

1  
00:00:05,419 --> 00:00:10,169  
hello everybody welcome to today's

2  
00:00:07,859 --> 00:00:12,900  
Hubble hang out my name is Tony Darnell

3  
00:00:10,169 --> 00:00:15,269  
and we have I think a really interesting

4  
00:00:12,900 --> 00:00:17,518  
topic today now you guys have been

5  
00:00:15,269 --> 00:00:19,829  
around Hubble hangouts long enough to

6  
00:00:17,518 --> 00:00:23,778  
know that Hubble has been over our heads

7  
00:00:19,829 --> 00:00:27,259  
for an almost 55 years circling overhead

8  
00:00:23,778 --> 00:00:30,719  
looking at things showing us stuff and

9  
00:00:27,259 --> 00:00:32,969  
today and this last Sunday was no

10  
00:00:30,719 --> 00:00:35,488  
exception Hubble looked at something and

11  
00:00:32,969 --> 00:00:37,890  
it showed us stuff specifically a

12  
00:00:35,488 --> 00:00:38,759  
comment that passed close by Mars and

13  
00:00:37,890 --> 00:00:41,549  
today we're going to be talking about

14  
00:00:38,759 --> 00:00:43,128  
that with the old gang of a lot of very

15  
00:00:41,549 --> 00:00:46,919  
familiar faces in a couple of new ones

16  
00:00:43,128 --> 00:00:50,280  
but and but before I get to that I want

17  
00:00:46,920 --> 00:00:53,300  
to make a quick announcement how today

18  
00:00:50,280 --> 00:00:56,280  
as I said a while ago to almost 25 years

19  
00:00:53,299 --> 00:00:57,509  
Hubble's been up in space and you're

20  
00:00:56,280 --> 00:00:58,499  
going to start to see a lot more about

21  
00:00:57,509 --> 00:01:02,248  
this from us we're going to be talking

22  
00:00:58,499 --> 00:01:03,239  
about it a lot more but the little all

23  
00:01:02,249 --> 00:01:04,859  
these events that are going to be coming

24  
00:01:03,238 --> 00:01:07,649  
up for Hubble's 25th anniversary which

25  
00:01:04,859 --> 00:01:09,629  
will be in April the first of those

26  
00:01:07,649 --> 00:01:13,140  
things are starting today so if you are

27  
00:01:09,629 --> 00:01:15,060  
in New York City the Big Apple you need

28  
00:01:13,140 --> 00:01:17,968  
to get your little booties over to the

29

00:01:15,060 --> 00:01:21,750  
inter the intrepid museum and they have

30  
00:01:17,968 --> 00:01:24,989  
opened up the Hubble at 25 exhibit it

31  
00:01:21,750 --> 00:01:27,269  
opens today and it it's going to be

32  
00:01:24,989 --> 00:01:28,709  
going on at least through april i know

33  
00:01:27,269 --> 00:01:30,239  
that much because one of the events they

34  
00:01:28,709 --> 00:01:33,059  
have planned i'm going to be there for

35  
00:01:30,239 --> 00:01:34,319  
so is so we've got plenty of time but

36  
00:01:33,060 --> 00:01:37,439  
get over there today if you have a

37  
00:01:34,319 --> 00:01:40,109  
chance go to the website if you'll learn

38  
00:01:37,438 --> 00:01:42,508  
more about it is intrepid museum dot o

39  
00:01:40,109 --> 00:01:44,549  
RG you can they learn about this they

40  
00:01:42,509 --> 00:01:46,439  
have tickets available for events and

41  
00:01:44,549 --> 00:01:48,329  
stuff that are coming up so it encourage

42  
00:01:46,438 --> 00:01:51,298  
you if you're in the area to check it

43  
00:01:48,328 --> 00:01:53,879

out hubble at 25 that's a great that's

44

00:01:51,299 --> 00:01:55,170

our new exhibit and I all we've posted

45

00:01:53,879 --> 00:01:56,670

about it on Facebook and Twitter and

46

00:01:55,170 --> 00:01:58,409

stuff like that I'm about to do it on G+

47

00:01:56,670 --> 00:02:01,280

after this event so well I'll give you

48

00:01:58,409 --> 00:02:04,740

more information as that progresses

49

00:02:01,280 --> 00:02:08,550

Carol and Scott dr. carol christian and

50

00:02:04,739 --> 00:02:11,250

scott internet the driver of the lewis

51

00:02:08,550 --> 00:02:12,790

oh wait i said i did not say that right

52

00:02:11,250 --> 00:02:17,229

did I not right

53

00:02:12,789 --> 00:02:19,900

well episode remember it watch it Scott

54

00:02:17,229 --> 00:02:22,358

Internet's a pretty cool name though and

55

00:02:19,900 --> 00:02:23,890

wait Scott will be Scott and Scott Lewis

56

00:02:22,359 --> 00:02:26,560

is helping drive the internet and this

57

00:02:23,889 --> 00:02:28,958

hangout as is dr. carol christian she is

58  
00:02:26,560 --> 00:02:31,449  
the outreach Hubble outreach scientists

59  
00:02:28,959 --> 00:02:33,878  
for the space Space Telescope Science

60  
00:02:31,449 --> 00:02:36,759  
Institute so today we're going to like I

61  
00:02:33,878 --> 00:02:41,378  
talked about Hubble on Sunday looked at

62  
00:02:36,759 --> 00:02:44,408  
a rare that a rather unusual close flyby

63  
00:02:41,378 --> 00:02:48,518  
of a comet to the planet Mars it went

64  
00:02:44,408 --> 00:02:50,679  
within 140,000 kilometres and about

65  
00:02:48,519 --> 00:02:53,319  
which is about 80 something thousand

66  
00:02:50,680 --> 00:02:55,569  
miles i believe which is really close

67  
00:02:53,318 --> 00:02:58,030  
really close and so Hubble went and

68  
00:02:55,568 --> 00:03:00,848  
looked at it and we took some images and

69  
00:02:58,030 --> 00:03:03,219  
with us to talk about this today are the

70  
00:03:00,848 --> 00:03:06,699  
various astronomers and people who

71  
00:03:03,219 --> 00:03:09,519  
helped get these images together Kari is

72  
00:03:06,699 --> 00:03:11,649  
it Lizzie listen list sorry thank you

73  
00:03:09,519 --> 00:03:17,229  
from Johns Hopkins he's an astronomer

74  
00:03:11,650 --> 00:03:19,090  
and a comet a comet person also john

75  
00:03:17,229 --> 00:03:20,620  
yang Lee you might remember him from the

76  
00:03:19,090 --> 00:03:22,479  
Planetary Science Institute he was

77  
00:03:20,620 --> 00:03:24,699  
around our hangouts when we were talking

78  
00:03:22,479 --> 00:03:27,159  
about comet Ison hi john yang welcome

79  
00:03:24,699 --> 00:03:29,349  
back also max Mutchler of the Institute

80  
00:03:27,158 --> 00:03:31,899  
and zola vay also of the Institute

81  
00:03:29,348 --> 00:03:34,689  
helped helped us put together all of

82  
00:03:31,900 --> 00:03:36,969  
these all of these images and so that

83  
00:03:34,689 --> 00:03:39,519  
we're seeing today and zol do you know

84  
00:03:36,969 --> 00:03:41,590  
you got a fan club wonder I don't yeah

85  
00:03:39,519 --> 00:03:43,449  
when I when I told people about this

86

00:03:41,590 --> 00:03:45,370  
event we got some comments on Twitter

87  
00:03:43,449 --> 00:03:48,129  
about all zoals going to be there so I

88  
00:03:45,370 --> 00:03:51,069  
have to go so you gotta fake of you're

89  
00:03:48,128 --> 00:03:55,959  
like famous now so we can live up to the

90  
00:03:51,068 --> 00:03:57,789  
hype I think again okay so before we get

91  
00:03:55,959 --> 00:03:59,979  
going too far to be into the Hangout let

92  
00:03:57,789 --> 00:04:02,289  
me remind you that you can tweet at us

93  
00:03:59,979 --> 00:04:04,269  
using the Twitter with the Hubble

94  
00:04:02,289 --> 00:04:07,209  
hashtag or the Hubble hangout hashtag

95  
00:04:04,269 --> 00:04:09,519  
we're also looking at the Q&A app on

96  
00:04:07,209 --> 00:04:11,799  
YouTube and G+ as well as the comment

97  
00:04:09,519 --> 00:04:13,569  
section on both of those pages so we

98  
00:04:11,799 --> 00:04:15,310  
hope you'll comment ask questions all of

99  
00:04:13,568 --> 00:04:16,538  
these guys are here ready to take your

100  
00:04:15,310 --> 00:04:20,649

comments and questions for you so we

101

00:04:16,538 --> 00:04:24,430

hope you will do it yesterday we talked

102

00:04:20,649 --> 00:04:26,739

about this this a little bit with Frank

103

00:04:24,430 --> 00:04:30,490

and he Frank summers

104

00:04:26,740 --> 00:04:32,410

and he was telling me that well that

105

00:04:30,490 --> 00:04:34,379

these images were a little slow in

106

00:04:32,410 --> 00:04:38,020

coming right I mean we were a little bit

107

00:04:34,379 --> 00:04:39,459

bubble looked at the flyby but because

108

00:04:38,019 --> 00:04:44,258

of something called the I think it's the

109

00:04:39,459 --> 00:04:47,068

SI sees this gets the the award for the

110

00:04:44,259 --> 00:04:50,770

worst acronym ever it's called si si and

111

00:04:47,069 --> 00:04:53,169

DP module inaudible which I guess is

112

00:04:50,769 --> 00:04:55,329

this thing that Hubble does this thing i

113

00:04:53,168 --> 00:04:58,418

did not know where it kind of does this

114

00:04:55,329 --> 00:05:00,879

equivalent of a spinning beachball where



115  
00:04:58,418 --> 00:05:03,250  
it this is a known thing it does and you

116  
00:05:00,879 --> 00:05:07,870  
just you just kind of have to wait for

117  
00:05:03,250 --> 00:05:10,990  
it to get done and uh uh I'm a prince

118  
00:05:07,870 --> 00:05:12,459  
the well that's the way it was described

119  
00:05:10,990 --> 00:05:14,228  
to me it i guess the hubble does this

120  
00:05:12,459 --> 00:05:15,698  
every one small this is for this is an

121  
00:05:14,228 --> 00:05:16,839  
inside behind-the-scenes look guys we

122  
00:05:15,699 --> 00:05:19,030  
got these emails earlier in the week

123  
00:05:16,839 --> 00:05:21,158  
Hubble's fine now but apparently it does

124  
00:05:19,029 --> 00:05:22,989  
this thing where it just kind of does a

125  
00:05:21,158 --> 00:05:24,908  
spinning beachball kind of thing and if

126  
00:05:22,990 --> 00:05:26,530  
and just like you know it's one of those

127  
00:05:24,908 --> 00:05:28,658  
things where if you get it on an Apple

128  
00:05:26,529 --> 00:05:29,859  
computer it's just you just have to wait

129  
00:05:28,658 --> 00:05:32,019  
for it to finish and then everything's

130  
00:05:29,860 --> 00:05:33,550  
fine supposedly so I'm going to this

131  
00:05:32,019 --> 00:05:35,889  
computer you get to please screen of

132  
00:05:33,550 --> 00:05:38,918  
death and sorry and that is a bigger

133  
00:05:35,889 --> 00:05:40,418  
problem yes so uh so I guess these

134  
00:05:38,918 --> 00:05:44,889  
images were a little late coming down

135  
00:05:40,418 --> 00:05:47,158  
isn't that right so uh I think maybe max

136  
00:05:44,889 --> 00:05:51,069  
can answer that a little bit better I

137  
00:05:47,158 --> 00:05:54,668  
yeah images that we had came down in

138  
00:05:51,069 --> 00:05:55,930  
good time yeah they came down over the

139  
00:05:54,668 --> 00:05:58,240  
weekend you know the there was a

140  
00:05:55,930 --> 00:06:00,610  
sequence that started I guess late on

141  
00:05:58,240 --> 00:06:03,699  
Saturday you know through Sunday and

142  
00:06:00,610 --> 00:06:05,408  
Monday that was all before the failure

143

00:06:03,699 --> 00:06:07,538  
that you mentioned so those data came

144  
00:06:05,408 --> 00:06:09,158  
down there was a little problem getting

145  
00:06:07,538 --> 00:06:10,870  
my the archive you know so we didn't

146  
00:06:09,158 --> 00:06:13,089  
really get to look at them until monday

147  
00:06:10,870 --> 00:06:14,709  
morning even though the closest approach

148  
00:06:13,089 --> 00:06:16,209  
had already occurred that was really the

149  
00:06:14,709 --> 00:06:19,418  
first chance we had to really dive into

150  
00:06:16,209 --> 00:06:22,120  
the data and then it was I think a good

151  
00:06:19,418 --> 00:06:24,068  
day day and a half later that the there

152  
00:06:22,120 --> 00:06:27,399  
was the real significant you know say

153  
00:06:24,069 --> 00:06:28,960  
finger you know SI c and d h event which

154  
00:06:27,399 --> 00:06:30,879  
caused a bigger hiccup so thankfully

155  
00:06:28,959 --> 00:06:33,279  
most of the data from this campaign was

156  
00:06:30,879 --> 00:06:35,560  
already in hand before that there was a

157  
00:06:33,279 --> 00:06:36,908

continuing program by john clark one of

158

00:06:35,560 --> 00:06:39,610  
the investigators involved in this

159

00:06:36,908 --> 00:06:40,659  
campaign that was more affected but

160

00:06:39,610 --> 00:06:43,270  
fortunately for the ball

161

00:06:40,660 --> 00:06:44,800  
to this campaign the timing was not too

162

00:06:43,269 --> 00:06:45,909  
bad it could have been much worse if it

163

00:06:44,800 --> 00:06:48,759  
landed right in the middle of our

164

00:06:45,910 --> 00:06:50,350  
campaign yeah yeah I guess you know I

165

00:06:48,759 --> 00:06:51,459  
wanted to bring that up just a little

166

00:06:50,350 --> 00:06:52,870  
too kind of give people a little bit

167

00:06:51,459 --> 00:06:55,269  
behind the scenes thing what it's like

168

00:06:52,870 --> 00:06:56,800  
to you know use the Hubble and some of

169

00:06:55,269 --> 00:06:58,569  
the things the Hubble goes through and I

170

00:06:56,800 --> 00:07:00,310  
just learned about that recently so I

171

00:06:58,569 --> 00:07:01,959  
thought I'd mention it it's not a

172  
00:07:00,310 --> 00:07:03,670  
serious thing that happens but we just

173  
00:07:01,959 --> 00:07:06,279  
have to wait for it to pass I suppose so

174  
00:07:03,670 --> 00:07:08,800  
ok John yang let's talk about the I like

175  
00:07:06,279 --> 00:07:12,059  
to ask you about this flyby what can you

176  
00:07:08,800 --> 00:07:16,420  
give us a an intro into what happened

177  
00:07:12,060 --> 00:07:18,220  
what went on last weekend well as you

178  
00:07:16,420 --> 00:07:20,170  
said basically the content of the comet

179  
00:07:18,220 --> 00:07:22,300  
is coming from far far away like the

180  
00:07:20,170 --> 00:07:25,300  
edge of a solar system and then you know

181  
00:07:22,300 --> 00:07:27,670  
it happens that it just a flyby plasmas

182  
00:07:25,300 --> 00:07:29,530  
from very close distance the distance is

183  
00:07:27,670 --> 00:07:31,060  
actually like only a third of the

184  
00:07:29,529 --> 00:07:33,669  
distance between the Earth and the moon

185  
00:07:31,060 --> 00:07:36,670  
so it's very close imagining if you have

186  
00:07:33,670 --> 00:07:38,650  
some kind of a comment on fly by the

187  
00:07:36,670 --> 00:07:40,270  
earth from that distance no that's going

188  
00:07:38,649 --> 00:07:42,370  
to be going to be amazing but this time

189  
00:07:40,269 --> 00:07:45,490  
it happened on Mars and basically the

190  
00:07:42,370 --> 00:07:46,990  
comet if you imagine the geometry uh you

191  
00:07:45,490 --> 00:07:48,970  
know the common basically comes from the

192  
00:07:46,990 --> 00:07:51,730  
bottom from the south you know below the

193  
00:07:48,970 --> 00:07:54,190  
the plan that the Mars is orbiting the

194  
00:07:51,730 --> 00:07:59,050  
Sun and then from the bottom and it it

195  
00:07:54,189 --> 00:08:02,620  
passes I think it's a slightly inside

196  
00:07:59,050 --> 00:08:04,960  
Mars orbit and then then cross the cross

197  
00:08:02,620 --> 00:08:08,410  
most Mars orbit plan to above and then

198  
00:08:04,959 --> 00:08:11,109  
then from there in it continues to go

199  
00:08:08,410 --> 00:08:12,939  
and go to his closest point to the Sun

200

00:08:11,110 --> 00:08:14,530  
which is very close to Mars too and then

201  
00:08:12,939 --> 00:08:18,430  
leave the solar system so what happened

202  
00:08:14,529 --> 00:08:21,189  
last Saturday was you know the clothes

203  
00:08:18,430 --> 00:08:24,189  
that the comet flyby to the close is the

204  
00:08:21,189 --> 00:08:27,009  
distance of the of Mars and that

205  
00:08:24,189 --> 00:08:32,200  
happened I think on eastern time about 2

206  
00:08:27,009 --> 00:08:33,968  
30 saturday ok but now I carry can you

207  
00:08:32,200 --> 00:08:36,009  
give us some idea of what the comment

208  
00:08:33,969 --> 00:08:39,640  
itself was like comet siding spring what

209  
00:08:36,009 --> 00:08:41,349  
what was it a amazing comment was it a

210  
00:08:39,639 --> 00:08:42,788  
regular old just run-of-the-mill comment

211  
00:08:41,349 --> 00:08:44,800  
any what kind of common are we talking

212  
00:08:42,788 --> 00:08:48,850  
about here it was actually a very little

213  
00:08:44,799 --> 00:08:51,189  
overachiever common what we heard well

214  
00:08:48,850 --> 00:08:53,200

god we saw this comment out almost the

215

00:08:51,190 --> 00:08:54,430  
orbit of Saturn just like the comet ison

216

00:08:53,200 --> 00:08:56,649  
last year

217

00:08:54,429 --> 00:08:58,629  
and what we've learned now just by the

218

00:08:56,649 --> 00:08:59,919  
flyby of Mars you with the emeril

219

00:08:58,629 --> 00:09:01,870  
high-rise which actually image the

220

00:08:59,919 --> 00:09:04,028  
nucleus is that this is a very small

221

00:09:01,870 --> 00:09:07,330  
comet maybe half a kilometer radius a

222

00:09:04,028 --> 00:09:09,639  
kilometer wide so there is no way we can

223

00:09:07,330 --> 00:09:11,620  
ever see a body that the remember

224

00:09:09,639 --> 00:09:13,088  
comments are very dark they're darker

225

00:09:11,620 --> 00:09:14,830  
than asphalt they're darker than cold

226

00:09:13,089 --> 00:09:16,810  
there's no way we can see a body that

227

00:09:14,830 --> 00:09:18,339  
small in that dark out by Saturn the

228

00:09:16,809 --> 00:09:19,778  
only way we could is if it was really



229  
00:09:18,339 --> 00:09:21,730  
really active it was throwing out a lot

230  
00:09:19,778 --> 00:09:23,320  
of material and gas and dust even where

231  
00:09:21,730 --> 00:09:26,139  
the local temperatures about 100 degrees

232  
00:09:23,320 --> 00:09:28,420  
help so it was a variant so it's very

233  
00:09:26,139 --> 00:09:30,250  
active then and most likely Terry active

234  
00:09:28,419 --> 00:09:32,019  
just as jinyang said it's been living

235  
00:09:30,250 --> 00:09:33,639  
for four and a half billion years the

236  
00:09:32,019 --> 00:09:35,740  
vast majority of the time it's been

237  
00:09:33,639 --> 00:09:37,028  
ordering the Sun the majority of the

238  
00:09:35,740 --> 00:09:39,610  
time it's orbiting the Sun on a very

239  
00:09:37,028 --> 00:09:42,129  
long gated orbit it's been way out away

240  
00:09:39,610 --> 00:09:43,419  
from the Sun and deep freeze and it was

241  
00:09:42,129 --> 00:09:44,708  
put together for a half billion years

242  
00:09:43,419 --> 00:09:46,750  
ago with the time when we were

243  
00:09:44,708 --> 00:09:49,329  
assembling the planets and it's a

244  
00:09:46,750 --> 00:09:50,980  
failure it failed miserably to actually

245  
00:09:49,330 --> 00:09:52,509  
become one of the giant planets instead

246  
00:09:50,980 --> 00:09:54,610  
he got it and had a near miss and got

247  
00:09:52,509 --> 00:09:56,588  
thrown out on this very elongated orbit

248  
00:09:54,610 --> 00:09:58,600  
possibly even half will go in elements

249  
00:09:56,589 --> 00:10:00,610  
to halfway to the other next star so

250  
00:09:58,600 --> 00:10:02,709  
it's never been in this close to the

251  
00:10:00,610 --> 00:10:05,200  
solar system into this to the Sun before

252  
00:10:02,708 --> 00:10:06,699  
it's always come in as close as may be

253  
00:10:05,200 --> 00:10:08,890  
one of the giant planets and go out

254  
00:10:06,700 --> 00:10:11,470  
again and know the clothes you called it

255  
00:10:08,889 --> 00:10:13,179  
a failure Walter really are called it a

256  
00:10:11,470 --> 00:10:14,440  
failure is a failure if it wanted to be

257

00:10:13,179 --> 00:10:15,819  
part of the giant planets the great

258  
00:10:14,440 --> 00:10:18,520  
success because it's lived a lot longer

259  
00:10:15,820 --> 00:10:20,589  
than its other brothers and sisters so

260  
00:10:18,519 --> 00:10:22,509  
the reason why it most likely was so

261  
00:10:20,589 --> 00:10:24,279  
hyper active is it's never been in this

262  
00:10:22,509 --> 00:10:25,958  
close before and it suddenly had

263  
00:10:24,278 --> 00:10:27,879  
materials that have never been heated so

264  
00:10:25,958 --> 00:10:29,919  
much and it was boiling off furiously

265  
00:10:27,879 --> 00:10:31,509  
and that's why we caught it out by

266  
00:10:29,919 --> 00:10:33,819  
Saturn and we've been watching all the

267  
00:10:31,509 --> 00:10:35,500  
way in so it had a very strong ramp up

268  
00:10:33,820 --> 00:10:37,540  
between Saturn and maybe out to the

269  
00:10:35,500 --> 00:10:39,610  
orbit of Jupiter so then it kind of

270  
00:10:37,539 --> 00:10:41,049  
flattened out and then it actually

271  
00:10:39,610 --> 00:10:42,610

started dropping just a little bit right

272

00:10:41,049 --> 00:10:44,949  
before in terms of its activity right

273

00:10:42,610 --> 00:10:46,149  
before it got to Mars okay let's go

274

00:10:44,950 --> 00:10:49,050  
ahead and take a look at what Hubble

275

00:10:46,149 --> 00:10:51,850  
image Zolt can you do you have any of

276

00:10:49,049 --> 00:10:54,370  
the images that we put out a press

277

00:10:51,850 --> 00:10:56,459  
release came out today on our website

278

00:10:54,370 --> 00:10:58,629  
where we have some of these images now

279

00:10:56,458 --> 00:11:01,109  
and I'd like to just kind of take a look

280

00:10:58,629 --> 00:11:03,309  
at this now uh carry this is the kind of

281

00:11:01,110 --> 00:11:05,829  
comment that's was on a similar

282

00:11:03,309 --> 00:11:08,018  
trajectory as comet Ison was right it

283

00:11:05,828 --> 00:11:09,998  
had a one of those really elongated

284

00:11:08,019 --> 00:11:11,528  
almost perpendicular to the plane and

285

00:11:09,999 --> 00:11:13,420  
solar system right there are a lot of

286  
00:11:11,528 --> 00:11:14,678  
very strong similarities between Ison

287  
00:11:13,419 --> 00:11:17,110  
and Siding Springs in terms of its

288  
00:11:14,678 --> 00:11:19,808  
origin at orbit yes okay so here you go

289  
00:11:17,110 --> 00:11:22,629  
what are you showing us here's old so

290  
00:11:19,808 --> 00:11:26,169  
this is a picture that we put out with

291  
00:11:22,629 --> 00:11:29,678  
the news release today this shows Mars

292  
00:11:26,169 --> 00:11:32,708  
in the lower center of the image and the

293  
00:11:29,678 --> 00:11:34,869  
comet up to the above that and to the

294  
00:11:32,708 --> 00:11:36,488  
left a little bit and then the

295  
00:11:34,869 --> 00:11:38,980  
scattering of stars in the background

296  
00:11:36,489 --> 00:11:41,110  
now this is a photo composite which

297  
00:11:38,980 --> 00:11:43,509  
means it's been put together from three

298  
00:11:41,110 --> 00:11:45,419  
separate components the image of the

299  
00:11:43,509 --> 00:11:49,329  
comet is an actual image from Hubble

300  
00:11:45,419 --> 00:11:52,448  
this is actually a composite of numerous

301  
00:11:49,328 --> 00:11:56,438  
exposures taken with the wide field

302  
00:11:52,448 --> 00:11:58,659  
camera 3 that have been combined the

303  
00:11:56,438 --> 00:12:00,519  
common was very faint so all these

304  
00:11:58,659 --> 00:12:03,188  
exposures were combined and that's the

305  
00:12:00,519 --> 00:12:05,499  
image we see of the comet and then the

306  
00:12:03,188 --> 00:12:09,159  
image of Mars was a separate image also

307  
00:12:05,499 --> 00:12:10,480  
taken with wide field camera 3 in two

308  
00:12:09,159 --> 00:12:13,389  
different filters and these were

309  
00:12:10,480 --> 00:12:16,990  
composited to make the color image now

310  
00:12:13,389 --> 00:12:20,558  
these are placed on this star field at

311  
00:12:16,990 --> 00:12:22,028  
the positions where we would have seen

312  
00:12:20,558 --> 00:12:25,240  
them if we could have seen them at the

313  
00:12:22,028 --> 00:12:27,610  
same time so at the time of the closest

314

00:12:25,240 --> 00:12:30,100  
approach so why not just get a picture

315  
00:12:27,610 --> 00:12:31,778  
of all of it in one in one go well not

316  
00:12:30,100 --> 00:12:33,369  
really that would have been really cool

317  
00:12:31,778 --> 00:12:36,458  
and we were kind of hoping for that and

318  
00:12:33,369 --> 00:12:38,829  
it turns out that at their closest

319  
00:12:36,458 --> 00:12:41,678  
approach technically it would have been

320  
00:12:38,828 --> 00:12:43,208  
possible to have the comet and Mars in

321  
00:12:41,678 --> 00:12:45,548  
the same field of view of the telescope

322  
00:12:43,208 --> 00:12:48,338  
the cameras field of view although very

323  
00:12:45,548 --> 00:12:50,048  
small and sky is such that they would

324  
00:12:48,339 --> 00:12:51,999  
have fit within that tiny field of view

325  
00:12:50,048 --> 00:12:53,980  
that's how close they got together in

326  
00:12:51,999 --> 00:12:55,798  
the sky unfortunately there's a lot of

327  
00:12:53,980 --> 00:12:58,418  
technical issues that get in the way

328  
00:12:55,798 --> 00:13:00,999

these are both moving targets these are

329

00:12:58,418 --> 00:13:02,798

moving with respect to the stars and

330

00:13:00,999 --> 00:13:04,600

their turns out they were moving

331

00:13:02,798 --> 00:13:06,668

perpendicular to each other john yang

332

00:13:04,600 --> 00:13:08,829

mentioned that the common was cutting up

333

00:13:06,668 --> 00:13:10,808

from underneath the plane of the planets

334

00:13:08,828 --> 00:13:13,298

of the solar system and traveling up

335

00:13:10,808 --> 00:13:15,610

through that plane and above it well it

336

00:13:13,298 --> 00:13:17,168

turns out that in this view the comma

337

00:13:15,610 --> 00:13:20,740

was coming up from the bottom and

338

00:13:17,168 --> 00:13:23,110

traveling through the frame me

339

00:13:20,740 --> 00:13:24,700

while Mars was traveling also through

340

00:13:23,110 --> 00:13:27,639

the frame in the perpendicular direction

341

00:13:24,700 --> 00:13:31,330

going from right to left to this frame

342

00:13:27,639 --> 00:13:33,610

so if we were to track on the comet to



343

00:13:31,330 --> 00:13:35,470

get a good exposure of the comet Mars

344

00:13:33,610 --> 00:13:37,990

would have trailed through the exposure

345

00:13:35,470 --> 00:13:40,450

and vice versa if we would have tracked

346

00:13:37,990 --> 00:13:42,039

on Mars through the exposure the comet

347

00:13:40,450 --> 00:13:43,810

would've trail now the other

348

00:13:42,039 --> 00:13:45,759

complication the bigger complication

349

00:13:43,809 --> 00:13:47,799

really is that the brightness of these

350

00:13:45,759 --> 00:13:50,289

things and tree in reality is

351

00:13:47,799 --> 00:13:52,809

tremendously different Mars is a big

352

00:13:50,289 --> 00:13:56,110

bright planet reflecting a lot of light

353

00:13:52,809 --> 00:13:59,500

from the Sun in reality at that distance

354

00:13:56,110 --> 00:14:03,399

something like 10,000 times brighter

355

00:13:59,500 --> 00:14:06,070

than the common as carat Casey mentioned

356

00:14:03,399 --> 00:14:08,110

the comet is incredibly dark and faint

357  
00:14:06,070 --> 00:14:10,750  
and even the coma the material that it's

358  
00:14:08,110 --> 00:14:12,879  
shedding is not reflecting a very much

359  
00:14:10,750 --> 00:14:15,519  
sunlight so some of the amateur

360  
00:14:12,879 --> 00:14:18,278  
photographs that came out before this

361  
00:14:15,519 --> 00:14:20,949  
encounter showed that like Mars was like

362  
00:14:18,278 --> 00:14:22,659  
vastly overexposed and then the comet

363  
00:14:20,950 --> 00:14:25,060  
and it kind of looked like a star and

364  
00:14:22,659 --> 00:14:27,069  
have the spikes and everything from the

365  
00:14:25,059 --> 00:14:28,719  
camera or Mars would be fainter and you

366  
00:14:27,070 --> 00:14:31,000  
could barely see the comet so it's very

367  
00:14:28,720 --> 00:14:33,220  
hard and the other thing is that we

368  
00:14:31,000 --> 00:14:36,669  
couldn't get the stars the comet and

369  
00:14:33,220 --> 00:14:38,680  
Mars all not moving we got to point at

370  
00:14:36,669 --> 00:14:41,349  
something either stars or the comet or

371

00:14:38,679 --> 00:14:42,939  
Mars so we did one of each and made the

372  
00:14:41,350 --> 00:14:44,620  
composite everything going in different

373  
00:14:42,940 --> 00:14:47,140  
directions and everything's going in

374  
00:14:44,620 --> 00:14:48,970  
different directions and I've been

375  
00:14:47,139 --> 00:14:50,708  
referring to it as you know in principle

376  
00:14:48,970 --> 00:14:51,879  
we could have taken that one shot you

377  
00:14:50,708 --> 00:14:53,259  
know where they're all in the same frame

378  
00:14:51,879 --> 00:14:55,328  
but frankly it would have just been a

379  
00:14:53,259 --> 00:14:57,069  
stunt you know it would have been just

380  
00:14:55,328 --> 00:14:59,319  
because we can because there's really no

381  
00:14:57,070 --> 00:15:00,700  
good scientific reason or it was all it

382  
00:14:59,320 --> 00:15:02,709  
was explaining it would not have made

383  
00:15:00,700 --> 00:15:05,860  
nice images that we could have used for

384  
00:15:02,708 --> 00:15:06,939  
analytical purposes so um you know

385  
00:15:05,860 --> 00:15:08,860

obviously we're trying to get the best

386

00:15:06,940 --> 00:15:10,990

science out of this campaign and not

387

00:15:08,860 --> 00:15:13,060

just pull a stunt like that well let's

388

00:15:10,990 --> 00:15:16,060

talk about this image if I may can just

389

00:15:13,059 --> 00:15:17,500

add is that Mars wasn't terribly big at

390

00:15:16,059 --> 00:15:20,199

this time it was relatively far away

391

00:15:17,500 --> 00:15:22,600

from the earth so the size of Mars here

392

00:15:20,200 --> 00:15:24,278

isn't a bad approximation of how big it

393

00:15:22,600 --> 00:15:26,170

is relatively you've probably all seen

394

00:15:24,278 --> 00:15:27,879

the review t'kul pictures of Mars when

395

00:15:26,169 --> 00:15:29,319

it's you know that sound like 20 hour

396

00:15:27,879 --> 00:15:31,750

seconds across this one is as close to

397

00:15:29,320 --> 00:15:33,278

Earth as possible at this time Mars is

398

00:15:31,750 --> 00:15:34,208

about six arc seconds across because a

399

00:15:33,278 --> 00:15:36,879

lot farther away

400  
00:15:34,208 --> 00:15:39,308  
closest approach I want to talk a little

401  
00:15:36,879 --> 00:15:41,528  
bit about the science what I and I'll

402  
00:15:39,308 --> 00:15:44,019  
leave this to John yang or you carry

403  
00:15:41,528 --> 00:15:45,399  
which uh what what was the science

404  
00:15:44,019 --> 00:15:50,198  
driver for this what were you hoping to

405  
00:15:45,399 --> 00:15:51,879  
learn go ahead Jenny sure yeah so so

406  
00:15:50,198 --> 00:15:54,578  
this event is actually a very unique

407  
00:15:51,879 --> 00:15:56,438  
event in that you know this comet is a

408  
00:15:54,578 --> 00:15:58,479  
different category cup of comments

409  
00:15:56,438 --> 00:16:01,178  
comments that have been visited by

410  
00:15:58,480 --> 00:16:02,949  
spacecraft from close distance and we

411  
00:16:01,178 --> 00:16:05,139  
know you know like those those missions

412  
00:16:02,948 --> 00:16:06,938  
like deep impact like Stardust like

413  
00:16:05,139 --> 00:16:08,889  
stutters next and all those you know

414  
00:16:06,938 --> 00:16:11,528  
like the Rosetta mission that is ongoing

415  
00:16:08,889 --> 00:16:13,058  
now however this country is very very

416  
00:16:11,528 --> 00:16:16,720  
different from all other comments in

417  
00:16:13,058 --> 00:16:18,188  
that it is a this time is it's the first

418  
00:16:16,720 --> 00:16:20,980  
time it comes into the inner solar

419  
00:16:18,188 --> 00:16:23,409  
system after like forbidding 4.5

420  
00:16:20,980 --> 00:16:26,528  
billions billions of years updates

421  
00:16:23,409 --> 00:16:28,149  
formation so um so but for this kind of

422  
00:16:26,528 --> 00:16:29,889  
comment because it only comes into the

423  
00:16:28,149 --> 00:16:32,318  
inner solar system for once and then

424  
00:16:29,889 --> 00:16:34,869  
it's gone we only have one time one shot

425  
00:16:32,318 --> 00:16:37,479  
and also we only have like one year

426  
00:16:34,869 --> 00:16:40,028  
after this discovery 2 is perihelion the

427  
00:16:37,480 --> 00:16:42,938  
boys calm so that time is very short for

428

00:16:40,028 --> 00:16:44,528  
us to do any space missions to look at

429  
00:16:42,938 --> 00:16:47,078  
the comment from caused by distance and

430  
00:16:44,528 --> 00:16:48,879  
then these opportunities the intensity

431  
00:16:47,078 --> 00:16:50,438  
in this sense this opportunity is very

432  
00:16:48,879 --> 00:16:52,659  
unique in that we can look at the

433  
00:16:50,438 --> 00:16:55,568  
comment from a close distance from the

434  
00:16:52,659 --> 00:16:58,808  
spacecraft on Mars so that is why we're

435  
00:16:55,568 --> 00:17:00,969  
doing it and then the the director

436  
00:16:58,808 --> 00:17:02,708  
direct scientific driver for how about

437  
00:17:00,970 --> 00:17:05,709  
you look at it during Mars encounter is

438  
00:17:02,708 --> 00:17:07,808  
because um more spacecraft will be

439  
00:17:05,709 --> 00:17:10,600  
looking at the comet when its flyby from

440  
00:17:07,808 --> 00:17:12,129  
phenyl from under the under Mars orbital

441  
00:17:10,599 --> 00:17:15,398  
plane and then cross it and then go

442  
00:17:12,130 --> 00:17:17,079

above so but then Hubble from the other

443

00:17:15,398 --> 00:17:19,359

will look at the comment from another

444

00:17:17,078 --> 00:17:21,788

from another very different perspective

445

00:17:19,359 --> 00:17:23,469

and when you combine in image from two

446

00:17:21,788 --> 00:17:25,778

different perspectives you will be able

447

00:17:23,470 --> 00:17:28,750

to construct the 3d structure of the

448

00:17:25,778 --> 00:17:31,538

inner you know in a coma of the comment

449

00:17:28,750 --> 00:17:34,778

so basically that's one driver for these

450

00:17:31,538 --> 00:17:37,569

observations we used how about the the

451

00:17:34,778 --> 00:17:40,269

tremendous spatial resolution howl howl

452

00:17:37,569 --> 00:17:43,000

is the almost to the working can provide

453

00:17:40,269 --> 00:17:44,710

us the best right best images that you

454

00:17:43,000 --> 00:17:48,099

know we can get from all the telescopes

455

00:17:44,710 --> 00:17:50,798

on the earth so that is one thing and

456

00:17:48,099 --> 00:17:53,349

the thing I think maybe Casey can tell



457  
00:17:50,798 --> 00:17:54,960  
us how we can study they are the gas of

458  
00:17:53,349 --> 00:17:58,449  
his comment and interactions with Mars

459  
00:17:54,960 --> 00:18:00,429  
okay okay let's do that alright i will

460  
00:17:58,450 --> 00:18:02,950  
let me just add one thing to what

461  
00:18:00,429 --> 00:18:05,048  
jinyang said all the spacecraft visits

462  
00:18:02,950 --> 00:18:06,880  
to comets we've had so far have been to

463  
00:18:05,048 --> 00:18:08,470  
what we call Jupiter family comets that

464  
00:18:06,880 --> 00:18:10,419  
come from the Kuiper belt from the edge

465  
00:18:08,470 --> 00:18:11,950  
of the disk of our system and if you

466  
00:18:10,419 --> 00:18:14,020  
think of this solar system as a record

467  
00:18:11,950 --> 00:18:15,130  
and the comment of the planet we're out

468  
00:18:14,019 --> 00:18:17,048  
in the grooves and the sun's at the

469  
00:18:15,130 --> 00:18:19,360  
center all these comets have pretty much

470  
00:18:17,048 --> 00:18:21,190  
been in the plane of that record but of

471  
00:18:19,359 --> 00:18:23,109  
the solar system these Oort cloud comets

472  
00:18:21,190 --> 00:18:24,970  
that come from a different collection or

473  
00:18:23,109 --> 00:18:26,740  
population your clog is expands

474  
00:18:24,970 --> 00:18:28,870  
basically like a sphere that surrounds

475  
00:18:26,740 --> 00:18:30,250  
our solar system and as to the farthest

476  
00:18:28,869 --> 00:18:31,509  
did most distant thing we have in the

477  
00:18:30,250 --> 00:18:33,130  
solar system and we have never been able

478  
00:18:31,509 --> 00:18:35,650  
to get this close and personal to one

479  
00:18:33,130 --> 00:18:36,820  
before we in my rocket simply in our

480  
00:18:35,650 --> 00:18:39,070  
spaceships simply don't have enough

481  
00:18:36,819 --> 00:18:41,109  
energy to get to them so instead we have

482  
00:18:39,069 --> 00:18:42,250  
to wait until you come to us so that's

483  
00:18:41,109 --> 00:18:46,269  
why another reason this is for special

484  
00:18:42,250 --> 00:18:48,490  
so little blessing coming to us um yeah

485

00:18:46,269 --> 00:18:51,099  
it's North normally we go to them but

486  
00:18:48,490 --> 00:18:52,839  
this is a wonderful example of reuse you

487  
00:18:51,099 --> 00:18:56,349  
can actually use NASA assets to have a

488  
00:18:52,839 --> 00:18:57,519  
free fly back so I jinyang wanted me to

489  
00:18:56,349 --> 00:18:59,949  
talk about the other things we want to

490  
00:18:57,519 --> 00:19:01,418  
learn from the flybot know that since

491  
00:18:59,950 --> 00:19:03,279  
the comment was coming to us we can

492  
00:19:01,419 --> 00:19:05,200  
actually watch it and watch how gas and

493  
00:19:03,279 --> 00:19:06,940  
dust are coming off of it and we can see

494  
00:19:05,200 --> 00:19:08,980  
if it varies you can see if that gas and

495  
00:19:06,940 --> 00:19:11,830  
that dust interacted at all with Mars

496  
00:19:08,980 --> 00:19:13,950  
most the the largest prediction was that

497  
00:19:11,829 --> 00:19:17,619  
the Martian atmosphere would heat up

498  
00:19:13,950 --> 00:19:19,298  
from gas molecules and tiny little bits

499  
00:19:17,619 --> 00:19:21,548

of dust hitting the upper atmosphere

500

00:19:19,298 --> 00:19:23,408

there wasn't much material coming from

501

00:19:21,548 --> 00:19:25,569

the comet the Miss was close but not

502

00:19:23,409 --> 00:19:27,220

that close but on the other hand the

503

00:19:25,569 --> 00:19:28,899

comet was moving what we call retrograde

504

00:19:27,220 --> 00:19:30,038

it was actually going backwards compared

505

00:19:28,900 --> 00:19:31,870

to the way that all the planets move

506

00:19:30,038 --> 00:19:34,000

around which is counterclockwise the

507

00:19:31,869 --> 00:19:36,609

comment was coming clockwise so it was

508

00:19:34,000 --> 00:19:39,009

almost a head-on collision almost and

509

00:19:36,609 --> 00:19:41,079

the relative velocity between the comet

510

00:19:39,009 --> 00:19:43,058

and Mars is about fifty six kilometers

511

00:19:41,079 --> 00:19:45,639

per second it's about 30-some miles per

512

00:19:43,058 --> 00:19:47,139

second so each atom and each piece of

513

00:19:45,640 --> 00:19:49,210

dust that would hit Mars's atmosphere

514  
00:19:47,140 --> 00:19:51,280  
brought a really large amount of huge

515  
00:19:49,210 --> 00:19:52,779  
amount of energy so even though there

516  
00:19:51,279 --> 00:19:54,099  
wasn't too much material coming off the

517  
00:19:52,779 --> 00:19:56,678  
comment again think of the common is a

518  
00:19:54,099 --> 00:19:57,730  
very very small mountain if that much we

519  
00:19:56,679 --> 00:20:00,100  
need smaller than the average

520  
00:19:57,730 --> 00:20:01,298  
Appalachian mountain but and shedding a

521  
00:20:00,099 --> 00:20:02,049  
little bit of it's tough maybe a

522  
00:20:01,298 --> 00:20:04,480  
fraction of

523  
00:20:02,049 --> 00:20:06,369  
sent but that stuff is can actually hit

524  
00:20:04,480 --> 00:20:08,170  
Mars and Mars atmosphere and we were

525  
00:20:06,369 --> 00:20:10,809  
looking to see whether any of that would

526  
00:20:08,170 --> 00:20:12,610  
again heat up the atmosphere also the

527  
00:20:10,809 --> 00:20:14,889  
comet was up wind and the solar wind

528  
00:20:12,609 --> 00:20:16,599  
from Mars so I on streaming off the

529  
00:20:14,890 --> 00:20:18,340  
comment into the solar wind interacting

530  
00:20:16,599 --> 00:20:19,269  
with the comet would then hit Mars we

531  
00:20:18,339 --> 00:20:21,490  
were interested to see whether there's

532  
00:20:19,269 --> 00:20:23,139  
any interaction and possible roar a or

533  
00:20:21,490 --> 00:20:25,779  
just kind of puffing up of the Martian

534  
00:20:23,140 --> 00:20:27,520  
ionosphere well was there any did did

535  
00:20:25,779 --> 00:20:29,410  
you see any interaction with the

536  
00:20:27,519 --> 00:20:31,690  
atmosphere we don't know yet Oh another

537  
00:20:29,410 --> 00:20:34,330  
problem we had a problem with the orbits

538  
00:20:31,690 --> 00:20:36,400  
it'll Thursday this happened like this

539  
00:20:34,329 --> 00:20:38,049  
happened like over the weekend we lost

540  
00:20:36,400 --> 00:20:39,790  
our background measurement we actually

541  
00:20:38,049 --> 00:20:42,009  
have to get that back real soon we don't

542

00:20:39,789 --> 00:20:43,470  
have a measure of what 0 is there was

543  
00:20:42,009 --> 00:20:46,359  
there was a problem with its spacecraft

544  
00:20:43,470 --> 00:20:50,769  
so what happens we'll hear more is that

545  
00:20:46,359 --> 00:20:52,719  
Max's job is not gonna get that max back

546  
00:20:50,769 --> 00:20:54,339  
with you know we get a background to

547  
00:20:52,720 --> 00:20:56,230  
sleep in the spacecraft had problem no

548  
00:20:54,339 --> 00:20:58,720  
the spacecraft there's a wonderful

549  
00:20:56,230 --> 00:20:59,829  
instrument morning for now 25 years you

550  
00:20:58,720 --> 00:21:01,900  
point out but just like every other

551  
00:20:59,829 --> 00:21:04,299  
machine or a robot ever built by man

552  
00:21:01,900 --> 00:21:07,930  
every now and then it has a hiccup ok

553  
00:21:04,299 --> 00:21:10,659  
i'm afraid i will let you image dave i'm

554  
00:21:07,930 --> 00:21:12,970  
sorry i can't open the cover the cover

555  
00:21:10,660 --> 00:21:14,740  
they don't actually move that anymore a

556  
00:21:12,970 --> 00:21:19,180

Charles Bell has a good question let me

557

00:21:14,740 --> 00:21:23,019

ask this one before mro high-rise image

558

00:21:19,180 --> 00:21:25,360

of comment see 20 31 a 1 which is siding

559

00:21:23,019 --> 00:21:28,359

spring at close approach what did you

560

00:21:25,359 --> 00:21:31,119

think the size of the comet nucleus was

561

00:21:28,359 --> 00:21:32,769

and what did you base that on I think

562

00:21:31,119 --> 00:21:34,179

that depends on who you ask I'll give my

563

00:21:32,769 --> 00:21:37,990

opinion than shiney I should give his

564

00:21:34,180 --> 00:21:39,519

okay should be close I hope well the

565

00:21:37,990 --> 00:21:41,559

lowest limit we had was somewhere around

566

00:21:39,519 --> 00:21:43,089

point 3.5 kilometers and that came

567

00:21:41,559 --> 00:21:45,279

typically from just seeing how much gas

568

00:21:43,089 --> 00:21:47,589

was coming off being evolved the gas

569

00:21:45,279 --> 00:21:49,149

production rate we call it and assuming

570

00:21:47,589 --> 00:21:51,039

that all of that was coming from a



571  
00:21:49,150 --> 00:21:52,870  
nucleus so just imagine a spherical

572  
00:21:51,039 --> 00:21:54,789  
nucleus to make life simple you can

573  
00:21:52,869 --> 00:21:56,529  
figure out what  $4\pi R^2$  has to be

574  
00:21:54,789 --> 00:21:58,960  
and because we know how fast water I

575  
00:21:56,529 --> 00:22:01,269  
spoils off at one and a half a you from

576  
00:21:58,960 --> 00:22:02,710  
the Sun for example the upper limit came

577  
00:22:01,269 --> 00:22:04,539  
from some of our earlier Hubble

578  
00:22:02,710 --> 00:22:06,340  
observations and we couldn't say very

579  
00:22:04,539 --> 00:22:07,869  
strenuously what that was if you wanted

580  
00:22:06,339 --> 00:22:10,119  
to be extremely conservative it was

581  
00:22:07,869 --> 00:22:11,619  
about 5 kilometers most likely the

582  
00:22:10,119 --> 00:22:13,989  
analysis had shown it couldn't even

583  
00:22:11,619 --> 00:22:15,279  
bigger than do two kilometers radius but

584  
00:22:13,990 --> 00:22:15,809  
we knew almost immediately from the

585  
00:22:15,279 --> 00:22:18,059  
first hub

586  
00:22:15,809 --> 00:22:19,829  
servations it wasn't a ginormous nucleus

587  
00:22:18,059 --> 00:22:21,419  
because that's the other possibility you

588  
00:22:19,829 --> 00:22:23,699  
can see it out by Saturn just because it

589  
00:22:21,420 --> 00:22:26,340  
is just big big big and we will that out

590  
00:22:23,700 --> 00:22:28,319  
pretty fast ginormous is that mess is

591  
00:22:26,339 --> 00:22:31,139  
another technical yeah that's a unit

592  
00:22:28,319 --> 00:22:35,159  
yeah so is actually tweeting that right

593  
00:22:31,140 --> 00:22:36,330  
now so yeah epi so's old Leia I don't

594  
00:22:35,160 --> 00:22:38,460  
know if you can show us this or not but

595  
00:22:36,329 --> 00:22:40,980  
let he were talking about the first

596  
00:22:38,460 --> 00:22:42,509  
observations of Hubble can we see the

597  
00:22:40,980 --> 00:22:44,160  
progression of Hubble images you happen

598  
00:22:42,509 --> 00:22:46,859  
to have that handy when some of the

599

00:22:44,160 --> 00:22:50,279  
first observations back in September

600  
00:22:46,859 --> 00:22:53,209  
versus the ones that were closer or is

601  
00:22:50,279 --> 00:22:56,069  
that wanna sleep I can bring that up

602  
00:22:53,210 --> 00:22:57,870  
well I don't mean I don't mean to throw

603  
00:22:56,069 --> 00:23:01,129  
a wrench in the works if you can ok just

604  
00:22:57,869 --> 00:23:03,329  
curious add that cued up but I didn't

605  
00:23:01,130 --> 00:23:06,270  
you're a rock star I'm sure I'll get it

606  
00:23:03,329 --> 00:23:08,189  
getting so it so let's talk about that a

607  
00:23:06,269 --> 00:23:09,389  
little bit Xianyang I'm i accidentally

608  
00:23:08,190 --> 00:23:11,070  
had to mute you cousin I didn't

609  
00:23:09,390 --> 00:23:13,680  
accidentally I purposely meted you but

610  
00:23:11,069 --> 00:23:16,589  
um I wanted to do there's an echo

611  
00:23:13,680 --> 00:23:17,850  
there's an echo there so I I had the and

612  
00:23:16,589 --> 00:23:24,029  
then he accidentally slapped you in the

613  
00:23:17,849 --> 00:23:27,240

face now that was used God um can you

614

00:23:24,029 --> 00:23:28,829

can you tell us a little bit about what

615

00:23:27,240 --> 00:23:30,359

happened to the comments from the first

616

00:23:28,829 --> 00:23:33,569

Hubble observations which I think we're

617

00:23:30,359 --> 00:23:34,889

back in September correct to do though

618

00:23:33,569 --> 00:23:39,450

what happened to the comet is it got

619

00:23:34,890 --> 00:23:41,880

closer to Mars uh well i think the the

620

00:23:39,450 --> 00:23:44,610

most interesting thing recent change of

621

00:23:41,880 --> 00:23:48,900

the comment uh was that something up

622

00:23:44,609 --> 00:23:50,309

thank you so go ahead yeah okay so so as

623

00:23:48,900 --> 00:23:51,660

you said how about actually the first

624

00:23:50,309 --> 00:23:54,240

time how about looked at his comment was

625

00:23:51,660 --> 00:23:56,759

last year in october almost a year ago I

626

00:23:54,240 --> 00:23:58,559

can't believe it anyway um so since then

627

00:23:56,759 --> 00:24:01,379

Hubble observed the climate two more

628  
00:23:58,559 --> 00:24:04,679  
times 11 Singh January this year and

629  
00:24:01,380 --> 00:24:07,350  
other finds in your head run March this

630  
00:24:04,680 --> 00:24:09,630  
year and you know from those three

631  
00:24:07,349 --> 00:24:13,079  
observations the comet actually does not

632  
00:24:09,630 --> 00:24:16,050  
change much but just I think a few weeks

633  
00:24:13,079 --> 00:24:19,259  
ago there was sign that this comment was

634  
00:24:16,049 --> 00:24:21,240  
you know this comet had behaved like all

635  
00:24:19,259 --> 00:24:23,599  
the way until a few weeks before the

636  
00:24:21,240 --> 00:24:25,920  
close encounter with Mars you know uh

637  
00:24:23,599 --> 00:24:27,809  
until that time we were all very happy

638  
00:24:25,920 --> 00:24:29,279  
that this come it just just the

639  
00:24:27,809 --> 00:24:30,690  
performance of the comment

640  
00:24:29,279 --> 00:24:33,180  
brightness of the comet just follows

641  
00:24:30,690 --> 00:24:35,789  
what people what scientists will predict

642  
00:24:33,180 --> 00:24:38,340  
they are then then we're all happy about

643  
00:24:35,789 --> 00:24:42,809  
that but unlike a few weeks away like

644  
00:24:38,339 --> 00:24:44,699  
the people suddenly realized that the

645  
00:24:42,809 --> 00:24:46,649  
the the brain is like a missile a

646  
00:24:44,700 --> 00:24:52,500  
starting huge carbon trading nificant

647  
00:24:46,650 --> 00:24:54,750  
like and so so and you know there's no

648  
00:24:52,500 --> 00:24:56,640  
sign no sign about what happened on

649  
00:24:54,750 --> 00:25:00,180  
comet and we have no explanation about

650  
00:24:56,640 --> 00:25:02,340  
about that yet so and also so that's

651  
00:25:00,180 --> 00:25:03,990  
what we actually saw in the first in

652  
00:25:02,339 --> 00:25:06,329  
Hubble images during a close encounter

653  
00:25:03,990 --> 00:25:08,130  
of the data down the first thing we look

654  
00:25:06,329 --> 00:25:10,349  
with check is of course whether we have

655  
00:25:08,130 --> 00:25:11,910  
exposed to comment well in our images

656

00:25:10,349 --> 00:25:14,519  
what whether we have enough signal to

657  
00:25:11,910 --> 00:25:15,810  
work with then in the first check the

658  
00:25:14,519 --> 00:25:17,579  
thing we noticed the first thing we

659  
00:25:15,809 --> 00:25:20,220  
noticed was that the comment was indeed

660  
00:25:17,579 --> 00:25:23,519  
Center than the prediction by like half

661  
00:25:20,220 --> 00:25:25,529  
to 1 magnitude so or signal is kind of

662  
00:25:23,519 --> 00:25:26,910  
low lower than or expectation but still

663  
00:25:25,529 --> 00:25:29,129  
we have enough signal to work with we

664  
00:25:26,910 --> 00:25:31,110  
believe and um you know that's the first

665  
00:25:29,130 --> 00:25:32,790  
thing we noticed in your data and that's

666  
00:25:31,109 --> 00:25:35,399  
I think the biggest change or what I

667  
00:25:32,789 --> 00:25:37,619  
would say now okay well and and as

668  
00:25:35,400 --> 00:25:39,120  
Carrie points out we may still see

669  
00:25:37,619 --> 00:25:42,319  
evidence of some interaction when it

670  
00:25:39,119 --> 00:25:45,299

flew by maybe see some aurori or or a

671

00:25:42,319 --> 00:25:46,409

hopefully I'll give until next tuesday

672

00:25:45,299 --> 00:25:48,839

hopefully i'll have something by the

673

00:25:46,410 --> 00:25:51,240

enemies given the weekend so Zolt now

674

00:25:48,839 --> 00:25:53,159

can you uh can you sort of short show us

675

00:25:51,240 --> 00:25:55,109

what your tell us what we're looking at

676

00:25:53,160 --> 00:25:56,850

here this is the observations back in

677

00:25:55,109 --> 00:25:58,379

march this was the observations from

678

00:25:56,849 --> 00:26:00,449

markers and actually maybe john yang

679

00:25:58,380 --> 00:26:01,770

would be better oh okay probably we're

680

00:26:00,450 --> 00:26:05,460

looking at but we're looking at on the

681

00:26:01,769 --> 00:26:07,589

left is the plane image of the basically

682

00:26:05,460 --> 00:26:09,180

the raw image of the comment as you can

683

00:26:07,589 --> 00:26:12,269

see the tail is pointing off to the

684

00:26:09,180 --> 00:26:15,150

upper right it's actually you do need a



685  
00:26:12,269 --> 00:26:18,150  
detectable tail and on the right is an

686  
00:26:15,150 --> 00:26:19,800  
image process to show the details very

687  
00:26:18,150 --> 00:26:22,259  
close to the nucleus and i think john

688  
00:26:19,799 --> 00:26:27,059  
yang can explain why it looks the way it

689  
00:26:22,259 --> 00:26:29,970  
looks well so what we did was that we

690  
00:26:27,059 --> 00:26:33,169  
are sort of but with we divided divided

691  
00:26:29,970 --> 00:26:36,630  
the image of the comment by a model that

692  
00:26:33,170 --> 00:26:40,529  
produce a you know uh what we called out

693  
00:26:36,630 --> 00:26:42,420  
isotropic isotropic dust emission you

694  
00:26:40,529 --> 00:26:43,200  
know we assume that you know if if this

695  
00:26:42,420 --> 00:26:45,450  
comment is

696  
00:26:43,200 --> 00:26:48,750  
meeting all the dust all the same of the

697  
00:26:45,450 --> 00:26:50,190  
same way in all directions then then it

698  
00:26:48,750 --> 00:26:52,740  
will be it what we look a slightly

699  
00:26:50,190 --> 00:26:55,350  
different and then the the image in the

700  
00:26:52,740 --> 00:26:57,210  
right hand side was the was that was a

701  
00:26:55,349 --> 00:26:59,609  
difference between his actual image and

702  
00:26:57,210 --> 00:27:01,860  
that ideal model so what this means is

703  
00:26:59,609 --> 00:27:05,398  
that the comet is actually emitting some

704  
00:27:01,859 --> 00:27:07,079  
tusk preferentially towards the left and

705  
00:27:05,398 --> 00:27:09,298  
also towards the right there were two

706  
00:27:07,079 --> 00:27:11,250  
features that you know we see a little

707  
00:27:09,298 --> 00:27:13,679  
bit slightly enhanced destination in a

708  
00:27:11,250 --> 00:27:15,210  
coma and this is an indication that the

709  
00:27:13,679 --> 00:27:18,509  
activity on the coming to a nuclear

710  
00:27:15,210 --> 00:27:20,970  
nucleus is not like the same not uniform

711  
00:27:18,509 --> 00:27:23,548  
not the same everywhere it has some area

712  
00:27:20,970 --> 00:27:26,250  
that is strong slightly more active than

713

00:27:23,548 --> 00:27:28,379  
the other in other areas so that's what

714  
00:27:26,250 --> 00:27:30,690  
we see here on the right hand side can

715  
00:27:28,380 --> 00:27:34,139  
you call them jets or is it just some

716  
00:27:30,690 --> 00:27:35,610  
sort of emissions of some kind well to

717  
00:27:34,138 --> 00:27:39,990  
be precisely we prefer to call them

718  
00:27:35,609 --> 00:27:42,898  
features Oh feature they're really

719  
00:27:39,990 --> 00:27:44,308  
brochures and or they could woman heart

720  
00:27:42,898 --> 00:27:47,278  
could be towards the stun yeah you have

721  
00:27:44,308 --> 00:27:49,648  
to be careful okay well i like to term

722  
00:27:47,278 --> 00:27:51,599  
jets but i guess that's not not precise

723  
00:27:49,648 --> 00:27:55,109  
enough and probably probably misleading

724  
00:27:51,599 --> 00:27:59,928  
I there's a cop here's a question from

725  
00:27:55,109 --> 00:28:03,629  
my cat food oh I love that I love that a

726  
00:27:59,929 --> 00:28:07,399  
handle to anybody on the panel did we

727  
00:28:03,630 --> 00:28:10,139

know the composition of siding spring

728

00:28:07,398 --> 00:28:13,500

now only know the composition I do its

729

00:28:10,138 --> 00:28:15,379

space stuff there you go we're all far

730

00:28:13,500 --> 00:28:18,269

does there you go ready that's right

731

00:28:15,380 --> 00:28:21,510

okay I'm gonna pull a Sagan and just

732

00:28:18,269 --> 00:28:23,278

it's our stuff we knew very roughly that

733

00:28:21,509 --> 00:28:25,500

we think it was about half water ice and

734

00:28:23,278 --> 00:28:27,298

and carbon dioxide and carbon dioxide

735

00:28:25,500 --> 00:28:30,089

and methane and ammonia etcetera Isis

736

00:28:27,298 --> 00:28:31,679

and roughly half rocky stuff but we

737

00:28:30,089 --> 00:28:32,759

didn't know the exact details and we

738

00:28:31,679 --> 00:28:34,889

didn't know how much carbonaceous

739

00:28:32,759 --> 00:28:36,599

material there was we can tell you that

740

00:28:34,888 --> 00:28:39,000

ison has seemed to have been very

741

00:28:36,599 --> 00:28:41,038

abundant in rich and very rich in

742  
00:28:39,000 --> 00:28:42,778  
organics more than the average comet

743  
00:28:41,038 --> 00:28:44,099  
last year so we've looking for that we

744  
00:28:42,778 --> 00:28:48,450  
don't have any response to that though

745  
00:28:44,099 --> 00:28:50,099  
yeah okay so also from my cat food also

746  
00:28:48,450 --> 00:28:51,629  
to anyone on the panel referring to the

747  
00:28:50,099 --> 00:28:53,398  
slough coverage it looked like there

748  
00:28:51,628 --> 00:28:55,168  
either was or wasn't an electrical

749  
00:28:53,398 --> 00:28:56,729  
interaction with the Martian atmosphere

750  
00:28:55,169 --> 00:28:59,370  
you have any common

751  
00:28:56,730 --> 00:29:03,120  
on that I don't know we talked about

752  
00:28:59,369 --> 00:29:05,308  
that look like it was or wasn't there

753  
00:29:03,119 --> 00:29:07,969  
would i look at the other one or what i

754  
00:29:05,308 --> 00:29:11,009  
wanted a quantum show i'm not sure um

755  
00:29:07,970 --> 00:29:13,500  
well we talked about already they don't

756  
00:29:11,009 --> 00:29:15,660  
know yet if there was any interactions

757  
00:29:13,500 --> 00:29:18,000  
with the atmosphere at all so they're

758  
00:29:15,660 --> 00:29:20,429  
going to find that out and and get back

759  
00:29:18,000 --> 00:29:22,079  
to us I hope a lot of people look like

760  
00:29:20,429 --> 00:29:23,790  
they're having trouble connecting so yes

761  
00:29:22,079 --> 00:29:25,589  
you're going to need to refresh your

762  
00:29:23,789 --> 00:29:27,418  
browser hopefully in the Hangout will

763  
00:29:25,589 --> 00:29:29,609  
appear to you but then you can't see me

764  
00:29:27,419 --> 00:29:32,190  
say that so I don't know why we bothered

765  
00:29:29,609 --> 00:29:34,740  
I link to the YouTube into the event

766  
00:29:32,190 --> 00:29:37,798  
patient oh ok yeah seem to be having

767  
00:29:34,740 --> 00:29:40,440  
trouble um alright so I told you you had

768  
00:29:37,798 --> 00:29:43,069  
created a really nice animated gif also

769  
00:29:40,440 --> 00:29:46,830  
with the press release can we see that

770

00:29:43,069 --> 00:29:50,579  
yes again that will take me a moment ok

771  
00:29:46,829 --> 00:29:54,990  
alright I will preface it by saying that

772  
00:29:50,579 --> 00:29:58,409  
that was a that was a model in an

773  
00:29:54,990 --> 00:30:01,950  
animation and it wasn't based on well it

774  
00:29:58,410 --> 00:30:06,120  
was based on the earlier image of the

775  
00:30:01,950 --> 00:30:09,090  
comet in an earlier image of Mars ok

776  
00:30:06,119 --> 00:30:12,178  
they were roughly positioned where I

777  
00:30:09,089 --> 00:30:13,349  
thought they ought to be okay while

778  
00:30:12,179 --> 00:30:18,750  
you're doing that let me ask one more

779  
00:30:13,349 --> 00:30:21,119  
question on Q&A app Nastya crew couch

780  
00:30:18,750 --> 00:30:22,980  
innova sorry if I messed that up could

781  
00:30:21,119 --> 00:30:26,819  
we know is it possible to know from

782  
00:30:22,980 --> 00:30:29,490  
which system that comic came from yes we

783  
00:30:26,819 --> 00:30:31,710  
know the orbit we've been following this

784  
00:30:29,490 --> 00:30:34,048

comment for a long time if I may digress

785

00:30:31,710 --> 00:30:35,880

think of the orbits of the planets like

786

00:30:34,048 --> 00:30:37,168

a rubber band it's almost like a circle

787

00:30:35,880 --> 00:30:39,570

remember that talked about grooves in a

788

00:30:37,169 --> 00:30:41,100

record your period comet that we go and

789

00:30:39,569 --> 00:30:42,298

fly to with our spacecraft would be if

790

00:30:41,099 --> 00:30:43,619

you took that rubber band you stretched

791

00:30:42,298 --> 00:30:45,720

it a little bit so it kind of looked

792

00:30:43,619 --> 00:30:47,729

like an ellipse or an egg they're not

793

00:30:45,720 --> 00:30:49,890

very stretched the orbits we see for the

794

00:30:47,730 --> 00:30:51,419

Oort cloud comets are stretched so long

795

00:30:49,890 --> 00:30:52,890

that it looks like almost two straight

796

00:30:51,419 --> 00:30:55,620

lines with just little kind of round the

797

00:30:52,890 --> 00:30:57,150

end caps but if we were to stretch it

798

00:30:55,619 --> 00:30:59,668

even farther so it came from another



799  
00:30:57,150 --> 00:31:01,320  
system the rubber band would break we

800  
00:30:59,669 --> 00:31:02,790  
know that the amount of energy this

801  
00:31:01,319 --> 00:31:04,409  
comment has in its orbit is such that it

802  
00:31:02,789 --> 00:31:06,029  
goes around the Sun every few million

803  
00:31:04,410 --> 00:31:09,720  
years it's never been outside of our

804  
00:31:06,029 --> 00:31:10,558  
system ok so a few million years so

805  
00:31:09,720 --> 00:31:11,879  
definitely not

806  
00:31:10,558 --> 00:31:14,460  
gonna be seeing this again anytime soon

807  
00:31:11,878 --> 00:31:16,558  
no jinyang said it weren't we had our

808  
00:31:14,460 --> 00:31:17,610  
shot looking at this one if you're gonna

809  
00:31:16,558 --> 00:31:19,769  
be around a few million years for now

810  
00:31:17,609 --> 00:31:22,498  
maybe but I wouldn't wait for it come

811  
00:31:19,769 --> 00:31:25,138  
home before it singularities coming are

812  
00:31:22,499 --> 00:31:26,669  
you go put yourself in that spaceship

813  
00:31:25,138 --> 00:31:32,998  
now and move it to speed of light there

814  
00:31:26,669 --> 00:31:36,240  
you go okay ray kurzweil okay okay so I

815  
00:31:32,999 --> 00:31:39,149  
so there's old sigh animation go ahead

816  
00:31:36,240 --> 00:31:41,700  
animation we put together and so you see

817  
00:31:39,148 --> 00:31:43,979  
as I described before you can see that

818  
00:31:41,700 --> 00:31:45,778  
the comments coming up from it and this

819  
00:31:43,980 --> 00:31:48,569  
is looping so it's just repeating the

820  
00:31:45,778 --> 00:31:51,359  
same sequence of events it's taking

821  
00:31:48,569 --> 00:31:53,460  
place over the space of an hour as this

822  
00:31:51,359 --> 00:31:56,699  
event is taking place so you can see how

823  
00:31:53,460 --> 00:31:59,879  
quickly these things move makes clear

824  
00:31:56,700 --> 00:32:02,038  
marshal bit out of this for this sped up

825  
00:31:59,878 --> 00:32:03,689  
dramatically but yeah Mars is moving

826  
00:32:02,038 --> 00:32:06,929  
from left to right across the bottom and

827

00:32:03,690 --> 00:32:11,999  
the comment is moving up from the bottom

828  
00:32:06,929 --> 00:32:14,700  
and there's a there's a area marked off

829  
00:32:11,999 --> 00:32:17,519  
in green and that's the that's the area

830  
00:32:14,700 --> 00:32:20,100  
of the sky that the Hubble's camera the

831  
00:32:17,519 --> 00:32:21,659  
wide field camera 3 can see in one frame

832  
00:32:20,099 --> 00:32:24,599  
so as you can see it's all taking place

833  
00:32:21,659 --> 00:32:25,919  
within one frame in principle though as

834  
00:32:24,599 --> 00:32:29,278  
we said before we couldn't actually

835  
00:32:25,919 --> 00:32:31,700  
image them at the same time so if that

836  
00:32:29,278 --> 00:32:34,950  
kind of gives you an idea of the scale

837  
00:32:31,700 --> 00:32:37,619  
Wow of what what's going right hey tires

838  
00:32:34,950 --> 00:32:41,340  
ago I'm orientation anymore yeah that's

839  
00:32:37,618 --> 00:32:44,638  
really neat okay uh so what's what's

840  
00:32:41,339 --> 00:32:46,678  
next for these observations uh Carrie

841  
00:32:44,638 --> 00:32:49,038

are you going to be obviously poring

842

00:32:46,679 --> 00:32:51,509

over the the observations you've got and

843

00:32:49,038 --> 00:32:52,888

what is what what do you were what are

844

00:32:51,509 --> 00:32:55,798

your plans for the immediate future with

845

00:32:52,888 --> 00:32:58,528

this well we have a few plans part of it

846

00:32:55,798 --> 00:33:00,808

is Jim Yang's program he's concentrating

847

00:32:58,528 --> 00:33:02,159

more on the nucleus I'm front and I'm in

848

00:33:00,808 --> 00:33:03,359

the dust I'm concentrating more on the

849

00:33:02,159 --> 00:33:04,710

gas it's not that I'm interested not

850

00:33:03,359 --> 00:33:07,048

interested in both but I have another

851

00:33:04,710 --> 00:33:08,009

program which is related let me point

852

00:33:07,048 --> 00:33:10,589

out one thing that's actually

853

00:33:08,009 --> 00:33:12,058

interesting jinyang sure owed the images

854

00:33:10,589 --> 00:33:15,388

from march where it looked like there

855

00:33:12,058 --> 00:33:16,710

were two features possibly jets but we

856  
00:33:15,388 --> 00:33:18,658  
had well the light curve we have the

857  
00:33:16,710 --> 00:33:20,639  
variation of the comet over time looked

858  
00:33:18,659 --> 00:33:22,470  
absolutely flat you can see any and

859  
00:33:20,638 --> 00:33:24,359  
nuclei the comet nucleus is usually

860  
00:33:22,470 --> 00:33:26,308  
rotating tumbling possibly even

861  
00:33:24,359 --> 00:33:27,599  
and so we'd expect those features to

862  
00:33:26,308 --> 00:33:30,569  
come in and out and get brighter and

863  
00:33:27,599 --> 00:33:31,709  
dimmer we need to see any now we're

864  
00:33:30,569 --> 00:33:33,389  
getting seen hints from at least three

865  
00:33:31,710 --> 00:33:35,519  
different spacecraft of a huge amount of

866  
00:33:33,390 --> 00:33:37,679  
variability but we don't see any obvious

867  
00:33:35,519 --> 00:33:39,660  
jets just in a very quick first look

868  
00:33:37,679 --> 00:33:41,100  
we're going to dig deeper so it's

869  
00:33:39,660 --> 00:33:43,950  
actually counterintuitive this is a

870  
00:33:41,099 --> 00:33:46,759  
little confusing and exciting okay so

871  
00:33:43,950 --> 00:33:49,110  
the moment get back to the gas I'm also

872  
00:33:46,759 --> 00:33:50,640  
have observing time with the Chandra

873  
00:33:49,109 --> 00:33:52,859  
x-ray telescope another one of the

874  
00:33:50,640 --> 00:33:54,299  
masses great observatories so we were

875  
00:33:52,859 --> 00:33:57,990  
watching both Mars in the comet which

876  
00:33:54,298 --> 00:33:59,129  
are both known x-ray objects and then

877  
00:33:57,990 --> 00:34:00,569  
reason they're x-ray objects is they're

878  
00:33:59,130 --> 00:34:02,669  
immersed in the solar wind the solar

879  
00:34:00,569 --> 00:34:04,529  
wind comes along and grabs electrons

880  
00:34:02,669 --> 00:34:06,059  
from their neutral species and as they d

881  
00:34:04,529 --> 00:34:08,250  
excite they give off characteristic

882  
00:34:06,058 --> 00:34:09,659  
x-rays so we were interested to see

883  
00:34:08,250 --> 00:34:11,369  
whether Mars in the comet would possibly

884

00:34:09,659 --> 00:34:13,500  
flare when they came close to each other

885  
00:34:11,369 --> 00:34:15,780  
and so one of the reasons we were using

886  
00:34:13,500 --> 00:34:18,239  
Hubble was actually watch the gas coming

887  
00:34:15,780 --> 00:34:19,800  
off the comet and monitoring that and

888  
00:34:18,239 --> 00:34:22,439  
watching Mars to see whether there were

889  
00:34:19,800 --> 00:34:24,480  
any changes in Mars and as we've already

890  
00:34:22,440 --> 00:34:26,128  
pointed out we don't know yet I can tell

891  
00:34:24,480 --> 00:34:27,869  
you that from Chandra we have detected

892  
00:34:26,128 --> 00:34:29,519  
Mars in the x-ray we don't know if it's

893  
00:34:27,869 --> 00:34:30,990  
changed it all due to the Comets passage

894  
00:34:29,519 --> 00:34:32,159  
we're still working on the comment it

895  
00:34:30,989 --> 00:34:35,368  
looks like we have it but it's pretty

896  
00:34:32,159 --> 00:34:36,898  
faint hmmm so we're trying to overlap

897  
00:34:35,369 --> 00:34:38,519  
the two great observatories and having

898  
00:34:36,898 --> 00:34:41,009

them help each other out support each

899

00:34:38,519 --> 00:34:43,710

other so we're working on that so well

900

00:34:41,010 --> 00:34:45,470

well Casey's talking about Chandra Casey

901

00:34:43,710 --> 00:34:47,970

could you just elaborate even further

902

00:34:45,469 --> 00:34:50,459

john yang alluded to it earlier but this

903

00:34:47,969 --> 00:34:52,918

was quite a multi-mission campaign oh

904

00:34:50,460 --> 00:34:54,510

and Casey played a very you know

905

00:34:52,918 --> 00:34:56,398

critical role in sort of the

906

00:34:54,510 --> 00:34:58,230

coordination across several NASA

907

00:34:56,398 --> 00:35:00,809

missions obviously most of those

908

00:34:58,230 --> 00:35:03,358

missions are the orbiters and Rovers at

909

00:35:00,809 --> 00:35:05,460

Mars but Hubble wasn't the only

910

00:35:03,358 --> 00:35:07,590

earth-based telescopes or earth orbiting

911

00:35:05,460 --> 00:35:09,570

telescope so as quite a it was quite a

912

00:35:07,590 --> 00:35:10,950

campaign and Casey hosted a few



913

00:35:09,570 --> 00:35:12,920

workshops and I'll just let him

914

00:35:10,949 --> 00:35:15,480

elaborate it was you know an interesting

915

00:35:12,920 --> 00:35:19,200

collaboration effort thanks for the plug

916

00:35:15,480 --> 00:35:21,960

max okay so starting with comet Ison

917

00:35:19,199 --> 00:35:24,239

NASA's has helped engender a group

918

00:35:21,960 --> 00:35:26,070

called The Sea Hawk which is the comet

919

00:35:24,239 --> 00:35:28,108

investigative observing campaign and

920

00:35:26,070 --> 00:35:29,519

what we realized was that so many people

921

00:35:28,108 --> 00:35:32,639

different people from around the world

922

00:35:29,519 --> 00:35:34,500

study comments and different kinds of

923

00:35:32,639 --> 00:35:36,179

people study comets for comet Ison last

924

00:35:34,500 --> 00:35:38,170

year we need involved not only what I

925

00:35:36,179 --> 00:35:40,509

call comet ears the usual

926

00:35:38,170 --> 00:35:43,539

oh that is such a great term I'm gonna

927  
00:35:40,510 --> 00:35:45,809  
just whip off the terms here and margins

928  
00:35:43,539 --> 00:35:48,308  
and your Koreans and Solarians and

929  
00:35:45,809 --> 00:35:50,109  
Venetians people who have two different

930  
00:35:48,309 --> 00:35:52,359  
planets and run the spacecraft at the

931  
00:35:50,108 --> 00:35:55,029  
different planets that Ison traveled by

932  
00:35:52,358 --> 00:35:56,348  
and so we have to get them all talk of

933  
00:35:55,030 --> 00:35:58,030  
each other and we realized that

934  
00:35:56,349 --> 00:35:59,410  
workshops which are online if you

935  
00:35:58,030 --> 00:36:01,990  
actually want to see how scientists work

936  
00:35:59,409 --> 00:36:03,818  
and talk and discuss and jinyang is part

937  
00:36:01,989 --> 00:36:06,519  
of this see och and also he he and Max

938  
00:36:03,818 --> 00:36:08,019  
both participated most the workshops any

939  
00:36:06,519 --> 00:36:09,460  
we had to get people together last year

940  
00:36:08,019 --> 00:36:11,139  
so we did the same thing this year for

941

00:36:09,460 --> 00:36:14,289  
siding spring the difference in the

942  
00:36:11,139 --> 00:36:16,000  
signing spring was that while we have

943  
00:36:14,289 --> 00:36:17,500  
involved so many different spacecraft at

944  
00:36:16,000 --> 00:36:19,599  
different planets signing spring was

945  
00:36:17,500 --> 00:36:21,460  
just going to be big for Mars and was

946  
00:36:19,599 --> 00:36:23,140  
less important from the earth except for

947  
00:36:21,460 --> 00:36:24,880  
early on during detection in the first

948  
00:36:23,139 --> 00:36:27,578  
monitoring because this was really a

949  
00:36:24,880 --> 00:36:29,950  
Mars encounter if you will just as soon

950  
00:36:27,579 --> 00:36:31,298  
yang said again if you had a comment

951  
00:36:29,949 --> 00:36:32,798  
that was but one third additionally the

952  
00:36:31,298 --> 00:36:34,119  
earth and the moon coming to our system

953  
00:36:32,798 --> 00:36:35,559  
everybody would be outside everybody

954  
00:36:34,119 --> 00:36:37,900  
been many a telescope and that's pretty

955  
00:36:35,559 --> 00:36:40,059

much what we did the really cool thing I

956

00:36:37,900 --> 00:36:41,530

liked the bit of a historian to is to

957

00:36:40,059 --> 00:36:43,180

think about that if we were trying to do

958

00:36:41,530 --> 00:36:44,769

this 20 years ago or this comment game

959

00:36:43,179 --> 00:36:46,598

20 years ago we didn't wouldn't have

960

00:36:44,769 --> 00:36:48,309

outposts at Mars we couldn't have done

961

00:36:46,599 --> 00:36:49,990

this science you could have done Hubble

962

00:36:48,309 --> 00:36:51,760

we could have done maybe Chandra but we

963

00:36:49,989 --> 00:36:54,098

actually taken the first baby step so we

964

00:36:51,760 --> 00:36:56,140

actually have robotic telescopic outpost

965

00:36:54,099 --> 00:36:58,720

sitting around another planet oh yeah

966

00:36:56,139 --> 00:37:00,489

that took a savior of the comet frettin

967

00:36:58,719 --> 00:37:02,828

in the sky of that planet pretty cool I

968

00:37:00,489 --> 00:37:07,269

know I've seen them and while though the

969

00:37:02,829 --> 00:37:10,869

rover's in the cameras on these the

970  
00:37:07,269 --> 00:37:12,730  
planetside rovers aren't ideally suited

971  
00:37:10,869 --> 00:37:14,380  
for looking up at the sky they did

972  
00:37:12,730 --> 00:37:16,929  
manage to get a couple of pictures so it

973  
00:37:14,380 --> 00:37:18,068  
was nice so I'm almost done good well

974  
00:37:16,929 --> 00:37:19,808  
one of the things to remember with all

975  
00:37:18,068 --> 00:37:21,670  
the Mars assets is that they work

976  
00:37:19,809 --> 00:37:24,220  
they're used to looking at the ground of

977  
00:37:21,670 --> 00:37:25,599  
Mars it's the the buzz phrase I use is

978  
00:37:24,219 --> 00:37:27,039  
imagine if you took the goes weather

979  
00:37:25,599 --> 00:37:28,539  
satellite it takes your nightly weather

980  
00:37:27,039 --> 00:37:29,829  
picture and shows you the fronts moving

981  
00:37:28,539 --> 00:37:31,690  
across the u.s. and the hurricanes

982  
00:37:29,829 --> 00:37:33,010  
coming up from the Gulf and you turned

983  
00:37:31,690 --> 00:37:35,230  
it around and made it look at a faint

984

00:37:33,010 --> 00:37:37,510

galaxies or comet in the sky it's not

985

00:37:35,230 --> 00:37:38,949

used to doing that it's not doesn't have

986

00:37:37,510 --> 00:37:40,450

nests it wasn't built for that and you

987

00:37:38,949 --> 00:37:42,129

have to plan and prepare it and that's

988

00:37:40,449 --> 00:37:44,108

what all the Mars assets had to do it

989

00:37:42,130 --> 00:37:46,180

it's pretty amazing how they worked all

990

00:37:44,108 --> 00:37:48,009

right but to back up so comment campaign

991

00:37:46,179 --> 00:37:50,469

org if you want to know facts about both

992

00:37:48,010 --> 00:37:52,059

Ison and siding Springs we probably know

993

00:37:50,469 --> 00:37:54,129

out there what's been going on

994

00:37:52,059 --> 00:37:55,839

on the observing schedules we talked

995

00:37:54,130 --> 00:37:57,369

about we have lots of information also

996

00:37:55,838 --> 00:37:59,349

from the pro amateurs I'm going to talk

997

00:37:57,369 --> 00:38:01,838

about them in one second as well the

998

00:37:59,349 --> 00:38:03,818  
professionals and what if you have any

999  
00:38:01,838 --> 00:38:05,558  
interest from this also Mars JPL has a

1000  
00:38:03,818 --> 00:38:07,179  
lot of siding Springs information as

1001  
00:38:05,559 --> 00:38:08,829  
well so it's been actually really kind

1002  
00:38:07,179 --> 00:38:10,448  
of fun getting everybody together and

1003  
00:38:08,829 --> 00:38:11,739  
talking a different group it's also kind

1004  
00:38:10,449 --> 00:38:13,719  
of exhausting trying to get everybody

1005  
00:38:11,739 --> 00:38:15,880  
knowing who's talking to who and who

1006  
00:38:13,719 --> 00:38:17,438  
knows what I've learned a lot in the

1007  
00:38:15,880 --> 00:38:18,939  
last week if people want to ask more

1008  
00:38:17,438 --> 00:38:21,038  
about some of the results from various

1009  
00:38:18,938 --> 00:38:23,108  
missions and they're still still coming

1010  
00:38:21,039 --> 00:38:24,880  
in but let me relate to that the way

1011  
00:38:23,108 --> 00:38:26,558  
that I found out most of what was going

1012  
00:38:24,880 --> 00:38:27,729

on during the day the encounter because

1013

00:38:26,559 --> 00:38:29,170

I went outside at two thirty in the

1014

00:38:27,728 --> 00:38:30,489

afternoon on Sunday and was bright blue

1015

00:38:29,170 --> 00:38:32,769

sky and there's no way you could see

1016

00:38:30,489 --> 00:38:35,438

Mars a comment with while following the

1017

00:38:32,768 --> 00:38:36,968

pro amateurs we had people of telescopes

1018

00:38:35,438 --> 00:38:38,649

just interest in amateurs around the

1019

00:38:36,969 --> 00:38:40,778

planet the best steep probably on the

1020

00:38:38,650 --> 00:38:43,568

planet was South Africa and these guys

1021

00:38:40,778 --> 00:38:45,548

were posting near real time on Facebook

1022

00:38:43,568 --> 00:38:47,199

and was just fascinating to watch what

1023

00:38:45,548 --> 00:38:48,400

was going on so if you haven't seen any

1024

00:38:47,199 --> 00:38:50,199

your images you should go in Google

1025

00:38:48,400 --> 00:38:56,769

they're really pretty cool you agreed

1026

00:38:50,199 --> 00:38:58,659

yeah so okay so they would have a hangout



1027  
00:38:56,768 --> 00:39:01,328  
a question from Charles Bell who's

1028  
00:38:58,659 --> 00:39:03,248  
asking how do you define the extent of

1029  
00:39:01,329 --> 00:39:07,929  
the inner coma how do you define these

1030  
00:39:03,248 --> 00:39:11,588  
are their boundaries things like that do

1031  
00:39:07,929 --> 00:39:14,079  
you want to engine yang oh no we we

1032  
00:39:11,588 --> 00:39:16,449  
don't me with this the inner kalma coma

1033  
00:39:14,079 --> 00:39:18,309  
and outer coma day so just like broadly

1034  
00:39:16,449 --> 00:39:20,469  
defined terms well actually there's no

1035  
00:39:18,309 --> 00:39:23,199  
definition about them we just use them

1036  
00:39:20,469 --> 00:39:25,269  
you know as well as or as we say we have

1037  
00:39:23,199 --> 00:39:27,130  
only look at the very inner part of the

1038  
00:39:25,268 --> 00:39:29,588  
coma we said in a coma and there's no

1039  
00:39:27,130 --> 00:39:31,900  
boundary in it you know just nothing we

1040  
00:39:29,588 --> 00:39:34,208  
just uh it's just or you know we used to

1041  
00:39:31,900 --> 00:39:36,009  
talk about us we say something in large

1042  
00:39:34,208 --> 00:39:37,538  
scale out you know follow a relatively

1043  
00:39:36,009 --> 00:39:40,208  
further away from the nucleus we say out

1044  
00:39:37,539 --> 00:39:41,920  
of coma but you know that's it okay if

1045  
00:39:40,208 --> 00:39:43,868  
wanted to be if you want to make a

1046  
00:39:41,920 --> 00:39:46,269  
definition of the tightest ones I've

1047  
00:39:43,869 --> 00:39:48,039  
heard are the intercom is where the

1048  
00:39:46,268 --> 00:39:49,868  
density of the gas coming off of nucleus

1049  
00:39:48,039 --> 00:39:51,429  
is still large enough that you actually

1050  
00:39:49,869 --> 00:39:53,619  
have pressured you're in the collisional

1051  
00:39:51,429 --> 00:39:55,179  
regime will call it announced out of

1052  
00:39:53,619 --> 00:39:57,189  
that you get molecular flow some other

1053  
00:39:55,179 --> 00:39:58,749  
people might distinguish where you get a

1054  
00:39:57,188 --> 00:40:02,678  
lot of chemistry versus where you get

1055

00:39:58,748 --> 00:40:05,828  
very little chemistry in the coma okay

1056  
00:40:02,679 --> 00:40:07,809  
good I see here on the Q&A a pro quo

1057  
00:40:05,829 --> 00:40:10,410  
I want to just take you in from Michael

1058  
00:40:07,809 --> 00:40:14,819  
job and that Tony is a comment tater and

1059  
00:40:10,409 --> 00:40:18,788  
I like oh look at that comet tater all

1060  
00:40:14,818 --> 00:40:20,409  
right yeah I like I métier still too i

1061  
00:40:18,789 --> 00:40:24,869  
got i got to get a t-shirt that says

1062  
00:40:20,409 --> 00:40:27,458  
that so on twitter we have a tweet yes

1063  
00:40:24,869 --> 00:40:30,880  
yes i'm going to read the tweet it's

1064  
00:40:27,458 --> 00:40:33,909  
from vossen akkus andreas will nasa

1065  
00:40:30,880 --> 00:40:38,729  
consider to continue funding of siding

1066  
00:40:33,909 --> 00:40:41,288  
spring ennio survey after all that um I

1067  
00:40:38,728 --> 00:40:42,879  
don't know what that is continue funding

1068  
00:40:41,289 --> 00:40:46,269  
of siding spring and is there any o

1069  
00:40:42,880 --> 00:40:48,400

survey on siding spring maybe just means

1070

00:40:46,268 --> 00:40:51,038

any o survey there's any other surveys

1071

00:40:48,400 --> 00:40:52,869

from Catalina from the meat uh there's

1072

00:40:51,039 --> 00:40:55,239

one there's one other one I'm blanking

1073

00:40:52,869 --> 00:40:56,709

on low Neos there's a few but I don't

1074

00:40:55,239 --> 00:40:59,380

know whether we're paying for sightings

1075

00:40:56,708 --> 00:41:02,228

friends okay oh I of course of course

1076

00:40:59,380 --> 00:41:03,400

here says yes oh ok yeah much I don't

1077

00:41:02,228 --> 00:41:04,899

know the answer to that question either

1078

00:41:03,400 --> 00:41:07,239

do you happen to anybody else Carol you

1079

00:41:04,900 --> 00:41:10,119

got any idea no I don't think I don't

1080

00:41:07,239 --> 00:41:12,099

think NASA is paying for any campaign

1081

00:41:10,119 --> 00:41:15,969

other than the observations that are

1082

00:41:12,099 --> 00:41:19,180

being described here ok ok I mean the I

1083

00:41:15,969 --> 00:41:21,400

do is really to look at stuff that might

1084  
00:41:19,179 --> 00:41:25,538  
come hit us so we know it's not going to

1085  
00:41:21,400 --> 00:41:28,088  
hit it so according to the criteria it's

1086  
00:41:25,539 --> 00:41:31,119  
not of interest yeah if it's not an

1087  
00:41:28,088 --> 00:41:33,449  
object at coming here earth and out and

1088  
00:41:31,119 --> 00:41:36,818  
it's not a near-earth object look next

1089  
00:41:33,449 --> 00:41:38,559  
yes Chelyabinsk is the one that got

1090  
00:41:36,818 --> 00:41:39,759  
everybody motivated to keep looking for

1091  
00:41:38,559 --> 00:41:42,969  
things that would hit the earth yeah

1092  
00:41:39,759 --> 00:41:45,278  
that was a wake-up call ok hello I

1093  
00:41:42,969 --> 00:41:48,219  
remember being woken up to cover that

1094  
00:41:45,278 --> 00:41:50,289  
and then the next few days afterwards

1095  
00:41:48,219 --> 00:41:53,650  
everyone seeing things in the sky like

1096  
00:41:50,289 --> 00:41:56,528  
that could hear all looking up exactly I

1097  
00:41:53,650 --> 00:41:59,588  
said what was that you know everybody's

1098  
00:41:56,528 --> 00:42:01,778  
that happens every day I was just

1099  
00:41:59,588 --> 00:42:05,978  
impressed by all those those webcams on

1100  
00:42:01,778 --> 00:42:08,349  
dashboards a man so dead dragon flame is

1101  
00:42:05,978 --> 00:42:10,149  
saying commenting thank you for the

1102  
00:42:08,349 --> 00:42:12,338  
explanation of the intended focal length

1103  
00:42:10,150 --> 00:42:14,650  
of the rover cameras as we pointed out

1104  
00:42:12,338 --> 00:42:16,179  
the cameras were designed for looking at

1105  
00:42:14,650 --> 00:42:18,369  
bright things on the ground not

1106  
00:42:16,179 --> 00:42:19,199  
necessarily dim things up in space but

1107  
00:42:18,369 --> 00:42:20,910  
they've

1108  
00:42:19,199 --> 00:42:22,169  
turn them up there and saw some stuff so

1109  
00:42:20,909 --> 00:42:24,719  
these are very versatile things what do

1110  
00:42:22,170 --> 00:42:26,960  
you think the chances are of us ever

1111  
00:42:24,719 --> 00:42:28,889  
putting some kind of ground-based

1112

00:42:26,960 --> 00:42:30,780  
telescope on another planet make a

1113  
00:42:28,889 --> 00:42:32,750  
robotic telescope designed specifically

1114  
00:42:30,780 --> 00:42:35,160  
for looking is there any scientific

1115  
00:42:32,750 --> 00:42:37,588  
usefulness to that or is it just another

1116  
00:42:35,159 --> 00:42:39,569  
being on another vantage point doesn't

1117  
00:42:37,588 --> 00:42:41,369  
really give us much folks have talked

1118  
00:42:39,570 --> 00:42:43,680  
for a long time by putting a telescope

1119  
00:42:41,369 --> 00:42:45,390  
on the far side of the moon yeah the

1120  
00:42:43,679 --> 00:42:47,250  
radio telescope in the first of the moon

1121  
00:42:45,389 --> 00:42:49,348  
is of one thing I've really heard mainly

1122  
00:42:47,250 --> 00:42:51,510  
from my radius run were friends today

1123  
00:42:49,349 --> 00:42:53,010  
economy UV astronomy good you have to

1124  
00:42:51,510 --> 00:42:54,720  
remember it cause it's gonna cost a lot

1125  
00:42:53,010 --> 00:42:57,630  
of money to put it there so you have to

1126  
00:42:54,719 --> 00:42:58,889

show that it's um nope nope because

1127

00:42:57,630 --> 00:43:02,880

we've got printers now we'd already

1128

00:42:58,889 --> 00:43:07,019

covered that we're just going on now you

1129

00:43:02,880 --> 00:43:08,670

solve that problem using Bigelow 25 in

1130

00:43:07,019 --> 00:43:11,730

here last week you just solved with

1131

00:43:08,670 --> 00:43:13,289

great well yeah you don't know how many

1132

00:43:11,730 --> 00:43:15,809

mysteries of the universe get solved in

1133

00:43:13,289 --> 00:43:19,139

these hand i created a cold fusion five

1134

00:43:15,809 --> 00:43:20,789

minutes ago so you're set energy that's

1135

00:43:19,139 --> 00:43:24,179

next week's hang out right there are so

1136

00:43:20,789 --> 00:43:26,190

see okay I mean I think people have been

1137

00:43:24,179 --> 00:43:27,929

talking about that for years I remember

1138

00:43:26,190 --> 00:43:29,760

the first proposal like I don't know 15

1139

00:43:27,929 --> 00:43:31,440

years ago and I think it's clear that

1140

00:43:29,760 --> 00:43:33,390

they've fallen out of favor that you



1141  
00:43:31,440 --> 00:43:35,068  
know having a telescope sitting on the

1142  
00:43:33,389 --> 00:43:36,318  
moon some on the far side of the Moon

1143  
00:43:35,068 --> 00:43:39,059  
might initially sound like a good idea

1144  
00:43:36,318 --> 00:43:41,190  
but you know you have moonquakes you

1145  
00:43:39,059 --> 00:43:43,349  
have moon dust you have who knows what

1146  
00:43:41,190 --> 00:43:48,780  
else that you don't have when you're

1147  
00:43:43,349 --> 00:43:50,280  
saying I yeah you know so you don't you

1148  
00:43:48,780 --> 00:43:52,019  
know it's not that it's not the best

1149  
00:43:50,280 --> 00:43:55,500  
environment to put a telescope in

1150  
00:43:52,019 --> 00:43:56,608  
whereas you know in orbit or at the l2

1151  
00:43:55,500 --> 00:43:58,619  
point where the James Webb Space

1152  
00:43:56,608 --> 00:44:00,150  
Telescope is going to go you know you

1153  
00:43:58,619 --> 00:44:02,309  
don't have quakes and you don't have

1154  
00:44:00,150 --> 00:44:04,530  
dust and you don't have you know so

1155  
00:44:02,309 --> 00:44:06,389  
there's you know it's it's not the most

1156  
00:44:04,530 --> 00:44:08,940  
ideal place to put something you know

1157  
00:44:06,389 --> 00:44:12,179  
you know something in orbit or in a

1158  
00:44:08,940 --> 00:44:14,338  
stable orbit like I2 is in a much less

1159  
00:44:12,179 --> 00:44:16,500  
complicated environment in terms of a

1160  
00:44:14,338 --> 00:44:18,690  
lot of hazards as well you need an

1161  
00:44:16,500 --> 00:44:23,670  
additional infrastructure to get the

1162  
00:44:18,690 --> 00:44:25,349  
data back orbiting or low you know

1163  
00:44:23,670 --> 00:44:27,889  
infrastructure on the surface of the

1164  
00:44:25,349 --> 00:44:31,030  
moon to transmit so that it can transmit

1165  
00:44:27,889 --> 00:44:34,299  
bacteria would be equipped to do that

1166  
00:44:31,030 --> 00:44:36,070  
lunar reconnaissance orbiter oh yeah

1167  
00:44:34,300 --> 00:44:38,200  
Hubble's been going for 25 years and

1168  
00:44:36,070 --> 00:44:40,090  
it's still one of the if not the premier

1169

00:44:38,199 --> 00:44:41,919  
reserve optical observing telescope

1170  
00:44:40,090 --> 00:44:45,519  
observatory that's pretty impressive run

1171  
00:44:41,920 --> 00:44:52,079  
yeah yep that is basically five more

1172  
00:44:45,519 --> 00:44:55,119  
years oh no yeah go to be funny I think

1173  
00:44:52,079 --> 00:44:57,429  
honestly as far as the having something

1174  
00:44:55,119 --> 00:44:59,799  
on the moon I think many things would

1175  
00:44:57,429 --> 00:45:01,329  
have to be put on the place is first we

1176  
00:44:59,800 --> 00:45:03,400  
would have to have another solid

1177  
00:45:01,329 --> 00:45:05,679  
presence on the moon for sustained

1178  
00:45:03,400 --> 00:45:09,250  
period of time before we could ever

1179  
00:45:05,679 --> 00:45:11,679  
think about building or landing

1180  
00:45:09,250 --> 00:45:15,250  
something on there for four observations

1181  
00:45:11,679 --> 00:45:18,609  
but we haven't been back to the moon at

1182  
00:45:15,250 --> 00:45:20,139  
least the United States hasn't but you

1183  
00:45:18,610 --> 00:45:21,400

have to kind of be there for a bit to be

1184

00:45:20,139 --> 00:45:23,980

able to do something like that and I

1185

00:45:21,400 --> 00:45:26,170

think we're far more interest with Mars

1186

00:45:23,980 --> 00:45:30,340

right now than putting something on the

1187

00:45:26,170 --> 00:45:32,440

moon that's my personal take on it from

1188

00:45:30,340 --> 00:45:34,660

I can't even pronounce this one I have

1189

00:45:32,440 --> 00:45:36,610

I'm sorry I can't projec abbr something

1190

00:45:34,659 --> 00:45:40,049

um it's got a lot of characters in there

1191

00:45:36,610 --> 00:45:42,250

boom well yeah coupe yep guccione Yakub

1192

00:45:40,050 --> 00:45:44,410

okay thank you for helping me there I'm

1193

00:45:42,250 --> 00:45:46,119

sorry if I'm butchering the name the

1194

00:45:44,409 --> 00:45:48,159

nucleus of his commenting and a gala

1195

00:45:46,119 --> 00:45:49,449

question at the end the nucleus of comet

1196

00:45:48,159 --> 00:45:51,699

siding spring was smaller than

1197

00:45:49,449 --> 00:45:53,710

originally expected I found old mass

1198  
00:45:51,699 --> 00:45:56,799  
estimate of comet hale-bopp nucleus and

1199  
00:45:53,710 --> 00:45:59,470  
it leads to nucleus with sighs max of 10

1200  
00:45:56,800 --> 00:46:02,620  
kilometers is it possible that our

1201  
00:45:59,469 --> 00:46:08,289  
previous estimates of nucleus sizes are

1202  
00:46:02,619 --> 00:46:10,329  
overvalued one of the questions I have

1203  
00:46:08,289 --> 00:46:12,759  
ended in your tent sighs max of 10

1204  
00:46:10,329 --> 00:46:14,799  
kilometers what density was used that

1205  
00:46:12,760 --> 00:46:16,750  
were honestly the density of comms

1206  
00:46:14,800 --> 00:46:18,760  
uncertain a different way putting is

1207  
00:46:16,750 --> 00:46:22,690  
that from what our results from deep

1208  
00:46:18,760 --> 00:46:23,980  
impact and an extra comet tempel 1 and I

1209  
00:46:22,690 --> 00:46:25,720  
think hopefully from Rosetta will hear

1210  
00:46:23,980 --> 00:46:28,059  
soon is that comets are incredibly

1211  
00:46:25,719 --> 00:46:31,149  
undhan stairs leave a cue seventy eighty

1212  
00:46:28,059 --> 00:46:32,500  
percent porous so if you take that mass

1213  
00:46:31,150 --> 00:46:34,329  
and you know allow for the fact that a

1214  
00:46:32,500 --> 00:46:36,400  
lot of its empty space you're actually

1215  
00:46:34,329 --> 00:46:39,549  
going to get a smaller nucleus size than

1216  
00:46:36,400 --> 00:46:41,410  
what we think we found from imaging and

1217  
00:46:39,550 --> 00:46:43,240  
the numbers I heard for hale-bopp or

1218  
00:46:41,409 --> 00:46:44,858  
somewhere between 25 and 50 kilometers

1219  
00:46:43,239 --> 00:46:46,179  
radius but how

1220  
00:46:44,858 --> 00:46:48,489  
over on the other hand it is true that

1221  
00:46:46,179 --> 00:46:49,690  
usually we think we the same way that

1222  
00:46:48,489 --> 00:46:51,309  
when we first see a comet we're not

1223  
00:46:49,690 --> 00:46:53,380  
sure if it could hit anything us the

1224  
00:46:51,309 --> 00:46:54,789  
moon Mars the first time you just see

1225  
00:46:53,380 --> 00:46:57,068  
these things quickly they have a very

1226

00:46:54,789 --> 00:46:58,690  
large error lips usually when we see

1227  
00:46:57,068 --> 00:47:00,518  
them we usually err on the side of how

1228  
00:46:58,690 --> 00:47:02,858  
big they're bigger than they eventually

1229  
00:47:00,518 --> 00:47:03,969  
we Whittle them down a bit so i don't

1230  
00:47:02,858 --> 00:47:07,989  
think the sense of this question is

1231  
00:47:03,969 --> 00:47:09,998  
wrong ok so the these these uh almost

1232  
00:47:07,989 --> 00:47:11,849  
all comments are sort of like you say

1233  
00:47:09,998 --> 00:47:15,699  
loosely packed together kind of fuzzy

1234  
00:47:11,849 --> 00:47:17,829  
fuzzy and and a lot of these things or

1235  
00:47:15,699 --> 00:47:19,268  
don't have well-defined properties of

1236  
00:47:17,829 --> 00:47:20,769  
the boundaries of a lot of the

1237  
00:47:19,268 --> 00:47:24,639  
characteristics these comments it sounds

1238  
00:47:20,768 --> 00:47:26,919  
like but the how would you characterize

1239  
00:47:24,639 --> 00:47:28,838  
the advancement of common knowledge over

1240  
00:47:26,920 --> 00:47:32,108

I don't know say that say since Hubble's

1241  
00:47:28,838 --> 00:47:33,278  
been up Oh incredible but to get back to

1242  
00:47:32,108 --> 00:47:35,469  
your previous point just really quickly

1243  
00:47:33,278 --> 00:47:37,509  
o magic comments were not assembled in a

1244  
00:47:35,469 --> 00:47:39,699  
factory they're just basically the loose

1245  
00:47:37,509 --> 00:47:41,440  
assemblage dust and gas the first things

1246  
00:47:39,699 --> 00:47:43,268  
that coagulated out of what we call the

1247  
00:47:41,440 --> 00:47:45,700  
protoplanetary disc the disc material

1248  
00:47:43,268 --> 00:47:47,828  
left around the protosun as the Sun was

1249  
00:47:45,699 --> 00:47:49,778  
forming and is there the disc was the

1250  
00:47:47,829 --> 00:47:53,140  
leftovers the stuff that hadn't fallen

1251  
00:47:49,778 --> 00:47:54,548  
into the middle of the cloud yet because

1252  
00:47:53,139 --> 00:47:55,778  
it was spinning around the middle of the

1253  
00:47:54,548 --> 00:47:58,179  
cloud there's a net angular momentum

1254  
00:47:55,778 --> 00:47:59,409  
anyway long story short is the same way



1255  
00:47:58,179 --> 00:48:00,969  
that if you just take your hand and kind

1256  
00:47:59,409 --> 00:48:02,528  
of loosely drag it through a snowbank

1257  
00:48:00,969 --> 00:48:04,268  
just to kind of push together and try to

1258  
00:48:02,528 --> 00:48:06,219  
make up your first attempt at a snowball

1259  
00:48:04,268 --> 00:48:07,598  
that's kind of what comments are it's

1260  
00:48:06,219 --> 00:48:09,219  
why they're kind of loose and porous and

1261  
00:48:07,599 --> 00:48:10,720  
they're very weak you stand on the

1262  
00:48:09,219 --> 00:48:12,399  
surface of one you probably weigh a gram

1263  
00:48:10,719 --> 00:48:14,288  
or two we think they have the strength

1264  
00:48:12,400 --> 00:48:15,849  
of like meringue or air talcum powder

1265  
00:48:14,289 --> 00:48:18,130  
literally could burrow even though

1266  
00:48:15,849 --> 00:48:19,269  
they're kilometers plumb in width you

1267  
00:48:18,130 --> 00:48:20,858  
could literally just burrow right

1268  
00:48:19,268 --> 00:48:22,538  
through them and it's also why they're

1269  
00:48:20,858 --> 00:48:23,710  
not very stable unless they're in deep

1270  
00:48:22,539 --> 00:48:24,999  
freeze if they come anywhere near a

1271  
00:48:23,710 --> 00:48:26,588  
planet or they come near the Sun they

1272  
00:48:24,998 --> 00:48:29,108  
just start boiling burbling that their

1273  
00:48:26,588 --> 00:48:31,239  
time is done but they were again

1274  
00:48:29,108 --> 00:48:32,980  
assembled very loosely and it's when

1275  
00:48:31,239 --> 00:48:34,028  
they came together in call you notice

1276  
00:48:32,980 --> 00:48:35,349  
that you started piling all the

1277  
00:48:34,028 --> 00:48:36,548  
snowballs together that's when you made

1278  
00:48:35,349 --> 00:48:37,960  
and you had to make billions of these

1279  
00:48:36,548 --> 00:48:39,940  
piles together that's when they made the

1280  
00:48:37,960 --> 00:48:41,139  
giant planets and they were so massive

1281  
00:48:39,940 --> 00:48:42,548  
at that point they started collapsing

1282  
00:48:41,139 --> 00:48:44,288  
each other and started changing and

1283

00:48:42,548 --> 00:48:46,088  
eating themselves up and turning into

1284  
00:48:44,289 --> 00:48:49,180  
the planetary material we see that so

1285  
00:48:46,088 --> 00:48:50,768  
the comments are the raw material so

1286  
00:48:49,179 --> 00:48:52,210  
anyway I went on a little bit sorry

1287  
00:48:50,768 --> 00:48:53,889  
about that so that's why they are loose

1288  
00:48:52,210 --> 00:48:55,659  
and fuzzy and weird and crazy and in

1289  
00:48:53,889 --> 00:48:57,368  
terms of what we've learned since Hubble

1290  
00:48:55,659 --> 00:48:58,279  
went up frankly the Rosetta is

1291  
00:48:57,369 --> 00:48:59,960  
absolutely revelry

1292  
00:48:58,280 --> 00:49:01,370  
we've never gone in orbit or trying to

1293  
00:48:59,960 --> 00:49:02,809  
land on the comment you're gonna see

1294  
00:49:01,369 --> 00:49:04,250  
incredible things in the next year from

1295  
00:49:02,809 --> 00:49:06,110  
that tell it tell us about it tell us

1296  
00:49:04,250 --> 00:49:08,599  
about that real quick yes also we just

1297  
00:49:06,110 --> 00:49:11,360

we just imaged the first or comment from

1298

00:49:08,599 --> 00:49:13,670

from with siding spring Rosetta is going

1299

00:49:11,360 --> 00:49:15,110

is actually living in the environment we

1300

00:49:13,670 --> 00:49:16,159

haven't heard a lot from the project

1301

00:49:15,110 --> 00:49:18,050

they're putting together their papers

1302

00:49:16,159 --> 00:49:19,429

now but you've got a mission that has

1303

00:49:18,050 --> 00:49:21,080

now I think they're within six

1304

00:49:19,429 --> 00:49:22,909

kilometers in the center of the nucleus

1305

00:49:21,079 --> 00:49:25,159

there they're literally hovering right

1306

00:49:22,909 --> 00:49:26,539

near it they're feeling Nick the dust

1307

00:49:25,159 --> 00:49:27,920

that's coming out of this comet if

1308

00:49:26,539 --> 00:49:29,329

you've been looking at a pot the

1309

00:49:27,920 --> 00:49:31,490

electronic pictures of the day they have

1310

00:49:29,329 --> 00:49:33,079

incredible images we've only had fast

1311

00:49:31,489 --> 00:49:35,839

flybys before they're actually seen

1312  
00:49:33,079 --> 00:49:38,900  
flows and boulders and scarps and what

1313  
00:49:35,840 --> 00:49:40,970  
looks like mass wasting and land falls

1314  
00:49:38,900 --> 00:49:43,970  
and all kinds of structures and also

1315  
00:49:40,969 --> 00:49:45,289  
sharp edges they see craters and overall

1316  
00:49:43,969 --> 00:49:47,719  
everybody's heard about the rubber ducky

1317  
00:49:45,289 --> 00:49:50,029  
it looks like this two pieces stuck

1318  
00:49:47,719 --> 00:49:51,919  
together and one of the real questions

1319  
00:49:50,030 --> 00:49:55,370  
we've had since the fast flybys was our

1320  
00:49:51,920 --> 00:49:56,659  
comets one big kind of rough snowball as

1321  
00:49:55,369 --> 00:49:57,710  
I mentioned before that have been eaten

1322  
00:49:56,659 --> 00:50:00,079  
away at the center because they've been

1323  
00:49:57,710 --> 00:50:01,970  
spinning if you took the earth and you

1324  
00:50:00,079 --> 00:50:03,409  
made it out of ice the we all know the

1325  
00:50:01,969 --> 00:50:04,609  
earth is hottest at the equator and if

1326  
00:50:03,409 --> 00:50:05,839  
you let it just spend for four and a

1327  
00:50:04,610 --> 00:50:07,099  
half billion years it eventually eat

1328  
00:50:05,840 --> 00:50:09,470  
away the equator and you leave the poles

1329  
00:50:07,099 --> 00:50:11,719  
so you kind of have to kind of pipe to

1330  
00:50:09,469 --> 00:50:13,309  
loathe the other possibilities you just

1331  
00:50:11,719 --> 00:50:14,689  
kind of stuck some pieces together the

1332  
00:50:13,309 --> 00:50:17,299  
early part of the solar system and

1333  
00:50:14,690 --> 00:50:18,740  
they've been stuck together forever so

1334  
00:50:17,300 --> 00:50:20,180  
we've been wondering about that the

1335  
00:50:18,739 --> 00:50:21,619  
rubber duckies pretty hard to believe

1336  
00:50:20,179 --> 00:50:24,109  
that it started out as a spear you just

1337  
00:50:21,619 --> 00:50:26,150  
need away the middle though well I think

1338  
00:50:24,110 --> 00:50:28,190  
already Rosetta by just getting to that

1339  
00:50:26,150 --> 00:50:29,900  
comment has revolutionized what we think

1340

00:50:28,190 --> 00:50:33,950  
of how these things are put together and

1341  
00:50:29,900 --> 00:50:36,019  
then Bert and Ernie showed up and well

1342  
00:50:33,949 --> 00:50:36,980  
the other thing also when I was a kid we

1343  
00:50:36,019 --> 00:50:38,389  
weren't sure where the comments were

1344  
00:50:36,980 --> 00:50:40,130  
flying snow banks or whether they were

1345  
00:50:38,389 --> 00:50:41,299  
actually at a solid nucleus we've

1346  
00:50:40,130 --> 00:50:42,650  
learned that they're solid and they're

1347  
00:50:41,300 --> 00:50:46,010  
pretty much you know dirty the dirty

1348  
00:50:42,650 --> 00:50:48,110  
snowball you ever through as a kid we're

1349  
00:50:46,010 --> 00:50:50,420  
learning that again the Kuiper belt me

1350  
00:50:48,110 --> 00:50:51,829  
Oort cloud we're really just being found

1351  
00:50:50,420 --> 00:50:53,510  
when I was young and getting into the

1352  
00:50:51,829 --> 00:50:55,190  
business now we're you know we're sure

1353  
00:50:53,510 --> 00:50:58,310  
that they're there so that's pretty

1354  
00:50:55,190 --> 00:51:00,769

revolutionary another thing is Casey

1355

00:50:58,309 --> 00:51:04,759

when you were young they had records and

1356

00:51:00,769 --> 00:51:07,550

so what's your record in it now Mike

1357

00:51:04,760 --> 00:51:10,570

ever let a record is but it's kind of

1358

00:51:07,550 --> 00:51:19,519

like a CD or a DVD

1359

00:51:10,570 --> 00:51:20,480

even LLC one of them yeah yeah now the

1360

00:51:19,519 --> 00:51:21,829

other thing I would say that's pretty

1361

00:51:20,480 --> 00:51:23,480

cool is it looks like we're learning

1362

00:51:21,829 --> 00:51:26,000

more and more as the carbon dioxide

1363

00:51:23,480 --> 00:51:27,530

looks like it's the major carbon bearing

1364

00:51:26,000 --> 00:51:28,849

molecule in comets which is a little

1365

00:51:27,530 --> 00:51:31,430

surprising we always these fingers

1366

00:51:28,849 --> 00:51:33,019

carbon monoxide and why is this

1367

00:51:31,429 --> 00:51:35,480

important well it's a more complicated

1368

00:51:33,019 --> 00:51:37,099

molecule people have done surveys of the



1369  
00:51:35,480 --> 00:51:38,750  
galaxy and the cosmos and carbon

1370  
00:51:37,099 --> 00:51:40,369  
monoxide but nobody's looked for carbon

1371  
00:51:38,750 --> 00:51:41,599  
dioxide is being the kind of the

1372  
00:51:40,369 --> 00:51:43,159  
molecule everywhere that you build

1373  
00:51:41,599 --> 00:51:44,690  
things out of and there's a reason for

1374  
00:51:43,159 --> 00:51:46,429  
that you can't do it from the bottom of

1375  
00:51:44,690 --> 00:51:48,349  
our atmosphere from instant because

1376  
00:51:46,429 --> 00:51:49,849  
their co2 in the air because our so much

1377  
00:51:48,349 --> 00:51:51,319  
so one of the things they learn from

1378  
00:51:49,849 --> 00:51:52,880  
comets over and over again as we found

1379  
00:51:51,320 --> 00:51:54,470  
the solar wind because of common ion

1380  
00:51:52,880 --> 00:51:56,000  
tails maybe now we're learning because

1381  
00:51:54,469 --> 00:51:57,639  
of carbon dioxide and comets it's time

1382  
00:51:56,000 --> 00:51:59,690  
to go look for that all over the galaxy

1383  
00:51:57,639 --> 00:52:01,969  
kind of cool to look kind of come keep

1384  
00:51:59,690 --> 00:52:03,440  
coming back to these dinosaur bones of

1385  
00:52:01,969 --> 00:52:06,049  
solar system formation see what they can

1386  
00:52:03,440 --> 00:52:09,740  
teach us yes here's that selfie of

1387  
00:52:06,050 --> 00:52:11,090  
Rosetta and is Lord it set this is from

1388  
00:52:09,739 --> 00:52:14,119  
a pod as your as you were mentioning

1389  
00:52:11,090 --> 00:52:16,430  
before and yeah so Rosetta's taking a

1390  
00:52:14,119 --> 00:52:19,130  
selfie and you can see the comment up

1391  
00:52:16,429 --> 00:52:21,289  
there I just it's that's amazing I don't

1392  
00:52:19,130 --> 00:52:23,690  
matter you get the a pod from two days

1393  
00:52:21,289 --> 00:52:25,130  
ago they had high resolution images of

1394  
00:52:23,690 --> 00:52:27,050  
the surface it's just absolutely

1395  
00:52:25,130 --> 00:52:30,019  
gorgeous yep I'll pull it up real quick

1396  
00:52:27,050 --> 00:52:31,550  
right possibly so we were showing us

1397

00:52:30,019 --> 00:52:34,190  
before was the lander which is going to

1398  
00:52:31,550 --> 00:52:36,800  
be ejected from the mothership which

1399  
00:52:34,190 --> 00:52:38,599  
looks like a Borg cube yes I said it on

1400  
00:52:36,800 --> 00:52:40,580  
the 12 but it's going to take about

1401  
00:52:38,599 --> 00:52:42,319  
seven or eight hours to try and land on

1402  
00:52:40,579 --> 00:52:45,319  
the surface the head of the rubber ducky

1403  
00:52:42,320 --> 00:52:48,820  
the flat part of the head there's that

1404  
00:52:45,320 --> 00:52:48,820  
szabo again photobombing you Scott

1405  
00:52:49,960 --> 00:52:54,289  
doctors hey we're getting ready for

1406  
00:52:51,739 --> 00:52:57,919  
doing in the clips outreach here at

1407  
00:52:54,289 --> 00:52:59,480  
suria anything prepped I mr. a shuttle

1408  
00:52:57,920 --> 00:53:01,280  
mission to fix those he does not need a

1409  
00:52:59,480 --> 00:53:06,740  
shuttle mission too big though should

1410  
00:53:01,280 --> 00:53:08,090  
get one anyway so what are you so I have

1411  
00:53:06,739 --> 00:53:10,250

a comment here from dead dragon flame

1412

00:53:08,090 --> 00:53:13,039

again he's is it possible that comets

1413

00:53:10,250 --> 00:53:15,230

don't actually out gas but rather the

1414

00:53:13,039 --> 00:53:17,659

movement through the through the ether

1415

00:53:15,230 --> 00:53:19,760

causes an organization into plasma that

1416

00:53:17,659 --> 00:53:22,159

actually manufacturers material instead

1417

00:53:19,760 --> 00:53:24,170

I don't understand that question

1418

00:53:22,159 --> 00:53:27,858

actually there's no luminiferous

1419

00:53:24,170 --> 00:53:29,900

ether or not may I see the ether thing

1420

00:53:27,858 --> 00:53:33,798

in here i don't i don't think we yeah

1421

00:53:29,900 --> 00:53:36,260

there's no easel no no ether alright

1422

00:53:33,798 --> 00:53:38,568

guys well um i guess i'm trying to think

1423

00:53:36,260 --> 00:53:41,420

it while scott i know you're looking for

1424

00:53:38,568 --> 00:53:44,480

the ipod i'm i'm not seeing one from two

1425

00:53:41,420 --> 00:53:46,670

days ago with that but they're there i

1426  
00:53:44,480 --> 00:53:49,250  
will say that on an ipod there is the

1427  
00:53:46,670 --> 00:53:55,309  
nice picture of Mars on the comment

1428  
00:53:49,250 --> 00:54:00,559  
couple days back well go that you got

1429  
00:53:55,309 --> 00:54:03,109  
that I'm I'm pulling it up yeah well in

1430  
00:54:00,559 --> 00:54:05,480  
a million comments so Zolt is there

1431  
00:54:03,108 --> 00:54:07,130  
anything that you had that we had that

1432  
00:54:05,480 --> 00:54:08,690  
you wanted to show that we haven't

1433  
00:54:07,130 --> 00:54:10,760  
talked about yet or did we get to the

1434  
00:54:08,690 --> 00:54:12,650  
main images that we'd that Hubble had I

1435  
00:54:10,760 --> 00:54:15,890  
can show the image of the mars that we

1436  
00:54:12,650 --> 00:54:18,139  
got because the one on the in that

1437  
00:54:15,889 --> 00:54:23,690  
illustration is so teeny tiny that you

1438  
00:54:18,139 --> 00:54:26,328  
can't really appreciate and as as

1439  
00:54:23,690 --> 00:54:30,079  
someone mentioned i think that earful

1440  
00:54:26,329 --> 00:54:32,720  
our image of Mars is a little fuzzier

1441  
00:54:30,079 --> 00:54:36,170  
than some of the earlier images of Mars

1442  
00:54:32,719 --> 00:54:39,409  
that we've seen from mobile yeah but

1443  
00:54:36,170 --> 00:54:41,838  
it's not as it's not as close as it gets

1444  
00:54:39,409 --> 00:54:43,159  
to us so those numbers in the upper left

1445  
00:54:41,838 --> 00:54:45,380  
those are the filters that were used on

1446  
00:54:43,159 --> 00:54:48,048  
level names of the filters there's a

1447  
00:54:45,380 --> 00:54:50,480  
blue filter and a red filter that were

1448  
00:54:48,048 --> 00:54:54,559  
combined to make the color image the

1449  
00:54:50,480 --> 00:54:57,338  
fuzziness due to dust I don't I don't

1450  
00:54:54,559 --> 00:55:02,329  
know I don't know somebody said that

1451  
00:54:57,338 --> 00:55:04,250  
results Instagram filter city and also

1452  
00:55:02,329 --> 00:55:06,410  
as you pointed out it's much further

1453  
00:55:04,250 --> 00:55:08,480  
away than when we take you know we take

1454

00:55:06,409 --> 00:55:11,029  
optimum pictures of Mars when it's much

1455  
00:55:08,480 --> 00:55:13,730  
closer so we have more pixels across the

1456  
00:55:11,030 --> 00:55:15,589  
image is only 140 for ya those across

1457  
00:55:13,730 --> 00:55:17,358  
the image the reason i asked about the

1458  
00:55:15,588 --> 00:55:19,940  
dust is this is the dust season I

1459  
00:55:17,358 --> 00:55:21,858  
understand us to instill i was told an

1460  
00:55:19,940 --> 00:55:23,329  
opportunity actually had a dust storm to

1461  
00:55:21,858 --> 00:55:25,578  
its West when it took the picture of the

1462  
00:55:23,329 --> 00:55:27,769  
comment moscato interesting so well it

1463  
00:55:25,579 --> 00:55:30,890  
could be part of the reason it's looks

1464  
00:55:27,769 --> 00:55:32,480  
more obscure than usual now the

1465  
00:55:30,889 --> 00:55:33,650  
interesting thing about opportunity

1466  
00:55:32,480 --> 00:55:34,880  
probably everybody's heard about it we

1467  
00:55:33,650 --> 00:55:37,670  
haven't heard anything from curiosity

1468  
00:55:34,880 --> 00:55:40,338

yet and curiosities you know got that

1469

00:55:37,670 --> 00:55:42,289

the plutonium-powered ability to look at

1470

00:55:40,338 --> 00:55:45,199

night and I think they were actually

1471

00:55:42,289 --> 00:55:46,750

going into the nightfall opportunity was

1472

00:55:45,199 --> 00:55:49,098

coming into daylight when when

1473

00:55:46,750 --> 00:55:50,449

observations were taken so I'm very

1474

00:55:49,099 --> 00:55:52,010

curious to see if they found anything

1475

00:55:50,449 --> 00:55:52,789

haven't read that like you said that

1476

00:55:52,010 --> 00:55:54,829

like it was a superpower

1477

00:55:52,789 --> 00:55:59,480

plutonium-powered ability to live out

1478

00:55:54,829 --> 00:56:01,579

there like that way to think about if

1479

00:55:59,480 --> 00:56:03,139

you don't is that opportunity has to be

1480

00:56:01,579 --> 00:56:04,910

very careful it gets no power at night

1481

00:56:03,139 --> 00:56:07,039

and it has to be very careful not to run

1482

00:56:04,909 --> 00:56:09,199

out of power and not to get cold though



1483  
00:56:07,039 --> 00:56:10,670  
they have if they were running taking

1484  
00:56:09,199 --> 00:56:12,318  
observations when it was getting dark is

1485  
00:56:10,670 --> 00:56:14,690  
they had to do they had to go get a

1486  
00:56:12,318 --> 00:56:16,009  
little risky whereas MSL curiosity just

1487  
00:56:14,690 --> 00:56:17,568  
keeps going you know go dislike

1488  
00:56:16,010 --> 00:56:20,299  
energizer bunny keeps going and going to

1489  
00:56:17,568 --> 00:56:23,690  
you want to go yep all right so Scott

1490  
00:56:20,298 --> 00:56:26,030  
has let's have the picture they a part

1491  
00:56:23,690 --> 00:56:28,039  
image hey I love because we're talking

1492  
00:56:26,030 --> 00:56:31,730  
about this earlier you're seeing yes how

1493  
00:56:28,039 --> 00:56:33,558  
bright Mars is compared a nice that's

1494  
00:56:31,730 --> 00:56:35,900  
that's kind of a real image ours is a

1495  
00:56:33,559 --> 00:56:37,790  
compartment so this does give you an

1496  
00:56:35,900 --> 00:56:40,700  
appreciation which takes such good

1497  
00:56:37,789 --> 00:56:42,409  
images yeah yeah it's always so yeah

1498  
00:56:40,699 --> 00:56:44,118  
this is outstanding example of how

1499  
00:56:42,409 --> 00:56:46,818  
bright the planet is versus the comic

1500  
00:56:44,119 --> 00:56:49,579  
too so that's yeah so much very

1501  
00:56:46,818 --> 00:56:53,449  
beautiful all right well I guess we'll

1502  
00:56:49,579 --> 00:56:55,579  
on that note we will we will we'll close

1503  
00:56:53,449 --> 00:56:57,199  
this hangout down it's been a really

1504  
00:56:55,579 --> 00:56:59,030  
interesting kind thank you all of you

1505  
00:56:57,199 --> 00:57:02,298  
for it's great seeing a lot of you again

1506  
00:56:59,030 --> 00:57:04,160  
many Zolt max and john yang was good to

1507  
00:57:02,298 --> 00:57:05,780  
see you and carry it was awesome to meet

1508  
00:57:04,159 --> 00:57:08,058  
you so i'm glad to have you here i hope

1509  
00:57:05,780 --> 00:57:09,440  
you'll come back and tell us what you've

1510  
00:57:08,059 --> 00:57:12,339  
learned after you've had a chance to go

1511

00:57:09,440 --> 00:57:15,019  
through some more of these data and yeah

1512  
00:57:12,338 --> 00:57:19,009  
awesome okay well thank you guys very

1513  
00:57:15,019 --> 00:57:22,159  
much next week speaking of Hubble's 25th

1514  
00:57:19,010 --> 00:57:24,740  
anniversary celebration will be in one

1515  
00:57:22,159 --> 00:57:26,690  
of the first of our actual Hubble 25th

1516  
00:57:24,739 --> 00:57:28,699  
themed hangouts will be having it's

1517  
00:57:26,690 --> 00:57:30,048  
called the history of the Hubble Space

1518  
00:57:28,699 --> 00:57:32,239  
Telescope we're not going to cover the

1519  
00:57:30,048 --> 00:57:33,889  
entire history on that one hang out but

1520  
00:57:32,239 --> 00:57:35,868  
we are going to have some guests in

1521  
00:57:33,889 --> 00:57:37,489  
panelists who are very familiar with the

1522  
00:57:35,869 --> 00:57:39,349  
early days of Hubble and it throughout

1523  
00:57:37,489 --> 00:57:41,689  
its hole throughout its whole mission so

1524  
00:57:39,349 --> 00:57:42,859  
we're going to talk about that next week

1525  
00:57:41,690 --> 00:57:44,960

we hope you guys will make it on a

1526

00:57:42,858 --> 00:57:46,338

thursday at three o'clock until then

1527

00:57:44,960 --> 00:57:47,659

thank you all for all your great

1528

00:57:46,338 --> 00:57:49,608

comments and questions we really

1529

00:57:47,659 --> 00:57:51,009

appreciated it yeah and if you guys want

1530

00:57:49,608 --> 00:57:53,529

to see the Eclipse

1531

00:57:51,010 --> 00:57:56,590

join me in an hour with no the cosmos we

1532

00:57:53,530 --> 00:57:57,940

will be doing a free live webcast of the

1533

00:57:56,590 --> 00:57:59,860

Eclipse not only through a white light

1534

00:57:57,940 --> 00:58:03,130

filter but to a hydrogen alpha filter

1535

00:57:59,860 --> 00:58:04,960

here in Los Angeles so stay tuned for

1536

00:58:03,130 --> 00:58:07,000

that because not that's one of those who

1537

00:58:04,960 --> 00:58:08,740

say you had a coronado telescope set up

1538

00:58:07,000 --> 00:58:10,599

on additional Coronado pity that will

1539

00:58:08,739 --> 00:58:12,969

because those are outstanding those are

1540  
00:58:10,599 --> 00:58:15,819  
all saying I have one myself so very

1541  
00:58:12,969 --> 00:58:17,379  
good okay so he has if you have your

1542  
00:58:15,820 --> 00:58:20,740  
event Lee and everything already set up

1543  
00:58:17,380 --> 00:58:22,960  
your get it all set up I it's on twitter

1544  
00:58:20,739 --> 00:58:24,579  
on google+ and facebook soon I'm gonna

1545  
00:58:22,960 --> 00:58:29,550  
be watching cuz I can't see it from here

1546  
00:58:24,579 --> 00:58:33,250  
bro well sorry's close rights reserved

1547  
00:58:29,550 --> 00:58:35,530  
it's a makeup okay well thanks everybody

1548  
00:58:33,250 --> 00:58:39,130  
for watching thank you so much hard yes

1549  
00:58:35,530 --> 00:58:41,620  
thank you soon as a fantastic one the

1550  
00:58:39,130 --> 00:58:43,329  
images yeah it was great having you back

1551  
00:58:41,619 --> 00:58:47,219  
thanks for all your work and thanks for

1552  
00:58:43,329 --> 00:58:50,699  
for joining us until next time I keep

1553  
00:58:47,219 --> 00:58:50,699  
waking up

