
00:23:01,120 --> 00:22:57,870
a wrench in the works if you can ok just

604
00:23:03,320 --> 00:23:01,130
curious add that cued up but I didn't

605
00:23:06,260 --> 00:23:03,330
you're a rock star I'm sure I'll get it

606
00:23:08,180 --> 00:23:06,270
getting so it so let's talk about that a

607
00:23:09,380 --> 00:23:08,190
little bit Xianyang I'm i accidentally

608
00:23:11,060 --> 00:23:09,390
had to mute you cousin I didn't

609
00:23:13,670 --> 00:23:11,070
accidentally I purposely meted you but

610
00:23:16,580 --> 00:23:13,680
um I wanted to do there's an echo

611
00:23:17,840 --> 00:23:16,590
there's an echo there so I I had the and

612
00:23:24,020 --> 00:23:17,850
then he accidentally slapped you in the

613
00:23:27,230 --> 00:23:24,030

face now that was used God um can you

614
00:23:28,820 --> 00:23:27,240
can you tell us a little bit about what

615
00:23:30,350 --> 00:23:28,830
happened to the comments from the first

616
00:23:33,560 --> 00:23:30,360
Hubble observations which I think we're

617
00:23:34,880 --> 00:23:33,570
back in September correct to do though

618
00:23:39,440 --> 00:23:34,890
what happened to the comet is it got

619
00:23:41,870 --> 00:23:39,450
closer to Mars uh well i think the the

620
00:23:44,600 --> 00:23:41,880
most interesting thing recent change of

621
00:23:48,890 --> 00:23:44,610
the comment uh was that something up

622
00:23:50,300 --> 00:23:48,900
thank you so go ahead yeah okay so so as

623
00:23:51,650 --> 00:23:50,310
you said how about actually the first

624
00:23:54,230 --> 00:23:51,660
time how about looked at his comment was

625
00:23:56,750 --> 00:23:54,240
last year in october almost a year ago I

626
00:23:58,550 --> 00:23:56,760
can't believe it anyway um so since then

627
00:24:01,370 --> 00:23:58,560
Hubble observed the climate two more

628
00:24:04,670 --> 00:24:01,380
times 11 Singh January this year and

629
00:24:07,340 --> 00:24:04,680
other finds in your head run March this

630
00:24:09,620 --> 00:24:07,350
year and you know from those three

631
00:24:13,070 --> 00:24:09,630
observations the comet actually does not

632
00:24:16,040 --> 00:24:13,080
change much but just I think a few weeks

633
00:24:19,250 --> 00:24:16,050
ago there was sign that this comment was

634
00:24:21,230 --> 00:24:19,260
you know this comet had behaved like all

635
00:24:23,590 --> 00:24:21,240
the way until a few weeks before the

636
00:24:25,910 --> 00:24:23,600
close encounter with Mars you know uh

637
00:24:27,800 --> 00:24:25,920
until that time we were all very happy

638
00:24:29,270 --> 00:24:27,810

that this come it just just the

639
00:24:30,680 --> 00:24:29,280
performance of the comment

640
00:24:33,170 --> 00:24:30,690
brightness of the comet just follows

641
00:24:35,780 --> 00:24:33,180
what people what scientists will predict

642
00:24:38,330 --> 00:24:35,790
they are then then we're all happy about

643
00:24:42,800 --> 00:24:38,340
that but unlike a few weeks away like

644
00:24:44,690 --> 00:24:42,810
the people suddenly realized that the

645
00:24:46,640 --> 00:24:44,700
the the brain is like a missile a

646
00:24:52,490 --> 00:24:46,650
starting huge carbon trading nificant

647
00:24:54,740 --> 00:24:52,500
like and so so and you know there's no

648
00:24:56,630 --> 00:24:54,750
sign no sign about what happened on

649
00:25:00,170 --> 00:24:56,640
comet and we have no explanation about

650
00:25:02,330 --> 00:25:00,180
about that yet so and also so that's

651
00:25:03,980 --> 00:25:02,340
what we actually saw in the first in

652
00:25:06,320 --> 00:25:03,990
Hubble images during a close encounter

653
00:25:08,120 --> 00:25:06,330
of the data down the first thing we look

654
00:25:10,340 --> 00:25:08,130
with check is of course whether we have

655
00:25:11,900 --> 00:25:10,350
exposed to comment well in our images

656
00:25:14,510 --> 00:25:11,910
what whether we have enough signal to

657
00:25:15,800 --> 00:25:14,520
work with then in the first check the

658
00:25:17,570 --> 00:25:15,810
thing we noticed the first thing we

659
00:25:20,210 --> 00:25:17,580
noticed was that the comment was indeed

660
00:25:23,510 --> 00:25:20,220
Center than the prediction by like half

661
00:25:25,520 --> 00:25:23,520
to 1 magnitude so or signal is kind of

662
00:25:26,900 --> 00:25:25,530
low lower than or expectation but still

663
00:25:29,120 --> 00:25:26,910

we have enough signal to work with we

664
00:25:31,100 --> 00:25:29,130
believe and um you know that's the first

665
00:25:32,780 --> 00:25:31,110
thing we noticed in your data and that's

666
00:25:35,390 --> 00:25:32,790
I think the biggest change or what I

667
00:25:37,610 --> 00:25:35,400
would say now okay well and and as

668
00:25:39,110 --> 00:25:37,620
Carrie points out we may still see

669
00:25:42,310 --> 00:25:39,120
evidence of some interaction when it

670
00:25:45,290 --> 00:25:42,320
flew by maybe see some aurori or or a

671
00:25:46,400 --> 00:25:45,300
hopefully I'll give until next tuesday

672
00:25:48,830 --> 00:25:46,410
hopefully i'll have something by the

673
00:25:51,230 --> 00:25:48,840
enemies given the weekend so Zolt now

674
00:25:53,150 --> 00:25:51,240
can you uh can you sort of short show us

675
00:25:55,100 --> 00:25:53,160
what your tell us what we're looking at

676
00:25:56,840 --> 00:25:55,110
here this is the observations back in

677
00:25:58,370 --> 00:25:56,850
march this was the observations from

678
00:26:00,440 --> 00:25:58,380
markers and actually maybe john yang

679
00:26:01,760 --> 00:26:00,450
would be better oh okay probably we're

680
00:26:05,450 --> 00:26:01,770
looking at but we're looking at on the

681
00:26:07,580 --> 00:26:05,460
left is the plane image of the basically

682
00:26:09,170 --> 00:26:07,590
the raw image of the comment as you can

683
00:26:12,260 --> 00:26:09,180
see the tail is pointing off to the

684
00:26:15,140 --> 00:26:12,270
upper right it's actually you do need a

685
00:26:18,140 --> 00:26:15,150
detectable tail and on the right is an

686
00:26:19,790 --> 00:26:18,150
image process to show the details very

687
00:26:22,250 --> 00:26:19,800
close to the nucleus and i think john

688
00:26:27,050 --> 00:26:22,260

yang can explain why it looks the way it

689
00:26:29,960 --> 00:26:27,060
looks well so what we did was that we

690
00:26:33,160 --> 00:26:29,970
are sort of but with we divided divided

691
00:26:36,620 --> 00:26:33,170
the image of the comment by a model that

692
00:26:40,520 --> 00:26:36,630
produce a you know uh what we called out

693
00:26:42,410 --> 00:26:40,530
isotropic isotropic dust emission you

694
00:26:43,190 --> 00:26:42,420
know we assume that you know if if this

695
00:26:45,440 --> 00:26:43,200
comment is

696
00:26:48,740 --> 00:26:45,450
meeting all the dust all the same of the

697
00:26:50,180 --> 00:26:48,750
same way in all directions then then it

698
00:26:52,730 --> 00:26:50,190
will be it what we look a slightly

699
00:26:55,340 --> 00:26:52,740
different and then the the image in the

700
00:26:57,200 --> 00:26:55,350
right hand side was the was that was a

701
00:26:59,600 --> 00:26:57,210
difference between his actual image and

702
00:27:01,850 --> 00:26:59,610
that ideal model so what this means is

703
00:27:05,389 --> 00:27:01,860
that the comet is actually emitting some

704
00:27:07,070 --> 00:27:05,399
tusk preferentially towards the left and

705
00:27:09,289 --> 00:27:07,080
also towards the right there were two

706
00:27:11,240 --> 00:27:09,299
features that you know we see a little

707
00:27:13,669 --> 00:27:11,250
bit slightly enhanced destination in a

708
00:27:15,200 --> 00:27:13,679
coma and this is an indication that the

709
00:27:18,500 --> 00:27:15,210
activity on the coming to a nuclear

710
00:27:20,960 --> 00:27:18,510
nucleus is not like the same not uniform

711
00:27:23,539 --> 00:27:20,970
not the same everywhere it has some area

712
00:27:26,240 --> 00:27:23,549
that is strong slightly more active than

713
00:27:28,370 --> 00:27:26,250

the other in other areas so that's what

714
00:27:30,680 --> 00:27:28,380
we see here on the right hand side can

715
00:27:34,129 --> 00:27:30,690
you call them jets or is it just some

716
00:27:35,600 --> 00:27:34,139
sort of emissions of some kind well to

717
00:27:39,980 --> 00:27:35,610
be precisely we prefer to call them

718
00:27:42,889 --> 00:27:39,990
features Oh feature they're really

719
00:27:44,299 --> 00:27:42,899
brochures and or they could woman heart

720
00:27:47,269 --> 00:27:44,309
could be towards the stun yeah you have

721
00:27:49,639 --> 00:27:47,279
to be careful okay well i like to term

722
00:27:51,590 --> 00:27:49,649
jets but i guess that's not not precise

723
00:27:55,100 --> 00:27:51,600
enough and probably probably misleading

724
00:27:59,919 --> 00:27:55,110
I there's a cop here's a question from

725
00:28:03,620 --> 00:27:59,929
my cat food oh I love that I love that a

726
00:28:07,389 --> 00:28:03,630
handle to anybody on the panel did we

727
00:28:10,129 --> 00:28:07,399
know the composition of siding spring

728
00:28:13,490 --> 00:28:10,139
now only know the composition I do its

729
00:28:15,370 --> 00:28:13,500
space stuff there you go we're all far

730
00:28:18,259 --> 00:28:15,380
does there you go ready that's right

731
00:28:21,500 --> 00:28:18,269
okay I'm gonna pull a Sagan and just

732
00:28:23,269 --> 00:28:21,510
it's our stuff we knew very roughly that

733
00:28:25,490 --> 00:28:23,279
we think it was about half water ice and

734
00:28:27,289 --> 00:28:25,500
and carbon dioxide and carbon dioxide

735
00:28:30,080 --> 00:28:27,299
and methane and ammonia etcetera Isis

736
00:28:31,669 --> 00:28:30,090
and roughly half rocky stuff but we

737
00:28:32,750 --> 00:28:31,679
didn't know the exact details and we

738
00:28:34,879 --> 00:28:32,760

didn't know how much carbonaceous

739
00:28:36,590 --> 00:28:34,889
material there was we can tell you that

740
00:28:38,990 --> 00:28:36,600
ison has seemed to have been very

741
00:28:41,029 --> 00:28:39,000
abundant in rich and very rich in

742
00:28:42,769 --> 00:28:41,039
organics more than the average comet

743
00:28:44,090 --> 00:28:42,779
last year so we've looking for that we

744
00:28:48,440 --> 00:28:44,100
don't have any response to that though

745
00:28:50,090 --> 00:28:48,450
yeah okay so also from my cat food also

746
00:28:51,619 --> 00:28:50,100
to anyone on the panel referring to the

747
00:28:53,389 --> 00:28:51,629
slough coverage it looked like there

748
00:28:55,159 --> 00:28:53,399
either was or wasn't an electrical

749
00:28:56,720 --> 00:28:55,169
interaction with the Martian atmosphere

750
00:28:59,360 --> 00:28:56,730
you have any common

751
00:29:03,110 --> 00:28:59,370
on that I don't know we talked about

752
00:29:05,299 --> 00:29:03,120
that look like it was or wasn't there

753
00:29:07,960 --> 00:29:05,309
would i look at the other one or what i

754
00:29:11,000 --> 00:29:07,970
wanted a quantum show i'm not sure um

755
00:29:13,490 --> 00:29:11,010
well we talked about already they don't

756
00:29:15,650 --> 00:29:13,500
know yet if there was any interactions

757
00:29:17,990 --> 00:29:15,660
with the atmosphere at all so they're

758
00:29:20,419 --> 00:29:18,000
going to find that out and and get back

759
00:29:22,070 --> 00:29:20,429
to us I hope a lot of people look like

760
00:29:23,780 --> 00:29:22,080
they're having trouble connecting so yes

761
00:29:25,580 --> 00:29:23,790
you're going to need to refresh your

762
00:29:27,409 --> 00:29:25,590
browser hopefully in the Hangout will

763
00:29:29,600 --> 00:29:27,419

appear to you but then you can't see me

764
00:29:32,180 --> 00:29:29,610
say that so I don't know why we bothered

765
00:29:34,730 --> 00:29:32,190
I link to the YouTube into the event

766
00:29:37,789 --> 00:29:34,740
patient oh ok yeah seem to be having

767
00:29:40,430 --> 00:29:37,799
trouble um alright so I told you you had

768
00:29:43,060 --> 00:29:40,440
created a really nice animated gif also

769
00:29:46,820 --> 00:29:43,070
with the press release can we see that

770
00:29:50,570 --> 00:29:46,830
yes again that will take me a moment ok

771
00:29:54,980 --> 00:29:50,580
alright I will preface it by saying that

772
00:29:58,400 --> 00:29:54,990
that was a that was a model in an

773
00:30:01,940 --> 00:29:58,410
animation and it wasn't based on well it

774
00:30:06,110 --> 00:30:01,950
was based on the earlier image of the

775
00:30:09,080 --> 00:30:06,120
comet in an earlier image of Mars ok

776
00:30:12,169 --> 00:30:09,090
they were roughly positioned where I

777
00:30:13,340 --> 00:30:12,179
thought they ought to be okay while

778
00:30:18,740 --> 00:30:13,350
you're doing that let me ask one more

779
00:30:21,110 --> 00:30:18,750
question on Q&A app Nastya crew couch

780
00:30:22,970 --> 00:30:21,120
innova sorry if I messed that up could

781
00:30:26,810 --> 00:30:22,980
we know is it possible to know from

782
00:30:29,480 --> 00:30:26,820
which system that comic came from yes we

783
00:30:31,700 --> 00:30:29,490
know the orbit we've been following this

784
00:30:34,039 --> 00:30:31,710
comment for a long time if I may digress

785
00:30:35,870 --> 00:30:34,049
think of the orbits of the planets like

786
00:30:37,159 --> 00:30:35,880
a rubber band it's almost like a circle

787
00:30:39,560 --> 00:30:37,169
remember that talked about grooves in a

788
00:30:41,090 --> 00:30:39,570

record your period comet that we go and

789
00:30:42,289 --> 00:30:41,100
fly to with our spacecraft would be if

790
00:30:43,610 --> 00:30:42,299
you took that rubber band you stretched

791
00:30:45,710 --> 00:30:43,620
it a little bit so it kind of looked

792
00:30:47,720 --> 00:30:45,720
like an ellipse or an egg they're not

793
00:30:49,880 --> 00:30:47,730
very stretched the orbits we see for the

794
00:30:51,409 --> 00:30:49,890
Oort cloud comets are stretched so long

795
00:30:52,880 --> 00:30:51,419
that it looks like almost two straight

796
00:30:55,610 --> 00:30:52,890
lines with just little kind of round the

797
00:30:57,140 --> 00:30:55,620
end caps but if we were to stretch it

798
00:30:59,659 --> 00:30:57,150
even farther so it came from another

799
00:31:01,310 --> 00:30:59,669
system the rubber band would break we

800
00:31:02,780 --> 00:31:01,320
know that the amount of energy this

801
00:31:04,400 --> 00:31:02,790
comment has in its orbit is such that it

802
00:31:06,020 --> 00:31:04,410
goes around the Sun every few million

803
00:31:09,710 --> 00:31:06,030
years it's never been outside of our

804
00:31:10,549 --> 00:31:09,720
system ok so a few million years so

805
00:31:11,869 --> 00:31:10,559
definitely not

806
00:31:14,450 --> 00:31:11,879
gonna be seeing this again anytime soon

807
00:31:16,549 --> 00:31:14,460
no jinyang said it weren't we had our

808
00:31:17,600 --> 00:31:16,559
shot looking at this one if you're gonna

809
00:31:19,759 --> 00:31:17,610
be around a few million years for now

810
00:31:22,489 --> 00:31:19,769
maybe but I wouldn't wait for it come

811
00:31:25,129 --> 00:31:22,499
home before it singularities coming are

812
00:31:26,659 --> 00:31:25,139
you go put yourself in that spaceship

813
00:31:32,989 --> 00:31:26,669

now and move it to speed of light there

814
00:31:36,230 --> 00:31:32,999
you go okay ray kurzweil okay okay so I

815
00:31:39,139 --> 00:31:36,240
so there's old sigh animation go ahead

816
00:31:41,690 --> 00:31:39,149
animation we put together and so you see

817
00:31:43,970 --> 00:31:41,700
as I described before you can see that

818
00:31:45,769 --> 00:31:43,980
the comments coming up from it and this

819
00:31:48,560 --> 00:31:45,779
is looping so it's just repeating the

820
00:31:51,350 --> 00:31:48,570
same sequence of events it's taking

821
00:31:53,450 --> 00:31:51,360
place over the space of an hour as this

822
00:31:56,690 --> 00:31:53,460
event is taking place so you can see how

823
00:31:59,869 --> 00:31:56,700
quickly these things move makes clear

824
00:32:02,029 --> 00:31:59,879
marshal bit out of this for this sped up

825
00:32:03,680 --> 00:32:02,039
dramatically but yeah Mars is moving

826
00:32:06,919 --> 00:32:03,690
from left to right across the bottom and

827
00:32:11,989 --> 00:32:06,929
the comment is moving up from the bottom

828
00:32:14,690 --> 00:32:11,999
and there's a there's a area marked off

829
00:32:17,509 --> 00:32:14,700
in green and that's the that's the area

830
00:32:20,090 --> 00:32:17,519
of the sky that the Hubble's camera the

831
00:32:21,649 --> 00:32:20,100
wide field camera 3 can see in one frame

832
00:32:24,590 --> 00:32:21,659
so as you can see it's all taking place

833
00:32:25,909 --> 00:32:24,600
within one frame in principle though as

834
00:32:29,269 --> 00:32:25,919
we said before we couldn't actually

835
00:32:31,690 --> 00:32:29,279
image them at the same time so if that

836
00:32:34,940 --> 00:32:31,700
kind of gives you an idea of the scale

837
00:32:37,609 --> 00:32:34,950
Wow of what what's going right hey tires

838
00:32:41,330 --> 00:32:37,619

ago I'm orientation anymore yeah that's

839
00:32:44,629 --> 00:32:41,340
really neat okay uh so what's what's

840
00:32:46,669 --> 00:32:44,639
next for these observations uh Carrie

841
00:32:49,029 --> 00:32:46,679
are you going to be obviously poring

842
00:32:51,499 --> 00:32:49,039
over the the observations you've got and

843
00:32:52,879 --> 00:32:51,509
what is what what do you were what are

844
00:32:55,789 --> 00:32:52,889
your plans for the immediate future with

845
00:32:58,519 --> 00:32:55,799
this well we have a few plans part of it

846
00:33:00,799 --> 00:32:58,529
is Jim Yang's program he's concentrating

847
00:33:02,149 --> 00:33:00,809
more on the nucleus I'm front and I'm in

848
00:33:03,350 --> 00:33:02,159
the dust I'm concentrating more on the

849
00:33:04,700 --> 00:33:03,360
gas it's not that I'm interested not

850
00:33:07,039 --> 00:33:04,710
interested in both but I have another

851
00:33:07,999 --> 00:33:07,049
program which is related let me point

852
00:33:10,580 --> 00:33:08,009
out one thing that's actually

853
00:33:12,049 --> 00:33:10,590
interesting jinyang sure owed the images

854
00:33:15,379 --> 00:33:12,059
from march where it looked like there

855
00:33:16,700 --> 00:33:15,389
were two features possibly jets but we

856
00:33:18,649 --> 00:33:16,710
had well the light curve we have the

857
00:33:20,629 --> 00:33:18,659
variation of the comet over time looked

858
00:33:22,460 --> 00:33:20,639
absolutely flat you can see any and

859
00:33:24,350 --> 00:33:22,470
nuclei the comet nucleus is usually

860
00:33:26,299 --> 00:33:24,360
rotating tumbling possibly even

861
00:33:27,590 --> 00:33:26,309
and so we'd expect those features to

862
00:33:30,560 --> 00:33:27,600
come in and out and get brighter and

863
00:33:31,700 --> 00:33:30,570

dimmer we need to see any now we're

864
00:33:33,380 --> 00:33:31,710
getting seen hints from at least three

865
00:33:35,510 --> 00:33:33,390
different spacecraft of a huge amount of

866
00:33:37,669 --> 00:33:35,520
variability but we don't see any obvious

867
00:33:39,650 --> 00:33:37,679
jets just in a very quick first look

868
00:33:41,090 --> 00:33:39,660
we're going to dig deeper so it's

869
00:33:43,940 --> 00:33:41,100
actually counterintuitive this is a

870
00:33:46,750 --> 00:33:43,950
little confusing and exciting okay so

871
00:33:49,100 --> 00:33:46,760
the moment get back to the gas I'm also

872
00:33:50,630 --> 00:33:49,110
have observing time with the Chandra

873
00:33:52,850 --> 00:33:50,640
x-ray telescope another one of the

874
00:33:54,289 --> 00:33:52,860
masses great observatories so we were

875
00:33:57,980 --> 00:33:54,299
watching both Mars in the comet which

876
00:33:59,120 --> 00:33:57,990
are both known x-ray objects and then

877
00:34:00,560 --> 00:33:59,130
reason they're x-ray objects is they're

878
00:34:02,659 --> 00:34:00,570
immersed in the solar wind the solar

879
00:34:04,520 --> 00:34:02,669
wind comes along and grabs electrons

880
00:34:06,049 --> 00:34:04,530
from their neutral species and as they d

881
00:34:08,240 --> 00:34:06,059
excite they give off characteristic

882
00:34:09,649 --> 00:34:08,250
x-rays so we were interested to see

883
00:34:11,359 --> 00:34:09,659
whether Mars in the comet would possibly

884
00:34:13,490 --> 00:34:11,369
flare when they came close to each other

885
00:34:15,770 --> 00:34:13,500
and so one of the reasons we were using

886
00:34:18,230 --> 00:34:15,780
Hubble was actually watch the gas coming

887
00:34:19,790 --> 00:34:18,240
off the comet and monitoring that and

888
00:34:22,430 --> 00:34:19,800

watching Mars to see whether there were

889
00:34:24,470 --> 00:34:22,440
any changes in Mars and as we've already

890
00:34:26,119 --> 00:34:24,480
pointed out we don't know yet I can tell

891
00:34:27,859 --> 00:34:26,129
you that from Chandra we have detected

892
00:34:29,510 --> 00:34:27,869
Mars in the x-ray we don't know if it's

893
00:34:30,980 --> 00:34:29,520
changed it all due to the Comets passage

894
00:34:32,149 --> 00:34:30,990
we're still working on the comment it

895
00:34:35,359 --> 00:34:32,159
looks like we have it but it's pretty

896
00:34:36,889 --> 00:34:35,369
faint hmmm so we're trying to overlap

897
00:34:38,510 --> 00:34:36,899
the two great observatories and having

898
00:34:41,000 --> 00:34:38,520
them help each other out support each

899
00:34:43,700 --> 00:34:41,010
other so we're working on that so well

900
00:34:45,460 --> 00:34:43,710
well Casey's talking about Chandra Casey

901
00:34:47,960 --> 00:34:45,470
could you just elaborate even further

902
00:34:50,450 --> 00:34:47,970
john yang alluded to it earlier but this

903
00:34:52,909 --> 00:34:50,460
was quite a multi-mission campaign oh

904
00:34:54,500 --> 00:34:52,919
and Casey played a very you know

905
00:34:56,389 --> 00:34:54,510
critical role in sort of the

906
00:34:58,220 --> 00:34:56,399
coordination across several NASA

907
00:35:00,800 --> 00:34:58,230
missions obviously most of those

908
00:35:03,349 --> 00:35:00,810
missions are the orbiters and Rovers at

909
00:35:05,450 --> 00:35:03,359
Mars but Hubble wasn't the only

910
00:35:07,580 --> 00:35:05,460
earth-based telescopes or earth orbiting

911
00:35:09,560 --> 00:35:07,590
telescope so as quite a it was quite a

912
00:35:10,940 --> 00:35:09,570
campaign and Casey hosted a few

913
00:35:12,910 --> 00:35:10,950

workshops and I'll just let him

914
00:35:15,470 --> 00:35:12,920
elaborate it was you know an interesting

915
00:35:19,190 --> 00:35:15,480
collaboration effort thanks for the plug

916
00:35:21,950 --> 00:35:19,200
max okay so starting with comet Ison

917
00:35:24,230 --> 00:35:21,960
NASA's has helped engender a group

918
00:35:26,060 --> 00:35:24,240
called The Sea Hawk which is the comet

919
00:35:28,099 --> 00:35:26,070
investigative observing campaign and

920
00:35:29,510 --> 00:35:28,109
what we realized was that so many people

921
00:35:32,630 --> 00:35:29,520
different people from around the world

922
00:35:34,490 --> 00:35:32,640
study comments and different kinds of

923
00:35:36,170 --> 00:35:34,500
people study comets for comet Ison last

924
00:35:38,160 --> 00:35:36,180
year we need involved not only what I

925
00:35:40,500 --> 00:35:38,170
call comet ears the usual

926
00:35:43,530 --> 00:35:40,510
oh that is such a great term I'm gonna

927
00:35:45,799 --> 00:35:43,540
just whip off the terms here and margins

928
00:35:48,299 --> 00:35:45,809
and your Koreans and Solarians and

929
00:35:50,099 --> 00:35:48,309
Venetians people who have two different

930
00:35:52,349 --> 00:35:50,109
planets and run the spacecraft at the

931
00:35:55,020 --> 00:35:52,359
different planets that Ison traveled by

932
00:35:56,339 --> 00:35:55,030
and so we have to get them all talk of

933
00:35:58,020 --> 00:35:56,349
each other and we realized that

934
00:35:59,400 --> 00:35:58,030
workshops which are online if you

935
00:36:01,980 --> 00:35:59,410
actually want to see how scientists work

936
00:36:03,809 --> 00:36:01,990
and talk and discuss and jinyang is part

937
00:36:06,510 --> 00:36:03,819
of this see och and also he he and Max

938
00:36:08,010 --> 00:36:06,520

both participated most the workshops any

939
00:36:09,450 --> 00:36:08,020
we had to get people together last year

940
00:36:11,130 --> 00:36:09,460
so we did the same thing this year for

941
00:36:14,280 --> 00:36:11,140
siding spring the difference in the

942
00:36:15,990 --> 00:36:14,290
signing spring was that while we have

943
00:36:17,490 --> 00:36:16,000
involved so many different spacecraft at

944
00:36:19,589 --> 00:36:17,500
different planets sighing spring was

945
00:36:21,450 --> 00:36:19,599
just going to be big for Mars and was

946
00:36:23,130 --> 00:36:21,460
less important from the earth except for

947
00:36:24,870 --> 00:36:23,140
early on during detection in the first

948
00:36:27,569 --> 00:36:24,880
monitoring because this was really a

949
00:36:29,940 --> 00:36:27,579
Mars encounter if you will just as soon

950
00:36:31,289 --> 00:36:29,950
yang said again if you had a comment

951
00:36:32,789 --> 00:36:31,299
that was but one third additionally the

952
00:36:34,109 --> 00:36:32,799
earth and the moon coming to our system

953
00:36:35,549 --> 00:36:34,119
everybody would be outside everybody

954
00:36:37,890 --> 00:36:35,559
been many a telescope and that's pretty

955
00:36:40,049 --> 00:36:37,900
much what we did the really cool thing I

956
00:36:41,520 --> 00:36:40,059
liked the bit of a historian to is to

957
00:36:43,170 --> 00:36:41,530
think about that if we were trying to do

958
00:36:44,760 --> 00:36:43,180
this 20 years ago or this comment game

959
00:36:46,589 --> 00:36:44,770
20 years ago we didn't wouldn't have

960
00:36:48,299 --> 00:36:46,599
outposts at Mars we couldn't have done

961
00:36:49,980 --> 00:36:48,309
this science you could have done Hubble

962
00:36:51,750 --> 00:36:49,990
we could have done maybe Chandra but we

963
00:36:54,089 --> 00:36:51,760

actually taken the first baby step so we

964
00:36:56,130 --> 00:36:54,099
actually have robotic telescopic outpost

965
00:36:58,710 --> 00:36:56,140
sitting around another planet oh yeah

966
00:37:00,480 --> 00:36:58,720
that took a savior of the comet frettin

967
00:37:02,819 --> 00:37:00,490
in the sky of that planet pretty cool I

968
00:37:07,260 --> 00:37:02,829
know I've seen them and while though the

969
00:37:10,859 --> 00:37:07,270
rover's in the cameras on these the

970
00:37:12,720 --> 00:37:10,869
planetside rovers aren't ideally suited

971
00:37:14,370 --> 00:37:12,730
for looking up at the sky they did

972
00:37:16,920 --> 00:37:14,380
manage to get a couple of pictures so it

973
00:37:18,059 --> 00:37:16,930
was nice so I'm almost done good well

974
00:37:19,799 --> 00:37:18,069
one of the things to remember with all

975
00:37:21,660 --> 00:37:19,809
the Mars assets is that they work

976
00:37:24,210 --> 00:37:21,670
they're used to looking at the ground of

977
00:37:25,589 --> 00:37:24,220
Mars it's the the buzz phrase I use is

978
00:37:27,030 --> 00:37:25,599
imagine if you took the goes weather

979
00:37:28,530 --> 00:37:27,040
satellite it takes your nightly weather

980
00:37:29,819 --> 00:37:28,540
picture and shows you the fronts moving

981
00:37:31,680 --> 00:37:29,829
across the u.s. and the hurricanes

982
00:37:33,000 --> 00:37:31,690
coming up from the Gulf and you turned

983
00:37:35,220 --> 00:37:33,010
it around and made it look at a faint

984
00:37:37,500 --> 00:37:35,230
galaxies or comet in the sky it's not

985
00:37:38,940 --> 00:37:37,510
used to doing that it's not doesn't have

986
00:37:40,440 --> 00:37:38,950
nests it wasn't built for that and you

987
00:37:42,120 --> 00:37:40,450
have to plan and prepare it and that's

988
00:37:44,099 --> 00:37:42,130

what all the Mars assets had to do it

989
00:37:46,170 --> 00:37:44,109
it's pretty amazing how they worked all

990
00:37:48,000 --> 00:37:46,180
right but to back up so comment campaign

991
00:37:50,460 --> 00:37:48,010
org if you want to know facts about both

992
00:37:52,049 --> 00:37:50,470
Ison and siding Springs we probably know

993
00:37:54,120 --> 00:37:52,059
out there what's been going on

994
00:37:55,829 --> 00:37:54,130
on the observing schedules we talked

995
00:37:57,359 --> 00:37:55,839
about we have lots of information also

996
00:37:59,339 --> 00:37:57,369
from the pro amateurs I'm going to talk

997
00:38:01,829 --> 00:37:59,349
about them in one second as well the

998
00:38:03,809 --> 00:38:01,839
professionals and what if you have any

999
00:38:05,549 --> 00:38:03,819
interest from this also Mars JPL has a

1000
00:38:07,170 --> 00:38:05,559
lot of siding Springs information as

1001
00:38:08,819 --> 00:38:07,180
well so it's been actually really kind

1002
00:38:10,439 --> 00:38:08,829
of fun getting everybody together and

1003
00:38:11,729 --> 00:38:10,449
talking a different group it's also kind

1004
00:38:13,709 --> 00:38:11,739
of exhausting trying to get everybody

1005
00:38:15,870 --> 00:38:13,719
knowing who's talking to who and who

1006
00:38:17,429 --> 00:38:15,880
knows what I've learned a lot in the

1007
00:38:18,929 --> 00:38:17,439
last week if people want to ask more

1008
00:38:21,029 --> 00:38:18,939
about some of the results from various

1009
00:38:23,099 --> 00:38:21,039
missions and they're still still coming

1010
00:38:24,870 --> 00:38:23,109
in but let me relate to that the way

1011
00:38:26,549 --> 00:38:24,880
that I found out most of what was going

1012
00:38:27,719 --> 00:38:26,559
on during the day the encounter because

1013
00:38:29,160 --> 00:38:27,729

I went outside at two thirty in the

1014
00:38:30,479 --> 00:38:29,170
afternoon on sunday and was bright blue

1015
00:38:32,759 --> 00:38:30,489
sky and there's no way you could see

1016
00:38:35,429 --> 00:38:32,769
mars a comment with while following the

1017
00:38:36,959 --> 00:38:35,439
pro amateurs we had people of telescopes

1018
00:38:38,640 --> 00:38:36,969
just interest in amateurs around the

1019
00:38:40,769 --> 00:38:38,650
planet the best steep probably on the

1020
00:38:43,559 --> 00:38:40,779
planet was South Africa and these guys

1021
00:38:45,539 --> 00:38:43,569
were posting near real time on Facebook

1022
00:38:47,189 --> 00:38:45,549
and was just fascinating to watch what

1023
00:38:48,390 --> 00:38:47,199
was going on so if you haven't seen any

1024
00:38:50,189 --> 00:38:48,400
your images you should go in Google

1025
00:38:56,759 --> 00:38:50,199
they're really pretty cool you agreed

1026
00:38:58,650 --> 00:38:56,769
yeah so okay so the would have a hangout

1027
00:39:01,319 --> 00:38:58,660
a question from Charles Bell who's

1028
00:39:03,239 --> 00:39:01,329
asking how do you define the extent of

1029
00:39:07,919 --> 00:39:03,249
the inner coma how do you define these

1030
00:39:11,579 --> 00:39:07,929
are their boundaries things like that do

1031
00:39:14,069 --> 00:39:11,589
you want to engine yang oh no we we

1032
00:39:16,439 --> 00:39:14,079
don't me with this the inner kalma coma

1033
00:39:18,299 --> 00:39:16,449
and outer coma day so just like broadly

1034
00:39:20,459 --> 00:39:18,309
defined terms well actually there's no

1035
00:39:23,189 --> 00:39:20,469
definition about them we just use them

1036
00:39:25,259 --> 00:39:23,199
you know as well as or as we say we have

1037
00:39:27,120 --> 00:39:25,269
only look at the very inner part of the

1038
00:39:29,579 --> 00:39:27,130

coma we said in a coma and there's no

1039
00:39:31,890 --> 00:39:29,589
boundary in it you know just nothing we

1040
00:39:34,199 --> 00:39:31,900
just uh it's just or you know we used to

1041
00:39:35,999 --> 00:39:34,209
talk about us we say something in large

1042
00:39:37,529 --> 00:39:36,009
scale out you know follow a relatively

1043
00:39:40,199 --> 00:39:37,539
further away from the nucleus we say out

1044
00:39:41,910 --> 00:39:40,209
of coma but you know that's it okay if

1045
00:39:43,859 --> 00:39:41,920
wanted to be if you want to make a

1046
00:39:46,259 --> 00:39:43,869
definition of the tightest ones I've

1047
00:39:48,029 --> 00:39:46,269
heard are the intercom is where the

1048
00:39:49,859 --> 00:39:48,039
density of the gas coming off of nucleus

1049
00:39:51,419 --> 00:39:49,869
is still large enough that you actually

1050
00:39:53,609 --> 00:39:51,429
have pressured you're in the collisional

1051
00:39:55,169 --> 00:39:53,619
regime will call it announced out of

1052
00:39:57,179 --> 00:39:55,179
that you get molecular flow some other

1053
00:39:58,739 --> 00:39:57,189
people might distinguish where you get a

1054
00:40:02,669 --> 00:39:58,749
lot of chemistry versus where you get

1055
00:40:05,819 --> 00:40:02,679
very little chemistry in the coma okay

1056
00:40:07,799 --> 00:40:05,829
good I see here on the Q&A a pro quo

1057
00:40:10,400 --> 00:40:07,809
I want to just take you in from Michael

1058
00:40:14,809 --> 00:40:10,410
job and that Tony is a comment tater and

1059
00:40:18,779 --> 00:40:14,819
I like oh look at that comet tater all

1060
00:40:20,400 --> 00:40:18,789
right yeah I like I métier still too i

1061
00:40:24,859 --> 00:40:20,410
got i got to get a t-shirt that says

1062
00:40:27,449 --> 00:40:24,869
that so on twitter we have a tweet yes

1063
00:40:30,870 --> 00:40:27,459

yes i'm going to read the tweet it's

1064
00:40:33,900 --> 00:40:30,880
from vossen akkus andreas will nasa

1065
00:40:38,719 --> 00:40:33,910
consider to continue funding of siding

1066
00:40:41,279 --> 00:40:38,729
spring ennio survey after all that um I

1067
00:40:42,870 --> 00:40:41,289
don't know what that is continue funding

1068
00:40:46,259 --> 00:40:42,880
of siding spring and is there any o

1069
00:40:48,390 --> 00:40:46,269
survey on siding spring maybe just means

1070
00:40:51,029 --> 00:40:48,400
any o survey there's any other surveys

1071
00:40:52,859 --> 00:40:51,039
from Catalina from the meat uh there's

1072
00:40:55,229 --> 00:40:52,869
one there's one other one I'm blanking

1073
00:40:56,699 --> 00:40:55,239
on low Neos there's a few but I don't

1074
00:40:59,370 --> 00:40:56,709
know whether we're paying for sightings

1075
00:41:02,219 --> 00:40:59,380
friends okay oh I of course of course

1076
00:41:03,390 --> 00:41:02,229
here says yes oh ok yeah much I don't

1077
00:41:04,890 --> 00:41:03,400
know the answer to that question either

1078
00:41:07,229 --> 00:41:04,900
do you happen to anybody else Carol you

1079
00:41:10,109 --> 00:41:07,239
got any idea no I don't think I don't

1080
00:41:12,089 --> 00:41:10,119
think NASA is paying for any campaign

1081
00:41:15,959 --> 00:41:12,099
other than the observations that are

1082
00:41:19,170 --> 00:41:15,969
being described here ok ok I mean the I

1083
00:41:21,390 --> 00:41:19,180
do is really to look at stuff that might

1084
00:41:25,529 --> 00:41:21,400
come hit us so we know it's not going to

1085
00:41:28,079 --> 00:41:25,539
hit it so according to the criteria it's

1086
00:41:31,109 --> 00:41:28,089
not of interest yeah if it's not an

1087
00:41:33,439 --> 00:41:31,119
object at coming here earth and out and

1088
00:41:36,809 --> 00:41:33,449

it's not a near-earth object look next

1089
00:41:38,549 --> 00:41:36,819
yes Chelyabinsk is the one that got

1090
00:41:39,749 --> 00:41:38,559
everybody motivated to keep looking for

1091
00:41:42,959 --> 00:41:39,759
things that would hit the earth yeah

1092
00:41:45,269 --> 00:41:42,969
that was a wake-up call ok hello I

1093
00:41:48,209 --> 00:41:45,279
remember being woken up to cover that

1094
00:41:50,279 --> 00:41:48,219
and then the next few days afterwards

1095
00:41:53,640 --> 00:41:50,289
everyone seeing things in the sky like

1096
00:41:56,519 --> 00:41:53,650
that could hear all looking up exactly I

1097
00:41:59,579 --> 00:41:56,529
said what was that you know everybody's

1098
00:42:01,769 --> 00:41:59,589
that happens every day I was just

1099
00:42:05,969 --> 00:42:01,779
impressed by all those those webcams on

1100
00:42:08,339 --> 00:42:05,979
dashboards a man so dead dragon flame is

1101
00:42:10,140 --> 00:42:08,349
saying commenting thank you for the

1102
00:42:12,329 --> 00:42:10,150
explanation of the intended focal length

1103
00:42:14,640 --> 00:42:12,339
of the rover cameras as we pointed out

1104
00:42:16,170 --> 00:42:14,650
the cameras were designed for looking at

1105
00:42:18,359 --> 00:42:16,180
bright things on the ground not

1106
00:42:19,190 --> 00:42:18,369
necessarily dim things up in space but

1107
00:42:20,900 --> 00:42:19,200
they've

1108
00:42:22,160 --> 00:42:20,910
turn them up there and saw some stuff so

1109
00:42:24,710 --> 00:42:22,170
these are very versatile things what do

1110
00:42:26,950 --> 00:42:24,720
you think the chances are of us ever

1111
00:42:28,880 --> 00:42:26,960
putting some kind of ground-based

1112
00:42:30,770 --> 00:42:28,890
telescope on another planet make a

1113
00:42:32,740 --> 00:42:30,780

robotic telescope designed specifically

1114
00:42:35,150 --> 00:42:32,750
for looking is there any scientific

1115
00:42:37,579 --> 00:42:35,160
usefulness to that or is it just another

1116
00:42:39,560 --> 00:42:37,589
being on another vantage point doesn't

1117
00:42:41,359 --> 00:42:39,570
really give us much folks have talked

1118
00:42:43,670 --> 00:42:41,369
for a long time by putting a telescope

1119
00:42:45,380 --> 00:42:43,680
on the far side of the moon yeah the

1120
00:42:47,240 --> 00:42:45,390
radio telescope in the first of the moon

1121
00:42:49,339 --> 00:42:47,250
is of one thing I've really heard mainly

1122
00:42:51,500 --> 00:42:49,349
from my radius run were friends today

1123
00:42:53,000 --> 00:42:51,510
economy UV astronomy good you have to

1124
00:42:54,710 --> 00:42:53,010
remember it cause it's gonna cost a lot

1125
00:42:57,620 --> 00:42:54,720
of money to put it there so you have to

1126
00:42:58,880 --> 00:42:57,630
show that it's um nope nope because

1127
00:43:02,870 --> 00:42:58,890
we've got printers now we'd already

1128
00:43:07,010 --> 00:43:02,880
covered that we're just going on now you

1129
00:43:08,660 --> 00:43:07,020
solve that problem using Bigelow 25 in

1130
00:43:11,720 --> 00:43:08,670
here last week you just solved with

1131
00:43:13,280 --> 00:43:11,730
great well yeah you don't know how many

1132
00:43:15,800 --> 00:43:13,290
mysteries of the universe get solved in

1133
00:43:19,130 --> 00:43:15,810
these hand i created a cold fusion five

1134
00:43:20,780 --> 00:43:19,140
minutes ago so you're set energy that's

1135
00:43:24,170 --> 00:43:20,790
next week's hang out right there are so

1136
00:43:26,180 --> 00:43:24,180
see okay I mean I think people have been

1137
00:43:27,920 --> 00:43:26,190
talking about that for years I remember

1138
00:43:29,750 --> 00:43:27,930

the first proposal like I don't know 15

1139
00:43:31,430 --> 00:43:29,760
years ago and I think it's clear that

1140
00:43:33,380 --> 00:43:31,440
they've fallen out of favor that you

1141
00:43:35,059 --> 00:43:33,390
know having a telescope sitting on the

1142
00:43:36,309 --> 00:43:35,069
moon some on the far side of the Moon

1143
00:43:39,050 --> 00:43:36,319
might initially sound like a good idea

1144
00:43:41,180 --> 00:43:39,060
but you know you have moonquakes you

1145
00:43:43,339 --> 00:43:41,190
have moon dust you have who knows what

1146
00:43:48,770 --> 00:43:43,349
else that you don't have when you're

1147
00:43:50,270 --> 00:43:48,780
saying I yeah you know so you don't you

1148
00:43:52,010 --> 00:43:50,280
know it's not that it's not the best

1149
00:43:55,490 --> 00:43:52,020
environment to put a telescope in

1150
00:43:56,599 --> 00:43:55,500
whereas you know in orbit or at the l2

1151
00:43:58,609 --> 00:43:56,609
point where the James Webb Space

1152
00:44:00,140 --> 00:43:58,619
Telescope is going to go you know you

1153
00:44:02,300 --> 00:44:00,150
don't have quakes and you don't have

1154
00:44:04,520 --> 00:44:02,310
dust and you don't have you know so

1155
00:44:06,380 --> 00:44:04,530
there's you know it's it's not the most

1156
00:44:08,930 --> 00:44:06,390
ideal place to put something you know

1157
00:44:12,170 --> 00:44:08,940
you know something in orbit or in a

1158
00:44:14,329 --> 00:44:12,180
stable orbit like l2 is in a much less

1159
00:44:16,490 --> 00:44:14,339
complicated environment in terms of a

1160
00:44:18,680 --> 00:44:16,500
lot of hazards as well you need an

1161
00:44:23,660 --> 00:44:18,690
additional infrastructure to get the

1162
00:44:25,339 --> 00:44:23,670
data back orbiting or low you know

1163
00:44:27,880 --> 00:44:25,349

infrastructure on the surface of the

1164
00:44:31,020 --> 00:44:27,890
moon to transmit so that it can transmit

1165
00:44:34,290 --> 00:44:31,030
bacteria would be equipped to do that

1166
00:44:36,060 --> 00:44:34,300
lunar reconnaissance orbiter oh yeah

1167
00:44:38,190 --> 00:44:36,070
Hubble's been going for 25 years and

1168
00:44:40,080 --> 00:44:38,200
it's still one of the if not the premier

1169
00:44:41,910 --> 00:44:40,090
reserve optical observing telescope

1170
00:44:45,510 --> 00:44:41,920
observatory that's pretty impressive run

1171
00:44:52,070 --> 00:44:45,520
yeah yep that is basically five more

1172
00:44:55,110 --> 00:44:52,080
years oh no yeah go to be funny I think

1173
00:44:57,420 --> 00:44:55,120
honestly as far as the having something

1174
00:44:59,790 --> 00:44:57,430
on the moon I think many things would

1175
00:45:01,320 --> 00:44:59,800
have to be put on the place is first we

1176
00:45:03,390 --> 00:45:01,330
would have to have another solid

1177
00:45:05,670 --> 00:45:03,400
presence on the moon for sustained

1178
00:45:09,240 --> 00:45:05,680
period of time before we could ever

1179
00:45:11,670 --> 00:45:09,250
think about building or landing

1180
00:45:15,240 --> 00:45:11,680
something on there for four observations

1181
00:45:18,600 --> 00:45:15,250
but we haven't been back to the moon at

1182
00:45:20,130 --> 00:45:18,610
least the United States hasn't but you

1183
00:45:21,390 --> 00:45:20,140
have to kind of be there for a bit to be

1184
00:45:23,970 --> 00:45:21,400
able to do something like that and I

1185
00:45:26,160 --> 00:45:23,980
think we're far more interest with Mars

1186
00:45:30,330 --> 00:45:26,170
right now than putting something on the

1187
00:45:32,430 --> 00:45:30,340
moon that's my personal take on it from

1188
00:45:34,650 --> 00:45:32,440

I can't even pronounce this one I have

1189
00:45:36,600 --> 00:45:34,660
I'm sorry I can't projec abbr something

1190
00:45:40,040 --> 00:45:36,610
um it's got a lot of characters in there

1191
00:45:42,240 --> 00:45:40,050
boom well yeah coupe yep guccione Yakub

1192
00:45:44,400 --> 00:45:42,250
okay thank you for helping me there I'm

1193
00:45:46,110 --> 00:45:44,410
sorry if I'm butchering the name the

1194
00:45:48,150 --> 00:45:46,120
nucleus of his commenting and a gala

1195
00:45:49,440 --> 00:45:48,160
question at the end the nucleus of comet

1196
00:45:51,690 --> 00:45:49,450
siding spring was smaller than

1197
00:45:53,700 --> 00:45:51,700
originally expected I found old mass

1198
00:45:56,790 --> 00:45:53,710
estimate of comet hale-bopp nucleus and

1199
00:45:59,460 --> 00:45:56,800
it leads to nucleus with sighs max of 10

1200
00:46:02,610 --> 00:45:59,470
kilometers is it possible that our

1201
00:46:08,280 --> 00:46:02,620
previous estimates of nucleus sizes are

1202
00:46:10,320 --> 00:46:08,290
overvalued one of the questions I have

1203
00:46:12,750 --> 00:46:10,330
ended in your tent sighs max of 10

1204
00:46:14,790 --> 00:46:12,760
kilometers what density was used that

1205
00:46:16,740 --> 00:46:14,800
were honestly the density of comms

1206
00:46:18,750 --> 00:46:16,750
uncertain a different way putting is

1207
00:46:22,680 --> 00:46:18,760
that from what our results from deep

1208
00:46:23,970 --> 00:46:22,690
impact and an extra comet tempel 1 and I

1209
00:46:25,710 --> 00:46:23,980
think hopefully from Rosetta will hear

1210
00:46:28,050 --> 00:46:25,720
soon is that comets are incredibly

1211
00:46:31,140 --> 00:46:28,060
undhan stairs leave a cue seventy eighty

1212
00:46:32,490 --> 00:46:31,150
percent porous so if you take that mass

1213
00:46:34,320 --> 00:46:32,500

and you know allow for the fact that a

1214
00:46:36,390 --> 00:46:34,330
lot of its empty space you're actually

1215
00:46:39,540 --> 00:46:36,400
going to get a smaller nucleus size than

1216
00:46:41,400 --> 00:46:39,550
what we think we found from imaging and

1217
00:46:43,230 --> 00:46:41,410
the numbers I heard for hale-bopp or

1218
00:46:44,849 --> 00:46:43,240
somewhere between 25 and 50 kilometers

1219
00:46:46,170 --> 00:46:44,859
radius but how

1220
00:46:48,479 --> 00:46:46,180
over on the other hand it is true that

1221
00:46:49,680 --> 00:46:48,489
usually we think we the same way that

1222
00:46:51,299 --> 00:46:49,690
when we first see a comment we're not

1223
00:46:53,370 --> 00:46:51,309
sure if it could hit anything us the

1224
00:46:54,779 --> 00:46:53,380
moon Mars the first time you just see

1225
00:46:57,059 --> 00:46:54,789
these things quickly they have a very

1226
00:46:58,680 --> 00:46:57,069
large error lips usually when we see

1227
00:47:00,509 --> 00:46:58,690
them we usually err on the side of how

1228
00:47:02,849 --> 00:47:00,519
big they're bigger than they eventually

1229
00:47:03,960 --> 00:47:02,859
we Whittle them down a bit so i don't

1230
00:47:07,979 --> 00:47:03,970
think the sense of this question is

1231
00:47:09,989 --> 00:47:07,989
wrong ok so the these these uh almost

1232
00:47:11,839 --> 00:47:09,999
all comments are sort of like you say

1233
00:47:15,690 --> 00:47:11,849
loosely packed together kind of fuzzy

1234
00:47:17,819 --> 00:47:15,700
fuzzy and and a lot of these things or

1235
00:47:19,259 --> 00:47:17,829
don't have well-defined properties of

1236
00:47:20,759 --> 00:47:19,269
the boundaries of a lot of the

1237
00:47:24,630 --> 00:47:20,769
characteristics these comments it sounds

1238
00:47:26,910 --> 00:47:24,640

like but the how would you characterize

1239
00:47:28,829 --> 00:47:26,920
the advancement of common knowledge over

1240
00:47:32,099 --> 00:47:28,839
I don't know say that say since Hubble's

1241
00:47:33,269 --> 00:47:32,109
been up Oh incredible but to get back to

1242
00:47:35,460 --> 00:47:33,279
your previous point just really quickly

1243
00:47:37,499 --> 00:47:35,470
o magic comments were not assembled in a

1244
00:47:39,690 --> 00:47:37,509
factory they're just basically the loose

1245
00:47:41,430 --> 00:47:39,700
assemblage dust and gas the first things

1246
00:47:43,259 --> 00:47:41,440
that coagulated out of what we call the

1247
00:47:45,690 --> 00:47:43,269
protoplanetary disc the disc material

1248
00:47:47,819 --> 00:47:45,700
left around the protosun as the Sun was

1249
00:47:49,769 --> 00:47:47,829
forming and is there the disc was the

1250
00:47:53,130 --> 00:47:49,779
leftovers the stuff that hadn't fallen

1251
00:47:54,539 --> 00:47:53,140
into the middle of the cloud yet because

1252
00:47:55,769 --> 00:47:54,549
it was spinning around the middle of the

1253
00:47:58,170 --> 00:47:55,779
cloud there's a net angular momentum

1254
00:47:59,400 --> 00:47:58,180
anyway long story short is the same way

1255
00:48:00,960 --> 00:47:59,410
that if you just take your hand and kind

1256
00:48:02,519 --> 00:48:00,970
of loosely drag it through a snowbank

1257
00:48:04,259 --> 00:48:02,529
just to kind of push together and try to

1258
00:48:06,210 --> 00:48:04,269
make up your first attempt at a snowball

1259
00:48:07,589 --> 00:48:06,220
that's kind of what comments are it's

1260
00:48:09,210 --> 00:48:07,599
why they're kind of loose and porous and

1261
00:48:10,710 --> 00:48:09,220
they're very weak you stand on the

1262
00:48:12,390 --> 00:48:10,720
surface of one you probably weigh a gram

1263
00:48:14,279 --> 00:48:12,400

or two we think they have the strength

1264
00:48:15,839 --> 00:48:14,289
of like meringue or air talcum powder

1265
00:48:18,120 --> 00:48:15,849
literally could burrow even though

1266
00:48:19,259 --> 00:48:18,130
they're kilometers plumb in width you

1267
00:48:20,849 --> 00:48:19,269
could literally just burrow right

1268
00:48:22,529 --> 00:48:20,859
through them and it's also why they're

1269
00:48:23,700 --> 00:48:22,539
not very stable unless they're in deep

1270
00:48:24,989 --> 00:48:23,710
freeze if they come anywhere near a

1271
00:48:26,579 --> 00:48:24,999
planet or they come near the Sun they

1272
00:48:29,099 --> 00:48:26,589
just start boiling burbling that their

1273
00:48:31,229 --> 00:48:29,109
time is done but they were again

1274
00:48:32,970 --> 00:48:31,239
assembled very loosely and it's when

1275
00:48:34,019 --> 00:48:32,980
they came together in call you notice

1276
00:48:35,339 --> 00:48:34,029
that you started piling all the

1277
00:48:36,539 --> 00:48:35,349
snowballs together that's when you made

1278
00:48:37,950 --> 00:48:36,549
and you had to make billions of these

1279
00:48:39,930 --> 00:48:37,960
piles together that's when they made the

1280
00:48:41,130 --> 00:48:39,940
giant planets and they were so massive

1281
00:48:42,539 --> 00:48:41,140
at that point they started collapsing

1282
00:48:44,279 --> 00:48:42,549
each other and started changing and

1283
00:48:46,079 --> 00:48:44,289
eating themselves up and turning into

1284
00:48:49,170 --> 00:48:46,089
the planetary material we see that so

1285
00:48:50,759 --> 00:48:49,180
the comments are the raw material so

1286
00:48:52,200 --> 00:48:50,769
anyway I went on a little bit sorry

1287
00:48:53,880 --> 00:48:52,210
about that so that's why they are loose

1288
00:48:55,650 --> 00:48:53,890

and fuzzy and weird and crazy and in

1289
00:48:57,359 --> 00:48:55,660
terms of what we've learned since Hubble

1290
00:48:58,270 --> 00:48:57,369
went up frankly the Rosetta is

1291
00:48:59,950 --> 00:48:58,280
absolutely revelry

1292
00:49:01,360 --> 00:48:59,960
we've never gone in orbit or trying to

1293
00:49:02,800 --> 00:49:01,370
land on the comment you're gonna see

1294
00:49:04,240 --> 00:49:02,810
incredible things in the next year from

1295
00:49:06,100 --> 00:49:04,250
that tell it tell us about it tell us

1296
00:49:08,590 --> 00:49:06,110
about that real quick yes also we just

1297
00:49:11,350 --> 00:49:08,600
we just imaged the first or comment from

1298
00:49:13,660 --> 00:49:11,360
from with siding spring Rosetta is going

1299
00:49:15,100 --> 00:49:13,670
is actually living in the environment we

1300
00:49:16,150 --> 00:49:15,110
haven't heard a lot from the project

1301
00:49:18,040 --> 00:49:16,160
they're putting together their papers

1302
00:49:19,420 --> 00:49:18,050
now but you've got a mission that has

1303
00:49:21,070 --> 00:49:19,430
now I think they're within six

1304
00:49:22,900 --> 00:49:21,080
kilometers in the center of the nucleus

1305
00:49:25,150 --> 00:49:22,910
there they're literally hovering right

1306
00:49:26,530 --> 00:49:25,160
near it they're feeling Nick the dust

1307
00:49:27,910 --> 00:49:26,540
that's coming out of this comet if

1308
00:49:29,320 --> 00:49:27,920
you've been looking at a pot the

1309
00:49:31,480 --> 00:49:29,330
electronic pictures of the day they have

1310
00:49:33,070 --> 00:49:31,490
incredible images we've only had fast

1311
00:49:35,830 --> 00:49:33,080
flybys before they're actually seen

1312
00:49:38,890 --> 00:49:35,840
flows and boulders and scarps and what

1313
00:49:40,960 --> 00:49:38,900

looks like mass wasting and land falls

1314
00:49:43,960 --> 00:49:40,970
and all kinds of structures and also

1315
00:49:45,280 --> 00:49:43,970
sharp edges they see craters and overall

1316
00:49:47,710 --> 00:49:45,290
everybody's heard about the rubber ducky

1317
00:49:50,020 --> 00:49:47,720
it looks like this two pieces stuck

1318
00:49:51,910 --> 00:49:50,030
together and one of the real questions

1319
00:49:55,360 --> 00:49:51,920
we've had since the fast flybys was our

1320
00:49:56,650 --> 00:49:55,370
comets one big kind of rough snowball as

1321
00:49:57,700 --> 00:49:56,660
I mentioned before that have been eaten

1322
00:50:00,070 --> 00:49:57,710
away at the center because they've been

1323
00:50:01,960 --> 00:50:00,080
spinning if you took the earth and you

1324
00:50:03,400 --> 00:50:01,970
made it out of ice the we all know the

1325
00:50:04,600 --> 00:50:03,410
earth is hottest at the equator and if

1326
00:50:05,830 --> 00:50:04,610
you let it just spend for four and a

1327
00:50:07,090 --> 00:50:05,840
half billion years it eventually eat

1328
00:50:09,460 --> 00:50:07,100
away the equator and you leave the poles

1329
00:50:11,710 --> 00:50:09,470
so you kind of have to kind of pipe to

1330
00:50:13,300 --> 00:50:11,720
loathe the other possibilities you just

1331
00:50:14,680 --> 00:50:13,310
kind of stuck some pieces together the

1332
00:50:17,290 --> 00:50:14,690
early part of the solar system and

1333
00:50:18,730 --> 00:50:17,300
they've been stuck together forever so

1334
00:50:20,170 --> 00:50:18,740
we've been wondering about that the

1335
00:50:21,610 --> 00:50:20,180
rubber duckies pretty hard to believe

1336
00:50:24,100 --> 00:50:21,620
that it started out as a spear you just

1337
00:50:26,140 --> 00:50:24,110
need away the middle though well I think

1338
00:50:28,180 --> 00:50:26,150

already Rosetta by just getting to that

1339
00:50:29,890 --> 00:50:28,190
comment has revolutionized what we think

1340
00:50:33,940 --> 00:50:29,900
of how these things are put together and

1341
00:50:36,010 --> 00:50:33,950
then Bert and Ernie showed up and well

1342
00:50:36,970 --> 00:50:36,020
the other thing also when I was a kid we

1343
00:50:38,380 --> 00:50:36,980
weren't sure where the comments were

1344
00:50:40,120 --> 00:50:38,390
flying snow banks or whether they were

1345
00:50:41,290 --> 00:50:40,130
actually at a solid nucleus we've

1346
00:50:42,640 --> 00:50:41,300
learned that they're solid and they're

1347
00:50:46,000 --> 00:50:42,650
pretty much you know dirty the dirty

1348
00:50:48,100 --> 00:50:46,010
snowball you ever through as a kid we're

1349
00:50:50,410 --> 00:50:48,110
learning that again the Kuiper belt me

1350
00:50:51,820 --> 00:50:50,420
Oort cloud we're really just being found

1351
00:50:53,500 --> 00:50:51,830
when I was young and getting into the

1352
00:50:55,180 --> 00:50:53,510
business now we're you know we're sure

1353
00:50:58,300 --> 00:50:55,190
that they're there so that's pretty

1354
00:51:00,760 --> 00:50:58,310
revolutionary another thing is Casey

1355
00:51:04,750 --> 00:51:00,770
when you were young they had records and

1356
00:51:07,540 --> 00:51:04,760
so what's your record in it now Mike

1357
00:51:10,560 --> 00:51:07,550
ever let a record is but it's kind of

1358
00:51:19,510 --> 00:51:10,570
like a CD or a DVD

1359
00:51:20,470 --> 00:51:19,520
even LLC one of them yeah yeah now the

1360
00:51:21,820 --> 00:51:20,480
other thing I would say that's pretty

1361
00:51:23,470 --> 00:51:21,830
cool is it looks like we're learning

1362
00:51:25,990 --> 00:51:23,480
more and more as the carbon dioxide

1363
00:51:27,520 --> 00:51:26,000

looks like it's the major carbon bearing

1364
00:51:28,840 --> 00:51:27,530
molecule in comets which is a little

1365
00:51:31,420 --> 00:51:28,850
surprising we always these fingers

1366
00:51:33,010 --> 00:51:31,430
carbon monoxide and why is this

1367
00:51:35,470 --> 00:51:33,020
important well it's a more complicated

1368
00:51:37,090 --> 00:51:35,480
molecule people have done surveys of the

1369
00:51:38,740 --> 00:51:37,100
galaxy and the cosmos and carbon

1370
00:51:40,360 --> 00:51:38,750
monoxide but nobody's looked for carbon

1371
00:51:41,590 --> 00:51:40,370
dioxide is being the kind of the

1372
00:51:43,150 --> 00:51:41,600
molecule everywhere that you build

1373
00:51:44,680 --> 00:51:43,160
things out of and there's a reason for

1374
00:51:46,420 --> 00:51:44,690
that you can't do it from the bottom of

1375
00:51:48,340 --> 00:51:46,430
our atmosphere from instant because

1376
00:51:49,840 --> 00:51:48,350
their co2 in the air because our so much

1377
00:51:51,310 --> 00:51:49,850
so one of the things they learn from

1378
00:51:52,870 --> 00:51:51,320
comets over and over again as we found

1379
00:51:54,460 --> 00:51:52,880
the solar wind because of common ion

1380
00:51:55,990 --> 00:51:54,470
tails maybe now we're learning because

1381
00:51:57,630 --> 00:51:56,000
of carbon dioxide and comets it's time

1382
00:51:59,680 --> 00:51:57,640
to go look for that all over the galaxy

1383
00:52:01,960 --> 00:51:59,690
kind of cool to look kind of come keep

1384
00:52:03,430 --> 00:52:01,970
coming back to these dinosaur bones of

1385
00:52:06,040 --> 00:52:03,440
solar system formation see what they can

1386
00:52:09,730 --> 00:52:06,050
teach us yes here's that selfie of

1387
00:52:11,080 --> 00:52:09,740
Rosetta and is Lord it set this is from

1388
00:52:14,110 --> 00:52:11,090

a pod as your as you were mentioning

1389
00:52:16,420 --> 00:52:14,120
before and yeah so Rosetta's taking a

1390
00:52:19,120 --> 00:52:16,430
selfie and you can see the comment up

1391
00:52:21,280 --> 00:52:19,130
there I just it's that's amazing I don't

1392
00:52:23,680 --> 00:52:21,290
matter you get the a pod from two days

1393
00:52:25,120 --> 00:52:23,690
ago they had high resolution images of

1394
00:52:27,040 --> 00:52:25,130
the surface it's just absolutely

1395
00:52:30,010 --> 00:52:27,050
gorgeous yep I'll pull it up real quick

1396
00:52:31,540 --> 00:52:30,020
right possibly so we were showing us

1397
00:52:34,180 --> 00:52:31,550
before was the lander which is going to

1398
00:52:36,790 --> 00:52:34,190
be ejected from the mothership which

1399
00:52:38,590 --> 00:52:36,800
looks like a Borg cube yes I said it on

1400
00:52:40,570 --> 00:52:38,600
the 12 but it's going to take about

1401
00:52:42,310 --> 00:52:40,580
seven or eight hours to try and land on

1402
00:52:45,310 --> 00:52:42,320
the surface the head of the rubber ducky

1403
00:52:49,950 --> 00:52:45,320
the flat part of the head there's that

1404
00:52:54,280 --> 00:52:51,730
doctors hey we're getting ready for

1405
00:52:57,910 --> 00:52:54,290
doing in the clips outreach here at

1406
00:52:59,470 --> 00:52:57,920
suria anything prepped I mr. a shuttle

1407
00:53:01,270 --> 00:52:59,480
mission to fix those he does not need a

1408
00:53:06,730 --> 00:53:01,280
shuttle mission too big though should

1409
00:53:08,080 --> 00:53:06,740
get one anyway so what are you so I have

1410
00:53:10,240 --> 00:53:08,090
a comment here from dead dragon flame

1411
00:53:13,030 --> 00:53:10,250
again he's is it possible that comets

1412
00:53:15,220 --> 00:53:13,040
don't actually out gas but rather the

1413
00:53:17,650 --> 00:53:15,230

movement through the through the ether

1414
00:53:19,750 --> 00:53:17,660
causes an organization into plasma that

1415
00:53:22,150 --> 00:53:19,760
actually manufacturers material instead

1416
00:53:24,160 --> 00:53:22,160
I don't understand that question

1417
00:53:27,849 --> 00:53:24,170
actually there's no luminiferous

1418
00:53:29,890 --> 00:53:27,859
ether or not may I see the ether thing

1419
00:53:33,789 --> 00:53:29,900
in here i don't i don't think we yeah

1420
00:53:36,250 --> 00:53:33,799
there's no easel no no ether alright

1421
00:53:38,559 --> 00:53:36,260
guys well um i guess i'm trying to think

1422
00:53:41,410 --> 00:53:38,569
it while scott i know you're looking for

1423
00:53:44,470 --> 00:53:41,420
the ipod i'm i'm not seeing one from two

1424
00:53:46,660 --> 00:53:44,480
days ago with that but they're there i

1425
00:53:49,240 --> 00:53:46,670
will say that on an ipod there is the

1426
00:53:55,299 --> 00:53:49,250
nice picture of Mars on the comment

1427
00:54:00,549 --> 00:53:55,309
couple days back well go that you got

1428
00:54:03,099 --> 00:54:00,559
that I'm I'm pulling it up yeah well in

1429
00:54:05,470 --> 00:54:03,109
a million comments so Zolt is there

1430
00:54:07,120 --> 00:54:05,480
anything that you had that we had that

1431
00:54:08,680 --> 00:54:07,130
you wanted to show that we haven't

1432
00:54:10,750 --> 00:54:08,690
talked about yet or did we get to the

1433
00:54:12,640 --> 00:54:10,760
main images that we'd that Hubble had I

1434
00:54:15,880 --> 00:54:12,650
can show the image of the mars that we

1435
00:54:18,130 --> 00:54:15,890
got because the one on the in that

1436
00:54:23,680 --> 00:54:18,140
illustration is so teeny tiny that you

1437
00:54:26,319 --> 00:54:23,690
can't really appreciate and as as

1438
00:54:30,069 --> 00:54:26,329

someone mentioned i think that earful

1439
00:54:32,710 --> 00:54:30,079
our image of Mars is a little fuzzier

1440
00:54:36,160 --> 00:54:32,720
than some of the earlier images of Mars

1441
00:54:39,400 --> 00:54:36,170
that we've seen from mobile yeah but

1442
00:54:41,829 --> 00:54:39,410
it's not as it's not as close as it gets

1443
00:54:43,150 --> 00:54:41,839
to us so those numbers in the upper left

1444
00:54:45,370 --> 00:54:43,160
those are the filters that were used on

1445
00:54:48,039 --> 00:54:45,380
level names of the filters there's a

1446
00:54:50,470 --> 00:54:48,049
blue filter and a red filter that were

1447
00:54:54,549 --> 00:54:50,480
combined to make the color image the

1448
00:54:57,329 --> 00:54:54,559
fuzziness due to dust I don't I don't

1449
00:55:02,319 --> 00:54:57,339
know I don't know somebody said that

1450
00:55:04,240 --> 00:55:02,329
results Instagram filter city and also

1451
00:55:06,400 --> 00:55:04,250
as you pointed out it's much further

1452
00:55:08,470 --> 00:55:06,410
away than when we take you know we take

1453
00:55:11,020 --> 00:55:08,480
optimum pictures of Mars when it's much

1454
00:55:13,720 --> 00:55:11,030
closer so we have more pixels across the

1455
00:55:15,579 --> 00:55:13,730
image is only 140 for ya those across

1456
00:55:17,349 --> 00:55:15,589
the image the reason i asked about the

1457
00:55:19,930 --> 00:55:17,359
dust is this is the dust season I

1458
00:55:21,849 --> 00:55:19,940
understand us to instill i was told an

1459
00:55:23,319 --> 00:55:21,859
opportunity actually had a dust storm to

1460
00:55:25,569 --> 00:55:23,329
its West when it took the picture of the

1461
00:55:27,760 --> 00:55:25,579
comment moscato interesting so well it

1462
00:55:30,880 --> 00:55:27,770
could be part of the reason it's looks

1463
00:55:32,470 --> 00:55:30,890

more obscure than usual now the

1464
00:55:33,640 --> 00:55:32,480
interesting thing about opportunity

1465
00:55:34,870 --> 00:55:33,650
probably everybody's heard about it we

1466
00:55:37,660 --> 00:55:34,880
haven't heard anything from curiosity

1467
00:55:40,329 --> 00:55:37,670
yet and curiosities you know got that

1468
00:55:42,280 --> 00:55:40,339
the plutonium-powered ability to look at

1469
00:55:45,190 --> 00:55:42,290
night and I think they were actually

1470
00:55:46,740 --> 00:55:45,200
going into the nightfall opportunity was

1471
00:55:49,089 --> 00:55:46,750
coming into daylight when when

1472
00:55:50,440 --> 00:55:49,099
observations were taken so I'm very

1473
00:55:52,000 --> 00:55:50,450
curious to see if they found anything

1474
00:55:52,780 --> 00:55:52,010
haven't read that like you said that

1475
00:55:54,819 --> 00:55:52,790
like it was a superpower

1476
00:55:59,470 --> 00:55:54,829
plutonium-powered ability to live out

1477
00:56:01,569 --> 00:55:59,480
there like that way to think about if

1478
00:56:03,130 --> 00:56:01,579
you don't is that opportunity has to be

1479
00:56:04,900 --> 00:56:03,140
very careful it gets no power at night

1480
00:56:07,030 --> 00:56:04,910
and it has to be very careful not to run

1481
00:56:09,190 --> 00:56:07,040
out of power and not to get cold though

1482
00:56:10,660 --> 00:56:09,200
they have if they were running taking

1483
00:56:12,309 --> 00:56:10,670
observations when it was getting dark is

1484
00:56:14,680 --> 00:56:12,319
they had to do they had to go get a

1485
00:56:16,000 --> 00:56:14,690
little risky whereas MSL curiosity just

1486
00:56:17,559 --> 00:56:16,010
keeps going you know go dislike

1487
00:56:20,289 --> 00:56:17,569
energizer bunny keeps going and going to

1488
00:56:23,680 --> 00:56:20,299

you want to go yep all right so Scott

1489
00:56:26,020 --> 00:56:23,690
has let's have the picture they a part

1490
00:56:28,030 --> 00:56:26,030
image hey I love because we're talking

1491
00:56:31,720 --> 00:56:28,040
about this earlier you're seeing yes how

1492
00:56:33,549 --> 00:56:31,730
bright Mars is compared a nice that's

1493
00:56:35,890 --> 00:56:33,559
that's kind of a real image ours is a

1494
00:56:37,780 --> 00:56:35,900
compartment so this does give you an

1495
00:56:40,690 --> 00:56:37,790
appreciation which takes such good

1496
00:56:42,400 --> 00:56:40,700
images yeah yeah it's always so yeah

1497
00:56:44,109 --> 00:56:42,410
this is outstanding example of how

1498
00:56:46,809 --> 00:56:44,119
bright the planet is versus the comic

1499
00:56:49,569 --> 00:56:46,819
too so that's yeah so much very

1500
00:56:53,440 --> 00:56:49,579
beautiful all right well I guess we'll

1501
00:56:55,569 --> 00:56:53,450
on that note we will we will we'll close

1502
00:56:57,190 --> 00:56:55,579
this hangout down it's been a really

1503
00:56:59,020 --> 00:56:57,200
interesting kind thank you all of you

1504
00:57:02,289 --> 00:56:59,030
for it's great seeing a lot of you again

1505
00:57:04,150 --> 00:57:02,299
many Zolt max and john yang was good to

1506
00:57:05,770 --> 00:57:04,160
see you and carry it was awesome to meet

1507
00:57:08,049 --> 00:57:05,780
you so i'm glad to have you here i hope

1508
00:57:09,430 --> 00:57:08,059
you'll come back and tell us what you've

1509
00:57:12,329 --> 00:57:09,440
learned after you've had a chance to go

1510
00:57:15,010 --> 00:57:12,339
through some more of these data and yeah

1511
00:57:19,000 --> 00:57:15,020
awesome okay well thank you guys very

1512
00:57:22,150 --> 00:57:19,010
much next week speaking of Hubble's 25th

1513
00:57:24,730 --> 00:57:22,160

anniversary celebration will be in one

1514
00:57:26,680 --> 00:57:24,740
of the first of our actual Hubble 25th

1515
00:57:28,690 --> 00:57:26,690
themed hangouts will be having it's

1516
00:57:30,039 --> 00:57:28,700
called the history of the Hubble Space

1517
00:57:32,230 --> 00:57:30,049
Telescope we're not going to cover the

1518
00:57:33,880 --> 00:57:32,240
entire history on that one hang out but

1519
00:57:35,859 --> 00:57:33,890
we are going to have some guests in

1520
00:57:37,480 --> 00:57:35,869
panelists who are very familiar with the

1521
00:57:39,339 --> 00:57:37,490
early days of Hubble and it throughout

1522
00:57:41,680 --> 00:57:39,349
its hole throughout its whole mission so

1523
00:57:42,849 --> 00:57:41,690
we're going to talk about that next week

1524
00:57:44,950 --> 00:57:42,859
we hope you guys will make it on a

1525
00:57:46,329 --> 00:57:44,960
thursday at three o'clock until then

1526
00:57:47,650 --> 00:57:46,339
thank you all for all your great

1527
00:57:49,599 --> 00:57:47,660
comments and questions we really

1528
00:57:51,000 --> 00:57:49,609
appreciated it yeah and if you guys want

1529
00:57:53,520 --> 00:57:51,010
to see the Eclipse

1530
00:57:56,580 --> 00:57:53,530
join me in an hour with no the cosmos we

1531
00:57:57,930 --> 00:57:56,590
will be doing a free live webcast of the

1532
00:57:59,850 --> 00:57:57,940
Eclipse not only through a white light

1533
00:58:03,120 --> 00:57:59,860
filter but to a hydrogen alpha filter

1534
00:58:04,950 --> 00:58:03,130
here in Los Angeles so stay tuned for

1535
00:58:06,990 --> 00:58:04,960
that because not that's one of those who

1536
00:58:08,730 --> 00:58:07,000
say you had a coronado telescope set up

1537
00:58:10,590 --> 00:58:08,740
on additional Coronado pity that will

1538
00:58:12,960 --> 00:58:10,600

because those are outstanding those are

1539
00:58:15,810 --> 00:58:12,970
all saying I have one myself so very

1540
00:58:17,370 --> 00:58:15,820
good okay so he has if you have your

1541
00:58:20,730 --> 00:58:17,380
event Lee and everything already set up

1542
00:58:22,950 --> 00:58:20,740
your get it all set up I it's on twitter

1543
00:58:24,570 --> 00:58:22,960
on google+ and facebook soon I'm gonna

1544
00:58:29,540 --> 00:58:24,580
be watching cuz I can't see it from here

1545
00:58:33,240 --> 00:58:29,550
bro well sorry's close rights reserved

1546
00:58:35,520 --> 00:58:33,250
it's a makeup okay well thanks everybody

1547
00:58:39,120 --> 00:58:35,530
for watching thank you so much hard yes

1548
00:58:41,610 --> 00:58:39,130
thank you soon as a fantastic one the

1549
00:58:43,320 --> 00:58:41,620
images yeah it was great having you back

1550
00:58:47,210 --> 00:58:43,330
thanks for all your work and thanks for