

1
00:00:01,820 --> 00:00:06,270
hello everybody and welcome to our

2
00:00:04,049 --> 00:00:07,859
latest Hubble hangout this is a place

3
00:00:06,269 --> 00:00:10,410
where you can come to learn about the

4
00:00:07,859 --> 00:00:12,480
latest news science and discoveries of

5
00:00:10,410 --> 00:00:13,740
the Hubble Space Telescope my name is

6
00:00:12,480 --> 00:00:15,839
Tony Darnell and I work at the Space

7
00:00:13,740 --> 00:00:17,759
Telescope Sciences to do and today we've

8
00:00:15,839 --> 00:00:20,850
got a really awesome hangout plan for

9
00:00:17,760 --> 00:00:22,260
you when when most people think of the

10
00:00:20,850 --> 00:00:24,689
Hubble Space Telescope and the science

11
00:00:22,260 --> 00:00:27,000
and observations it does we often think

12
00:00:24,689 --> 00:00:28,469
of peering into the deepest corners of

13
00:00:27,000 --> 00:00:30,268
the universe and looking at some of the

14
00:00:28,469 --> 00:00:33,479
most distant galaxies we've ever seen

15
00:00:30,268 --> 00:00:35,729
we've also looked at the amazing Hubble

16
00:00:33,479 --> 00:00:38,099
images of things within our own galaxy

17
00:00:35,729 --> 00:00:40,949
but these you know beautiful nebulae and

18
00:00:38,100 --> 00:00:43,980
star clusters and things like that but

19
00:00:40,950 --> 00:00:46,170
Hubble also spends a lot of time looking

20
00:00:43,979 --> 00:00:47,819
closer to home and by whom I mean within

21
00:00:46,170 --> 00:00:49,950
our own solar system and that's what

22
00:00:47,820 --> 00:00:52,558
we're gonna talk about today some reason

23
00:00:49,950 --> 00:00:54,480
and some not so recent observations made

24
00:00:52,558 --> 00:00:58,108
by Hubble of the largest planet in our

25
00:00:54,479 --> 00:00:59,729
solar system Jupiter so with me to

26
00:00:58,109 --> 00:01:02,280
discuss his latest Jupiter observations

27
00:00:59,729 --> 00:01:03,779
from Hubble is dr. Amy Simon she is the

28
00:01:02,280 --> 00:01:05,849
senior scientist for planetary

29

00:01:03,780 --> 00:01:07,950
atmospheres research for the solar

30
00:01:05,849 --> 00:01:09,658
system exploration division at NASA's

31
00:01:07,950 --> 00:01:11,250
Goddard Space Flight Center she is also

32
00:01:09,659 --> 00:01:14,219
a co-investigator of the Cassini

33
00:01:11,250 --> 00:01:15,989
composite infrared spectrometer and the

34
00:01:14,219 --> 00:01:18,900
deputy instrument scientists for the

35
00:01:15,989 --> 00:01:20,728
osiris-rex visible and near IR

36
00:01:18,900 --> 00:01:22,020
spectrometer now that has got to be the

37
00:01:20,728 --> 00:01:24,959
coolest name for an instrument I have

38
00:01:22,019 --> 00:01:27,149
ever heard osiris-rex so we got to talk

39
00:01:24,959 --> 00:01:29,009
more about that at some point - Amy with

40
00:01:27,150 --> 00:01:30,150
me also is dr. Glen Orton he's a

41
00:01:29,009 --> 00:01:32,549
planetary astronomer at the Jet

42
00:01:30,150 --> 00:01:35,159
Propulsion Laboratory in Pasadena he's

43
00:01:32,549 --> 00:01:37,079

interested in IR astronomy and I don't

44

00:01:35,159 --> 00:01:38,868

know of any astronomer around today who

45

00:01:37,078 --> 00:01:41,069

can't be interested in the infrared

46

00:01:38,868 --> 00:01:44,009

planetary atmospheres as well as

47

00:01:41,069 --> 00:01:45,839

extrasolar giant planets and hopefully a

48

00:01:44,009 --> 00:01:47,728

little bit later on we'll have dr. Mike

49

00:01:45,840 --> 00:01:51,868

Wong joining us he's from UC Berkeley

50

00:01:47,728 --> 00:01:56,670

who also works on planets and he's all

51

00:01:51,868 --> 00:01:59,430

he's a he is a member of the Mars

52

00:01:56,670 --> 00:02:00,868

Science Laboratory he he's a

53

00:01:59,430 --> 00:02:02,880

collaborator for that as well as these

54

00:02:00,868 --> 00:02:05,938

we work on the same instrument onboard

55

00:02:02,879 --> 00:02:07,468

curiosity so we're hoping he can he can

56

00:02:05,938 --> 00:02:12,930

join us a little bit later to discuss

57

00:02:07,468 --> 00:02:13,739

some of this - and of course I went oh

58
00:02:12,930 --> 00:02:16,409
so I went to

59
00:02:13,740 --> 00:02:17,580
everybody welcome you guys to to tell me

60
00:02:16,409 --> 00:02:19,859
talk about these and to help me

61
00:02:17,580 --> 00:02:21,719
facilitate this discussion with me today

62
00:02:19,860 --> 00:02:23,400
is also my colleague at Space Telescope

63
00:02:21,719 --> 00:02:28,289
Science Institute dr. Carol Christian

64
00:02:23,400 --> 00:02:31,230
whose insights and and perspective is

65
00:02:28,289 --> 00:02:33,449
always welcome here and dr. and almost

66
00:02:31,229 --> 00:02:36,679
said ah dr. Scott Lewis Scott Lewis from

67
00:02:33,449 --> 00:02:39,269
space fan news and no the cosmos comm

68
00:02:36,680 --> 00:02:39,930
welcome you everybody and let's go ahead

69
00:02:39,270 --> 00:02:43,020
and get started

70
00:02:39,930 --> 00:02:45,719
um I guess Amy let's start with you can

71
00:02:43,020 --> 00:02:47,340
you give us a general overview of what

72
00:02:45,719 --> 00:02:51,449
you're using the Hubble Space Telescope

73
00:02:47,340 --> 00:02:53,219
for in your studies of Jupiter okay well

74
00:02:51,449 --> 00:02:55,229
I study the winds and the clouds on

75
00:02:53,219 --> 00:02:58,199
Jupiter so I've been using Hubble now

76
00:02:55,229 --> 00:03:00,509
for 20 years actually it turns out for a

77
00:02:58,199 --> 00:03:03,479
variety of different projects and this

78
00:03:00,509 --> 00:03:05,759
particular project we wanted to look at

79
00:03:03,479 --> 00:03:07,649
the Great Red Spot on Jupiter because we

80
00:03:05,759 --> 00:03:10,169
have a network of amateur astronomers

81
00:03:07,650 --> 00:03:12,390
and they let us know that it looked like

82
00:03:10,169 --> 00:03:13,589
it was suddenly shrinking now we've

83
00:03:12,389 --> 00:03:15,329
known it's been shrinking for a long

84
00:03:13,590 --> 00:03:17,039
time but it looked like that rate had

85
00:03:15,330 --> 00:03:18,780
sped up so they brought it to our

86

00:03:17,039 --> 00:03:20,849
attention and we looked into it and

87
00:03:18,780 --> 00:03:23,939
basically requested the time with Hubble

88
00:03:20,849 --> 00:03:27,349
to look at that okay let's back up just

89
00:03:23,939 --> 00:03:29,609
a little bit though and it's interesting

90
00:03:27,349 --> 00:03:30,949
the audience know they can get a hold of

91
00:03:29,610 --> 00:03:34,230
us too so if they have any questions

92
00:03:30,949 --> 00:03:36,509
thank his garments that you guys comment

93
00:03:34,229 --> 00:03:38,549
and ask us questions on the G+ event

94
00:03:36,509 --> 00:03:40,079
page the YouTube page that we're

95
00:03:38,550 --> 00:03:42,270
broadcasting on as well as you could

96
00:03:40,080 --> 00:03:44,130
tweet to us using the hashtag Hubble

97
00:03:42,270 --> 00:03:46,890
hangouts thanks god I almost forgot why

98
00:03:44,129 --> 00:03:49,620
did for you I mean my ESP is tuned but

99
00:03:46,889 --> 00:03:52,529
not for the entire internet that's right

100
00:03:49,620 --> 00:03:53,909

so feel free dad to send us comments and

101

00:03:52,530 --> 00:03:55,500

questions we're monitoring all kinds of

102

00:03:53,909 --> 00:03:56,729

different activities here and we will

103

00:03:55,500 --> 00:03:58,050

hopefully have some time later in the

104

00:03:56,729 --> 00:04:01,829

Hangout and we'll get to those questions

105

00:03:58,050 --> 00:04:03,900

so Amy um the Great Red Spot on Jupiter

106

00:04:01,830 --> 00:04:06,660

give us a little background on just what

107

00:04:03,900 --> 00:04:08,219

give us the really basic background on

108

00:04:06,659 --> 00:04:09,509

what that is for those of us who you

109

00:04:08,219 --> 00:04:10,919

know maybe not know they don't know very

110

00:04:09,509 --> 00:04:12,149

much about Jupiter or they don't even

111

00:04:10,919 --> 00:04:14,939

know what we're talking about what is

112

00:04:12,150 --> 00:04:17,730

this thing so the Great Red Spot is kind

113

00:04:14,939 --> 00:04:20,310

of Jupiter's trademark feature it's a

114

00:04:17,730 --> 00:04:22,140

big storm in the atmosphere it's pretty

115
00:04:20,310 --> 00:04:23,910
much been there since we since we've

116
00:04:22,139 --> 00:04:27,300
ever looked with modern telescopes and

117
00:04:23,910 --> 00:04:29,430
it's kind of like a hurricane but it's

118
00:04:27,300 --> 00:04:31,020
in the opposite direction so instead of

119
00:04:29,430 --> 00:04:34,949
being a low pressure storm it's a high

120
00:04:31,019 --> 00:04:36,899
pressure so it's a very strong high

121
00:04:34,949 --> 00:04:41,699
velocity windstorm that's been around

122
00:04:36,899 --> 00:04:44,939
for at least 150 years and do we know so

123
00:04:41,699 --> 00:04:47,330
do we know what is driving the storm or

124
00:04:44,939 --> 00:04:50,310
is there any indication what might be

125
00:04:47,329 --> 00:04:52,258
keeping it going for so long actually we

126
00:04:50,310 --> 00:04:53,550
don't know storms cyclones and

127
00:04:52,259 --> 00:04:56,069
anticyclones on earth don't last

128
00:04:53,550 --> 00:04:57,990
anywhere near this long high pressure

129
00:04:56,069 --> 00:04:59,669
systems are more stable in low pressure

130
00:04:57,990 --> 00:05:01,590
systems and on earth of course

131
00:04:59,668 --> 00:05:03,870
hurricanes break up when they hit land

132
00:05:01,589 --> 00:05:05,969
often and we don't have land on Jupiter

133
00:05:03,870 --> 00:05:07,500
but nonetheless we have no reason why

134
00:05:05,970 --> 00:05:08,729
this storm should have lasted as long as

135
00:05:07,500 --> 00:05:10,649
it did so that's one of the big

136
00:05:08,728 --> 00:05:13,469
mysteries is what powers this torment

137
00:05:10,649 --> 00:05:15,538
keeps it around for so long you say at

138
00:05:13,470 --> 00:05:17,940
least 150 years do it is there any

139
00:05:15,538 --> 00:05:19,680
indication that you know something what

140
00:05:17,939 --> 00:05:22,288
was the first observations we ever had

141
00:05:19,680 --> 00:05:24,060
of the Great Red Spot so that's where it

142
00:05:22,288 --> 00:05:27,240
gets a little tricky we have definitive

143

00:05:24,060 --> 00:05:29,280
observations back to about 1870 it was

144
00:05:27,240 --> 00:05:30,960
well tracked from there forward so we we

145
00:05:29,279 --> 00:05:33,388
know exactly where it is and how big

146
00:05:30,959 --> 00:05:35,459
it's been since about 1870 but there are

147
00:05:33,389 --> 00:05:37,348
some very very early papers by Galileo

148
00:05:35,459 --> 00:05:39,089
and Cassini in the 1600s where they

149
00:05:37,348 --> 00:05:41,038
talked about a permanent spot but it

150
00:05:39,089 --> 00:05:43,049
kind of got mentioned once and never

151
00:05:41,038 --> 00:05:46,889
again so we don't know in between if

152
00:05:43,050 --> 00:05:48,750
it's the same storm yeah I guess I guess

153
00:05:46,889 --> 00:05:50,218
I always wonder if Galileo could really

154
00:05:48,750 --> 00:05:51,778
differentiate between what he was

155
00:05:50,218 --> 00:05:54,028
looking at with the features on the disk

156
00:05:51,778 --> 00:05:56,490
versus maybe the moons around around the

157
00:05:54,028 --> 00:05:58,918

planet - so I don't know there might

158

00:05:56,490 --> 00:06:04,769

have been a little confusion around that

159

00:05:58,918 --> 00:06:07,348

as well so yeah exactly so - Don Rogers

160

00:06:04,769 --> 00:06:09,478

and the in his book trying to join us

161

00:06:07,348 --> 00:06:11,370

who mentions that at some point that not

162

00:06:09,478 --> 00:06:13,589

very long after that there's a painting

163

00:06:11,370 --> 00:06:15,689

of Jupiter hanging in the Vatican museum

164

00:06:13,589 --> 00:06:17,968

with of all things looking like debris a

165

00:06:15,689 --> 00:06:20,728

great spot sitting in it so sort of

166

00:06:17,968 --> 00:06:23,699

undocumented evidence or someone's

167

00:06:20,728 --> 00:06:25,318

imagination of what should be there and

168

00:06:23,699 --> 00:06:27,060

what was this from I didn't hear the

169

00:06:25,319 --> 00:06:31,800

first part of what you said oh this is

170

00:06:27,060 --> 00:06:35,550

this is from John Rogers book follow-on

171

00:06:31,800 --> 00:06:36,960

to a study about the morphology of

172
00:06:35,550 --> 00:06:39,270
clouds and their history in the

173
00:06:36,959 --> 00:06:41,069
atmosphere of Jupiter Jupiter the giant

174
00:06:39,269 --> 00:06:48,449
planet

175
00:06:41,069 --> 00:06:51,240
University Press John Regina so yeah

176
00:06:48,449 --> 00:06:53,519
that's right get him in the hangout and

177
00:06:51,240 --> 00:06:56,550
we he didn't have a computer with with a

178
00:06:53,519 --> 00:06:58,289
laptop and I'm like anyway but this is

179
00:06:56,550 --> 00:07:00,090
standing in termination either there's

180
00:06:58,290 --> 00:07:02,850
some evidence and maybe something like

181
00:07:00,089 --> 00:07:06,319
that in that region but it's before 2015

182
00:07:02,850 --> 00:07:09,689
there's not very much conclusive okay so

183
00:07:06,319 --> 00:07:12,329
Amy you say we've we've this thing has

184
00:07:09,689 --> 00:07:16,170
been shrinking we know it's that this

185
00:07:12,329 --> 00:07:17,430
feature has been getting smaller but we

186
00:07:16,170 --> 00:07:19,350
and we've known this for quite some time

187
00:07:17,430 --> 00:07:20,519
right I mean this is not new news this

188
00:07:19,350 --> 00:07:22,860
is something we've known for a while how

189
00:07:20,519 --> 00:07:25,079
long has this been how long have we

190
00:07:22,860 --> 00:07:27,750
known that it's been getting smaller at

191
00:07:25,079 --> 00:07:30,389
least since the 1950s there was another

192
00:07:27,750 --> 00:07:32,370
book by an astronomer named peak in 1958

193
00:07:30,389 --> 00:07:34,349
and he documented it in his book that he

194
00:07:32,370 --> 00:07:36,540
thought it was shrinking but there was

195
00:07:34,350 --> 00:07:38,700
not a lot of high-quality observations a

196
00:07:36,540 --> 00:07:40,470
lot of this was based on transit timings

197
00:07:38,699 --> 00:07:42,180
where people literally watched the time

198
00:07:40,470 --> 00:07:44,040
when the Great Red Spot hit the center

199
00:07:42,180 --> 00:07:46,889
of the planet and when when it crossed

200

00:07:44,040 --> 00:07:49,410
over so they use that to estimate how

201
00:07:46,889 --> 00:07:51,930
big it is oh the observations don't have

202
00:07:49,410 --> 00:07:54,060
a lot of fidelity but they're actually

203
00:07:51,930 --> 00:07:55,709
quite good and so from that time forward

204
00:07:54,060 --> 00:07:57,780
we pretty much had some indication that

205
00:07:55,709 --> 00:07:59,250
it was shrinking and the rate seemed

206
00:07:57,779 --> 00:08:03,750
somewhat constant it varied a little bit

207
00:07:59,250 --> 00:08:07,290
now and again so it is getting it is

208
00:08:03,750 --> 00:08:09,779
getting smaller at a at a known rate

209
00:08:07,290 --> 00:08:12,030
then pretty much constant rate you're

210
00:08:09,779 --> 00:08:13,829
saying over the long term it's been a

211
00:08:12,029 --> 00:08:17,159
fairly constant rate so there's times

212
00:08:13,829 --> 00:08:18,389
where it gets smaller faster and slows

213
00:08:17,160 --> 00:08:20,610
down a little bit so that it does

214
00:08:18,389 --> 00:08:22,919

fluctuate somewhat absolutely okay

215

00:08:20,610 --> 00:08:25,500

what's the question

216

00:08:22,920 --> 00:08:27,860

yeah go ahead so I wanted ask Amy a

217

00:08:25,500 --> 00:08:29,879

Glenna question so we know that also

218

00:08:27,860 --> 00:08:34,469

both through ground-based observations

219

00:08:29,879 --> 00:08:36,990

and Hubble you all who do this research

220

00:08:34,469 --> 00:08:39,240

have seen other spots though right

221

00:08:36,990 --> 00:08:41,430

smaller spots and could you talk a

222

00:08:39,240 --> 00:08:44,129

little bit about what we know about the

223

00:08:41,429 --> 00:08:46,529

duration of those and how big they are

224

00:08:44,129 --> 00:08:50,669

and what their relationship might be

225

00:08:46,529 --> 00:08:54,309

like where on Jupiter's face they are

226

00:08:50,669 --> 00:08:56,649

and that's okay well Jupiter often

227

00:08:54,309 --> 00:08:59,049

a bad case of measles it has spots all

228

00:08:56,649 --> 00:09:00,490

over the place but primarily we see them

229
00:08:59,049 --> 00:09:04,209
in the southern hemisphere we don't know

230
00:09:00,490 --> 00:09:05,799
why most of them are pretty small in

231
00:09:04,210 --> 00:09:08,410
terms of the other round looking ones

232
00:09:05,799 --> 00:09:10,419
but some of them do last for quite some

233
00:09:08,409 --> 00:09:13,120
time so there were a bunch of them three

234
00:09:10,419 --> 00:09:16,269
of them that formed in 1939 we actually

235
00:09:13,120 --> 00:09:18,190
saw them form they they condensed down

236
00:09:16,269 --> 00:09:19,899
to three white storms they're all

237
00:09:18,190 --> 00:09:22,600
anticyclones just like the Great Red

238
00:09:19,899 --> 00:09:23,740
Spot and when they first formed they

239
00:09:22,600 --> 00:09:26,139
were kind of big they got a little bit

240
00:09:23,740 --> 00:09:28,389
smaller eventually they got close enough

241
00:09:26,139 --> 00:09:30,278
to each other they merged and then in

242
00:09:28,389 --> 00:09:31,899
2006 the one that was left turned red

243
00:09:30,278 --> 00:09:33,909
and that's actually the one we call Red

244
00:09:31,899 --> 00:09:35,409
Spot jr. now so it's smaller it's a

245
00:09:33,909 --> 00:09:38,799
little bit farther to the south but it's

246
00:09:35,409 --> 00:09:40,449
the same type of storm and so far that

247
00:09:38,799 --> 00:09:44,229
one hasn't gone away either but that

248
00:09:40,450 --> 00:09:47,410
one's only about 80 years old as you

249
00:09:44,230 --> 00:09:48,879
mention yeah now you mentioned the color

250
00:09:47,409 --> 00:09:51,699
that's another interesting thing about

251
00:09:48,879 --> 00:09:53,320
the color there is red but then you you

252
00:09:51,700 --> 00:09:55,839
just said there were other storms that

253
00:09:53,320 --> 00:09:58,839
were white so do we know what they began

254
00:09:55,839 --> 00:10:01,440
as white as well yeah wait we don't know

255
00:09:58,839 --> 00:10:04,270
most of most of them tend to be white on

256
00:10:01,440 --> 00:10:06,280
rare occasion we see one that turns red

257

00:10:04,269 --> 00:10:08,049
like that like Red Spot Gina did there's

258
00:10:06,279 --> 00:10:09,490
other small ones that form from time to

259
00:10:08,049 --> 00:10:11,409
time that are red they tend to be deeper

260
00:10:09,490 --> 00:10:14,529
in the atmosphere and they don't last

261
00:10:11,409 --> 00:10:16,149
very long but we don't we don't have a

262
00:10:14,529 --> 00:10:20,889
clue what the mechanism is it turns

263
00:10:16,149 --> 00:10:23,139
these red so Scott let's turn to the

264
00:10:20,889 --> 00:10:26,649
Hubble observations Scott's got the

265
00:10:23,139 --> 00:10:28,629
image up here on his screen now these

266
00:10:26,649 --> 00:10:31,509
are observations of the red spot going

267
00:10:28,629 --> 00:10:34,899
back to three different periods we had

268
00:10:31,509 --> 00:10:38,379
one in 95 with the wif picked to camera

269
00:10:34,899 --> 00:10:41,649
and again in 2009 with wipsy 3 and again

270
00:10:38,379 --> 00:10:43,629
with whip C 3 and 2014 are are these

271
00:10:41,649 --> 00:10:47,169

your observations Amy were you uh were

272

00:10:43,629 --> 00:10:48,490

you making these with the Hubble uh yes

273

00:10:47,169 --> 00:10:49,899

sir all Hubble I was actually involved

274

00:10:48,490 --> 00:10:51,909

in all three programs they were all done

275

00:10:49,899 --> 00:10:53,740

for different reasons but they nicely

276

00:10:51,909 --> 00:10:58,000

show how it's gotten quite a bit smaller

277

00:10:53,740 --> 00:10:59,620

since 1995 it really has I mean you can

278

00:10:58,000 --> 00:11:01,089

see this really does a nice and Scott

279

00:10:59,620 --> 00:11:03,700

also made an animated gif earlier

280

00:11:01,089 --> 00:11:07,660

yesterday that that kind of shows the

281

00:11:03,700 --> 00:11:08,080

morphology of it as well oh there it is

282

00:11:07,659 --> 00:11:10,419

okay

283

00:11:08,080 --> 00:11:11,860

well so you can see you can sort of see

284

00:11:10,419 --> 00:11:13,419

in this animation that it's you know

285

00:11:11,860 --> 00:11:16,110

getting getting a little bit smaller

286
00:11:13,419 --> 00:11:18,099
each time with each with each epic

287
00:11:16,110 --> 00:11:21,129
animation but I'll pull up here in a

288
00:11:18,100 --> 00:11:29,370
second this is this is still here from

289
00:11:21,129 --> 00:11:36,070
95 wow that's a pop and then here is 9

290
00:11:29,370 --> 00:11:37,959
and 14 so we can see it up up the the

291
00:11:36,070 --> 00:11:43,470
animation here in a second but frame by

292
00:11:37,958 --> 00:11:47,278
frame when this is the most recent one

293
00:11:43,470 --> 00:11:50,740
that's the previous one five years ago

294
00:11:47,278 --> 00:11:53,320
so we can see a big difference there in

295
00:11:50,740 --> 00:11:55,060
the penis size yeah stop right there for

296
00:11:53,320 --> 00:11:56,500
a second what is that thing on the upper

297
00:11:55,059 --> 00:11:58,509
right there upper left there what is

298
00:11:56,500 --> 00:12:00,519
that red spot there is that red that red

299
00:11:58,509 --> 00:12:03,490
Junior what is that no that's that's not

300
00:12:00,519 --> 00:12:05,409
red Junior that's probably a cyclonic

301
00:12:03,490 --> 00:12:06,970
feature again like I said we get these

302
00:12:05,409 --> 00:12:08,708
other little spots that form from time

303
00:12:06,970 --> 00:12:11,649
to time and they either get pulled apart

304
00:12:08,708 --> 00:12:12,879
or disappear on their own okay it's just

305
00:12:11,649 --> 00:12:14,679
another thing that's in the flow field

306
00:12:12,879 --> 00:12:15,970
near the Great Red Spot right if you

307
00:12:14,679 --> 00:12:17,679
tend to think of those as somewhat

308
00:12:15,970 --> 00:12:20,740
deeper in the atmosphere so the dark

309
00:12:17,679 --> 00:12:24,009
stuff you see there is our represents a

310
00:12:20,740 --> 00:12:25,600
clearing the clouds it's kind of the

311
00:12:24,009 --> 00:12:26,559
opposite of the red spot nice and so you

312
00:12:25,600 --> 00:12:28,089
have to be really careful not

313
00:12:26,559 --> 00:12:30,219
differentiating between the visible

314

00:12:28,089 --> 00:12:33,610
color and the real tomography of the

315
00:12:30,220 --> 00:12:35,920
pollen system so here's red jr. I went

316
00:12:33,610 --> 00:12:37,899
and got a high-res image of it so here's

317
00:12:35,919 --> 00:12:40,539
red jr. you can actually see the great

318
00:12:37,899 --> 00:12:43,000
red spot over here yeah and then here's

319
00:12:40,539 --> 00:12:44,319
red jr. that we're looking at right and

320
00:12:43,000 --> 00:12:48,570
so those are observations we took

321
00:12:44,320 --> 00:12:50,980
shortly after it turned red and to get a

322
00:12:48,570 --> 00:12:53,110
perspective of what we're looking at

323
00:12:50,980 --> 00:12:58,149
here's G burning again in the southern

324
00:12:53,110 --> 00:13:03,100
hemisphere so there's a great red spot

325
00:12:58,149 --> 00:13:05,049
and there's red spy jr. so I remember

326
00:13:03,100 --> 00:13:08,129
what when I was first starting out in my

327
00:13:05,049 --> 00:13:10,000
career I was voyager had just passed

328
00:13:08,129 --> 00:13:12,879

Jupiter and we got to see these

329

00:13:10,000 --> 00:13:14,299
time-lapse movies of the Jovian

330

00:13:12,879 --> 00:13:16,039
atmosphere and

331

00:13:14,299 --> 00:13:17,719
you know we got to see the band's kind

332

00:13:16,039 --> 00:13:19,459
of going along back you know sort of

333

00:13:17,720 --> 00:13:21,320
counter-rotating or going different

334

00:13:19,460 --> 00:13:23,540
directions and things like that what are

335

00:13:21,320 --> 00:13:26,330
the bands like what are what are those

336

00:13:23,539 --> 00:13:27,889
signify on Jupiter well you're exactly

337

00:13:26,330 --> 00:13:29,690
right the winds are very strongly

338

00:13:27,889 --> 00:13:31,460
east-west on Jupiter they don't change

339

00:13:29,690 --> 00:13:33,560
very much so if you're at any particular

340

00:13:31,460 --> 00:13:37,160
location year to year the wind speed

341

00:13:33,559 --> 00:13:39,109
doesn't vary very much at all so we

342

00:13:37,159 --> 00:13:40,459
think if we understand what's going on

343
00:13:39,110 --> 00:13:42,680
very well they're almost like Hadley

344
00:13:40,460 --> 00:13:44,629
cells on earth so when the wind shear is

345
00:13:42,679 --> 00:13:46,519
in one direction you actually get uplift

346
00:13:44,629 --> 00:13:48,080
and you should get more white clouds and

347
00:13:46,519 --> 00:13:49,519
when it's going the other direction you

348
00:13:48,080 --> 00:13:50,750
should get the clouds subsiding and

349
00:13:49,519 --> 00:13:52,759
clearing out and that's where you see

350
00:13:50,750 --> 00:13:53,990
the darker color now we also see a

351
00:13:52,759 --> 00:13:55,669
little thunderstorms and other things

352
00:13:53,990 --> 00:13:56,899
that pop up in those darker regions it's

353
00:13:55,669 --> 00:13:58,429
hard to see them in the white regions

354
00:13:56,899 --> 00:14:00,500
because that cloud is so high and thick

355
00:13:58,429 --> 00:14:02,209
so that's what we think we're seeing is

356
00:14:00,500 --> 00:14:06,110
basically the equivalent of Jupiter's

357
00:14:02,210 --> 00:14:08,870
Hadley cells what's that but what are

358
00:14:06,110 --> 00:14:10,940
what are those so on the earth the

359
00:14:08,870 --> 00:14:12,830
Hadley cells are basically how you drive

360
00:14:10,940 --> 00:14:16,640
the circulation from the equator to the

361
00:14:12,830 --> 00:14:18,170
poles and it creates by going north and

362
00:14:16,639 --> 00:14:20,360
south because we have a Coriolis force

363
00:14:18,169 --> 00:14:22,759
you also get East and West out of it at

364
00:14:20,360 --> 00:14:24,830
the same time so you end up getting the

365
00:14:22,759 --> 00:14:26,569
strong east easterly and westerly wind

366
00:14:24,830 --> 00:14:30,920
Jets on the earth from some of this

367
00:14:26,570 --> 00:14:34,129
circulation so these are really strong

368
00:14:30,919 --> 00:14:35,689
winds in different bands though right I

369
00:14:34,129 --> 00:14:37,100
mean some of the bands in Jupiter are

370
00:14:35,690 --> 00:14:41,120
going in different directions too I mean

371

00:14:37,100 --> 00:14:42,500
that's like the light the dark bands are

372
00:14:41,120 --> 00:14:43,820
both going and if those are really

373
00:14:42,500 --> 00:14:46,159
strong so you're saying that each one of

374
00:14:43,820 --> 00:14:48,379
those is one of those kinds of cells

375
00:14:46,159 --> 00:14:50,779
yeah though the winds are on the very

376
00:14:48,379 --> 00:14:52,669
edges of the bands and that cell kind of

377
00:14:50,779 --> 00:14:54,500
defines the distance between the two

378
00:14:52,669 --> 00:14:55,669
wind jets so you have an east wind jet

379
00:14:54,500 --> 00:14:57,710
and then a west wind jet and they

380
00:14:55,669 --> 00:14:59,029
alternate all the way to the poles Scott

381
00:14:57,710 --> 00:15:00,410
could you put another picture up just

382
00:14:59,029 --> 00:15:01,970
what it doesn't matter which one I'm

383
00:15:00,409 --> 00:15:03,559
gonna want to use it as a reference here

384
00:15:01,970 --> 00:15:06,769
for some of the bands on here because I

385
00:15:03,559 --> 00:15:09,259

wanna oh yeah the other thing that I

386

00:15:06,769 --> 00:15:11,329

think is remarkable is in the different

387

00:15:09,259 --> 00:15:13,100

images that you are showing and I'm sure

388

00:15:11,330 --> 00:15:16,460

every time you observe it the different

389

00:15:13,100 --> 00:15:18,470

kinds of turbulence in the bands and

390

00:15:16,460 --> 00:15:21,230

around the spot I mean sometimes there's

391

00:15:18,470 --> 00:15:22,550

really strong whirls around it and other

392

00:15:21,230 --> 00:15:25,639

times it kind of looks like there are

393

00:15:22,549 --> 00:15:28,009

waves around it and yet it persists it's

394

00:15:25,639 --> 00:15:29,779

pretty remarkable it's kind of true

395

00:15:28,009 --> 00:15:33,139

the planet I mean Jupiter's atmosphere

396

00:15:29,779 --> 00:15:37,730

is a fluid dynamicists dream extreme

397

00:15:33,139 --> 00:15:45,409

flow you've got turbulence you dynamic

398

00:15:37,730 --> 00:15:49,310

is so simple what it is it's global

399

00:15:45,409 --> 00:15:52,730

warming not really an answer but it's

400
00:15:49,309 --> 00:15:56,419
such a complex system of dynamics it's

401
00:15:52,730 --> 00:15:58,940
not an easy thing at all and seeing just

402
00:15:56,419 --> 00:16:01,490
how completely massive and how much

403
00:15:58,940 --> 00:16:04,370
larger in and in radius

404
00:16:01,490 --> 00:16:05,600
Jupiter is plus everything else going on

405
00:16:04,370 --> 00:16:08,179
its chemical composition is different

406
00:16:05,600 --> 00:16:11,210
the pressures and all the other things

407
00:16:08,179 --> 00:16:14,389
going on it's just beautiful and yeah I

408
00:16:11,210 --> 00:16:16,840
could totally see just if I was really

409
00:16:14,389 --> 00:16:20,269
into fluid dynamics which I'm not

410
00:16:16,840 --> 00:16:22,399
because that's really difficult but if I

411
00:16:20,269 --> 00:16:25,039
was this would just be a dream just to

412
00:16:22,399 --> 00:16:26,449
study this for the rest of my life it's

413
00:16:25,039 --> 00:16:28,039
interesting to note that region just

414
00:16:26,450 --> 00:16:31,879
northwest of the red spot that looked

415
00:16:28,039 --> 00:16:33,620
like stripes of things is a place where

416
00:16:31,879 --> 00:16:36,259
the DOS achievements are heading toward

417
00:16:33,620 --> 00:16:39,710
the red spot and getting mixed up in an

418
00:16:36,259 --> 00:16:42,189
extremely turbulent area note on those

419
00:16:39,710 --> 00:16:44,840
videos and see me videos that that's

420
00:16:42,190 --> 00:16:46,640
sending roiling and that's one of the

421
00:16:44,840 --> 00:16:48,649
places where I spectroscopically we see

422
00:16:46,639 --> 00:16:50,179
pristine ice which we don't see on

423
00:16:48,649 --> 00:16:53,029
anywhere else in the planet so let's go

424
00:16:50,179 --> 00:16:55,729
whose meaning moved up very fast so

425
00:16:53,029 --> 00:16:57,470
those are the seats of very strong

426
00:16:55,730 --> 00:16:58,789
vertical winds as well which we don't

427
00:16:57,470 --> 00:17:02,540
really otherwise have a good way of

428

00:16:58,789 --> 00:17:03,620
tracking so let's talk what so what are

429
00:17:02,539 --> 00:17:05,329
we talking about here what are some of

430
00:17:03,620 --> 00:17:07,609
the characteristics of this red spot in

431
00:17:05,329 --> 00:17:09,649
terms of what exactly is going on there

432
00:17:07,609 --> 00:17:11,629
I mean are we looking at you know what

433
00:17:09,650 --> 00:17:13,820
what kind of you know well first of all

434
00:17:11,630 --> 00:17:17,600
how high up is this in the atmosphere of

435
00:17:13,819 --> 00:17:19,399
Jupiter so the great red spot itself the

436
00:17:17,599 --> 00:17:21,049
the clouds all are at different heights

437
00:17:19,400 --> 00:17:22,880
so that's one thing you have to kind of

438
00:17:21,049 --> 00:17:25,069
get into your head is that we think

439
00:17:22,880 --> 00:17:27,470
there's water clouds deep down we think

440
00:17:25,069 --> 00:17:29,059
there's ammonia Isis should be the white

441
00:17:27,470 --> 00:17:30,910
clouds we see high up although I Scott

442
00:17:29,059 --> 00:17:33,950

as Glen says we don't see them

443

00:17:30,910 --> 00:17:36,050
spectroscopically very often but we

444

00:17:33,950 --> 00:17:38,269
think the clouds kind of vary from about

445

00:17:36,049 --> 00:17:39,799
one bar of pressure which is about the

446

00:17:38,269 --> 00:17:40,670
same as the pressure in the room you're

447

00:17:39,799 --> 00:17:41,389
sitting in now

448

00:17:40,670 --> 00:17:43,160
although

449

00:17:41,390 --> 00:17:45,830
to the stratosphere the Great Red Spot

450

00:17:43,160 --> 00:17:47,960
actually goes up all the way to the top

451

00:17:45,829 --> 00:17:49,879
of the troposphere so similar on the

452

00:17:47,960 --> 00:17:52,309
earth the clouds kind of stop between

453

00:17:49,880 --> 00:17:53,780
the troposphere and the stratosphere the

454

00:17:52,309 --> 00:17:56,210
highest ones on Jupiter hit about the

455

00:17:53,779 --> 00:17:59,059
same heights but so we're talking you

456

00:17:56,210 --> 00:18:02,539
know the equivalent of maybe 15 miles

457
00:17:59,059 --> 00:18:05,720
though above wow that's pretty that's

458
00:18:02,539 --> 00:18:07,399
amazing so the and and you know the wind

459
00:18:05,720 --> 00:18:10,549
speeds here I mean how do we how do we

460
00:18:07,400 --> 00:18:12,170
first of all I guess I'd like to know

461
00:18:10,549 --> 00:18:13,819
how we measure these things I mean we've

462
00:18:12,170 --> 00:18:15,620
got we look at things with Hubble and

463
00:18:13,819 --> 00:18:17,119
you see the images and you can take time

464
00:18:15,619 --> 00:18:19,699
lapse as you can get movies and stuff

465
00:18:17,119 --> 00:18:21,409
how do we know things like what what the

466
00:18:19,700 --> 00:18:24,289
things made of what you know what you

467
00:18:21,410 --> 00:18:25,970
know where how high up it is what wind

468
00:18:24,289 --> 00:18:27,379
and things like that and things like

469
00:18:25,970 --> 00:18:29,809
wind speeds what are the best ways of

470
00:18:27,380 --> 00:18:31,430
measuring these characteristics well I

471
00:18:29,809 --> 00:18:33,349
think way back when before we had really

472
00:18:31,430 --> 00:18:35,570
good observational data a lot of it was

473
00:18:33,349 --> 00:18:37,939
for models so we looked at what the

474
00:18:35,569 --> 00:18:39,889
temperature profile Jupiter should be

475
00:18:37,940 --> 00:18:41,750
and said well these various compounds

476
00:18:39,890 --> 00:18:43,340
should condense out and make laps so you

477
00:18:41,750 --> 00:18:45,140
should get water clouds at a certain

478
00:18:43,339 --> 00:18:47,299
pressure ammonia clouds at a different

479
00:18:45,140 --> 00:18:49,880
pressure now that we have much better

480
00:18:47,299 --> 00:18:51,619
imaging and spectroscopy we can test

481
00:18:49,880 --> 00:18:54,620
those theories and that's been one of

482
00:18:51,619 --> 00:18:56,209
our frustrations is just what we said

483
00:18:54,619 --> 00:18:58,669
before we should see ammonia ice all

484
00:18:56,210 --> 00:19:00,079
over the planet and we don't we should

485

00:18:58,670 --> 00:19:01,519
see other compounds all over the planet

486
00:19:00,079 --> 00:19:03,319
we know they're there but they're hard

487
00:19:01,519 --> 00:19:06,200
to see spectroscopically and some of it

488
00:19:03,319 --> 00:19:07,460
is that Jupiter has haze over everything

489
00:19:06,200 --> 00:19:09,410
and that kind of makes it hard to see

490
00:19:07,460 --> 00:19:11,120
certain things but in terms of winds

491
00:19:09,410 --> 00:19:12,890
winds are things we can do really well

492
00:19:11,119 --> 00:19:14,689
with things like Hubble because we can

493
00:19:12,890 --> 00:19:16,759
take time-lapse images and do exactly

494
00:19:14,690 --> 00:19:20,500
that we look at the same spot and watch

495
00:19:16,759 --> 00:19:24,259
the clouds move we can measure them did

496
00:19:20,500 --> 00:19:25,460
did any of you guys what were you guys

497
00:19:24,259 --> 00:19:28,519
I'm sure you guys were paying attention

498
00:19:25,460 --> 00:19:30,950
when the comet hale-bopp went into to

499
00:19:28,519 --> 00:19:36,200

Jupiter right should make me now

500

00:19:30,950 --> 00:19:38,000

in levity you guys were watching that

501

00:19:36,200 --> 00:19:39,759

pretty intently to where you were there

502

00:19:38,000 --> 00:19:44,059

any surprises there did you guys

503

00:19:39,759 --> 00:19:45,710

everything was a surprise I mean as far

504

00:19:44,059 --> 00:19:49,000

as what you expect it might happen is

505

00:19:45,710 --> 00:19:49,000

that to the planet itself

506

00:19:49,440 --> 00:19:58,740

and repeat when I hear surprise it to me

507

00:19:52,679 --> 00:20:00,538

like we expected anything from massive

508

00:19:58,740 --> 00:20:03,538

changes like the ones we actually saw to

509

00:20:00,538 --> 00:20:06,359

absolutely nothing and in fact the

510

00:20:03,538 --> 00:20:07,859

answer is all of the above all of the

511

00:20:06,359 --> 00:20:10,288

parts of the comet that were off the

512

00:20:07,859 --> 00:20:13,109

main line had nothing I mean no mass

513

00:20:10,288 --> 00:20:14,788

associated into the rest made them read

514
00:20:13,109 --> 00:20:17,069
new substantial changes both in the

515
00:20:14,788 --> 00:20:19,019
visual appearance that we saw with

516
00:20:17,069 --> 00:20:23,250
Hubble at the time then infrared and

517
00:20:19,019 --> 00:20:25,589
quite far enough yet in fact so this

518
00:20:23,250 --> 00:20:27,359
yeah I remember one night did you see a

519
00:20:25,589 --> 00:20:29,849
Scott did you see when it where'd you go

520
00:20:27,359 --> 00:20:30,859
are you there I'm here where you can't

521
00:20:29,849 --> 00:20:34,230
get me that easy

522
00:20:30,859 --> 00:20:39,990
looking for some time lapse images of

523
00:20:34,230 --> 00:20:41,970
that collision there yeah so I mean

524
00:20:39,990 --> 00:20:43,740
let's talk so that break the reason I

525
00:20:41,970 --> 00:20:45,298
bring that up is I wanna I wanted to

526
00:20:43,740 --> 00:20:46,740
talk a little bit about Jupiter's role

527
00:20:45,298 --> 00:20:50,128
in the solar system and one of the

528
00:20:46,740 --> 00:20:52,470
things I always hear about Jupiter or

529
00:20:50,128 --> 00:20:56,730
Jovi and I always want to say jovial

530
00:20:52,470 --> 00:20:59,759
planets I'm Jovian - is that they are

531
00:20:56,730 --> 00:21:00,899
actually a pretty important jupiter

532
00:20:59,759 --> 00:21:02,639
plays a pretty important role in our

533
00:21:00,898 --> 00:21:04,408
solar system recent has in the past in

534
00:21:02,638 --> 00:21:06,058
terms of clearing out these comets and

535
00:21:04,409 --> 00:21:13,320
kind of protecting earth a little bit is

536
00:21:06,058 --> 00:21:15,690
that right Glenn I think yes it's in

537
00:21:13,319 --> 00:21:17,148
part because of Jupiter's position one

538
00:21:15,690 --> 00:21:21,538
mass in the solar system

539
00:21:17,148 --> 00:21:23,878
yeah so you are interested in exoplanets

540
00:21:21,538 --> 00:21:26,308
and other in jupiter-sized planets

541
00:21:23,878 --> 00:21:28,648
around other stars systems

542

00:21:26,308 --> 00:21:29,878
how does Jupiter compare what's Jupiter

543
00:21:28,648 --> 00:21:34,349
like compared to the most of the other

544
00:21:29,878 --> 00:21:38,069
Joe Moses systems we know they're sort

545
00:21:34,349 --> 00:21:40,230
of a start with with a qualification

546
00:21:38,069 --> 00:21:42,359
that I can only talk about the things we

547
00:21:40,230 --> 00:21:44,128
happen to be able to see so there's an

548
00:21:42,359 --> 00:21:45,928
election effects starting effect there

549
00:21:44,128 --> 00:21:48,000
we don't see the really tiny things I

550
00:21:45,929 --> 00:21:50,519
mean we never see at this point not

551
00:21:48,000 --> 00:21:52,019
technology mercury around the Sun and so

552
00:21:50,519 --> 00:21:54,089
we're talking about figure things you're

553
00:21:52,019 --> 00:21:55,980
sort of moving down the things that the

554
00:21:54,089 --> 00:22:00,868
size of the earth slowly if you look

555
00:21:55,980 --> 00:22:03,329
kepler the Kepler mission but as it

556
00:22:00,868 --> 00:22:05,730

stands now the statistics paper

557

00:22:03,329 --> 00:22:10,199

most of the planets that we know in the

558

00:22:05,730 --> 00:22:12,690

known space are neptune size and jupiter

559

00:22:10,200 --> 00:22:14,220

is kind of an anomaly and our solar

560

00:22:12,690 --> 00:22:17,640

system in the race made up is kind of

561

00:22:14,220 --> 00:22:19,620

anomalous to many of these large sized

562

00:22:17,640 --> 00:22:21,930

planets are quite close into the Sun

563

00:22:19,619 --> 00:22:24,629

where favorite on Mars are even closer

564

00:22:21,930 --> 00:22:26,220

compared to our Sun but again I worry

565

00:22:24,630 --> 00:22:29,910

that that's a bit of a selection effect

566

00:22:26,220 --> 00:22:32,579

because the things we see most easy so

567

00:22:29,910 --> 00:22:34,410

what kind of the Jupiter's Jupiter's big

568

00:22:32,579 --> 00:22:36,419

being heard upon gorillas in our solar

569

00:22:34,410 --> 00:22:39,180

system then maybe many many others as

570

00:22:36,420 --> 00:22:41,700

well yeah I remember that I remember

571
00:22:39,180 --> 00:22:44,100
hearing that when when I wanted to

572
00:22:41,700 --> 00:22:46,710
Kepler news releases it was advertised

573
00:22:44,099 --> 00:22:48,509
that they you know that they were a

574
00:22:46,710 --> 00:22:51,600
little bit surprised at how many Neptune

575
00:22:48,509 --> 00:22:53,759
sized planets there were out there that

576
00:22:51,599 --> 00:22:56,039
you know as and did say that they were

577
00:22:53,759 --> 00:22:59,099
very close to their star like this so

578
00:22:56,039 --> 00:23:01,799
the okay so let's get back to the red

579
00:22:59,099 --> 00:23:03,539
spot for just a little bit it's

580
00:23:01,799 --> 00:23:05,819
shrinking we've known it's been

581
00:23:03,539 --> 00:23:07,799
shrinking for a while is it going to

582
00:23:05,819 --> 00:23:09,389
disappear do we have a rate at which it

583
00:23:07,799 --> 00:23:11,279
will no longer be there what's going to

584
00:23:09,390 --> 00:23:14,310
happen to anybody any any guesses any

585
00:23:11,279 --> 00:23:18,660
projections well we had looked at this

586
00:23:14,309 --> 00:23:20,519
actually earlier in I had a paper in

587
00:23:18,660 --> 00:23:22,529
2002 where we were looking at spacecraft

588
00:23:20,519 --> 00:23:24,750
data in particular a Voyager Galileo

589
00:23:22,529 --> 00:23:26,639
Hubble looking at the rate of shrinkage

590
00:23:24,750 --> 00:23:30,210
and at that point we were estimating it

591
00:23:26,640 --> 00:23:32,250
be round by about 2030 at the current

592
00:23:30,210 --> 00:23:34,079
rate it's sped up so if it state if it

593
00:23:32,250 --> 00:23:36,839
sustains this rate of shrinkage it'll be

594
00:23:34,079 --> 00:23:38,579
round even faster in terms of what does

595
00:23:36,839 --> 00:23:39,629
that mean is it going to go away well

596
00:23:38,579 --> 00:23:41,039
part of the problem is we don't

597
00:23:39,630 --> 00:23:43,230
understand what's sustaining it in the

598
00:23:41,039 --> 00:23:44,759
first place so one of the things we hope

599

00:23:43,230 --> 00:23:46,140
to do with those data is actually look

600
00:23:44,759 --> 00:23:48,000
at not just a great red spot but

601
00:23:46,140 --> 00:23:50,250
everything around it and see what else

602
00:23:48,000 --> 00:23:51,690
is changing so that we can determine if

603
00:23:50,250 --> 00:23:53,490
there's anything that feeds the great

604
00:23:51,690 --> 00:23:55,680
red spot that is slightly turned off now

605
00:23:53,490 --> 00:23:57,509
or if there's some other thing that

606
00:23:55,680 --> 00:23:59,009
counts it and so that's kind of the

607
00:23:57,509 --> 00:24:03,000
stuff we want to use this data in

608
00:23:59,009 --> 00:24:04,349
particular to look for so you brought up

609
00:24:03,000 --> 00:24:05,700
you know that's an interesting point we

610
00:24:04,349 --> 00:24:07,230
don't really know what's driving it so

611
00:24:05,700 --> 00:24:07,920
it's hard to say how long am I sustained

612
00:24:07,230 --> 00:24:10,890
itself

613
00:24:07,920 --> 00:24:12,900

now we've we just sent probes into

614

00:24:10,890 --> 00:24:14,520

Jupiter we were a probe I should say I

615

00:24:12,900 --> 00:24:15,929

was hoping Mike would be here by now we

616

00:24:14,519 --> 00:24:18,388

could talk a little bit more about

617

00:24:15,929 --> 00:24:19,559

but maybe maybe maybe you guys can leave

618

00:24:18,388 --> 00:24:22,138

me Glenn you can comment on this a

619

00:24:19,558 --> 00:24:24,960

little bit to the Jupiter probe back

620

00:24:22,138 --> 00:24:27,329

that was a part of the Galileo mission

621

00:24:24,960 --> 00:24:30,329

I was sent in to measure the atmospheres

622

00:24:27,329 --> 00:24:33,449

the map the atmosphere of Jupiter did it

623

00:24:30,329 --> 00:24:35,308

shed any light on this problem not

624

00:24:33,450 --> 00:24:37,679

particularly the probe itself went into

625

00:24:35,308 --> 00:24:40,288

a part of the planet that we wish her a

626

00:24:37,679 --> 00:24:43,710

little more commonplace that went into

627

00:24:40,288 --> 00:24:45,450

an extremely strange area which has the

628
00:24:43,710 --> 00:24:48,659
least cloudy parts of the planet

629
00:24:45,450 --> 00:24:51,288
completely cloudless and dry the

630
00:24:48,659 --> 00:24:55,830
gathering probe which went in December 7

631
00:24:51,288 --> 00:24:58,499
1995 this looked at one point and we

632
00:24:55,829 --> 00:24:59,878
realized supporting ground-based work at

633
00:24:58,499 --> 00:25:04,048
the claim that showed that it was coming

634
00:24:59,878 --> 00:25:09,058
into a region and that was quite strange

635
00:25:04,048 --> 00:25:11,429
so we really are careful to take not to

636
00:25:09,058 --> 00:25:14,940
extrapolate some of those data to the

637
00:25:11,429 --> 00:25:17,340
whole planet in general and the fact

638
00:25:14,940 --> 00:25:19,139
because of the lack of water and in part

639
00:25:17,339 --> 00:25:22,138
lack the clouds that we see in there we

640
00:25:19,138 --> 00:25:24,589
created them the Juno mission which is

641
00:25:22,138 --> 00:25:27,178
going to be using microwave to since

642
00:25:24,589 --> 00:25:28,888
there's deepest appear 100 bars of

643
00:25:27,179 --> 00:25:32,690
pressure to look for water and an

644
00:25:28,888 --> 00:25:35,729
ammonia in great blocks in the planet

645
00:25:32,690 --> 00:25:38,190
for mapping and vanie might remember

646
00:25:35,730 --> 00:25:40,139
more about the mapping what Galileo the

647
00:25:38,190 --> 00:25:41,970
orbiter to the orbiter instruments did

648
00:25:40,138 --> 00:25:44,638
for the Great Red Spot we had about

649
00:25:41,970 --> 00:25:47,639
three orbits election center targeted

650
00:25:44,638 --> 00:25:48,778
the red spot in some ways I don't know

651
00:25:47,638 --> 00:25:49,678
if you want to say any more about that

652
00:25:48,778 --> 00:25:53,460
yeah go ahead

653
00:25:49,679 --> 00:26:01,919
Scott's got a graphic up of a fully

654
00:25:53,460 --> 00:26:07,249
deployed this is what should have

655
00:26:01,919 --> 00:26:10,320
happened but if we could go back yeah

656

00:26:07,249 --> 00:26:12,960
yeah I'm listening scientist on Galileo

657
00:26:10,319 --> 00:26:18,298
and for the full remedy radiometer it's

658
00:26:12,960 --> 00:26:23,129
funny we got a whole punky here so

659
00:26:18,298 --> 00:26:24,720
you're welcome yeah so so Glenn's right

660
00:26:23,128 --> 00:26:26,069
though if you look at the region just

661
00:26:24,720 --> 00:26:28,309
north of the equator there's kind of

662
00:26:26,069 --> 00:26:30,589
grayish blueish areas and those the area

663
00:26:28,309 --> 00:26:32,149
with essentially new cloud and that's

664
00:26:30,589 --> 00:26:33,829
exactly where it went in we actually had

665
00:26:32,150 --> 00:26:35,960
Hubble data at the same time - we could

666
00:26:33,829 --> 00:26:39,349
show you exactly which hotspot or which

667
00:26:35,960 --> 00:26:40,640
opening it went in we call them hotspots

668
00:26:39,349 --> 00:26:42,319
because they glow in the infrared

669
00:26:40,640 --> 00:26:45,590
because the heat can come out without

670
00:26:42,319 --> 00:26:47,689

the clouds in the way but we did map get

671

00:26:45,589 --> 00:26:49,970

the red the Great Red Spot with Galileo

672

00:26:47,690 --> 00:26:51,890

and we were able to do to do some of

673

00:26:49,970 --> 00:26:53,930

these properties about cloud height and

674

00:26:51,890 --> 00:26:56,660

also measure the wind velocities at that

675

00:26:53,930 --> 00:26:58,820

time and you know again it's a very

676

00:26:56,660 --> 00:27:02,600

fierce storm we're talking 500 miles per

677

00:26:58,819 --> 00:27:04,609

hour or winds so okay well we're getting

678

00:27:02,599 --> 00:27:06,649

quite a few questions on the Q&A app and

679

00:27:04,609 --> 00:27:09,649

I've before - before - many of them

680

00:27:06,650 --> 00:27:11,360

scroll by I'm gonna go ahead and let me

681

00:27:09,650 --> 00:27:13,580

let me let me get one here's one from

682

00:27:11,359 --> 00:27:16,279

Michael Michael joban who asks I mean

683

00:27:13,579 --> 00:27:18,710

just selected here have others

684

00:27:16,279 --> 00:27:23,119

documented this finding before the HST

685
00:27:18,710 --> 00:27:25,519
stuff because I have seen the course I

686
00:27:23,119 --> 00:27:27,409
have seen the change over the years so I

687
00:27:25,519 --> 00:27:28,910
guess he wants to know is are there

688
00:27:27,410 --> 00:27:31,340
other telescopes besides Hubble

689
00:27:28,910 --> 00:27:33,650
recording this shrinking are this change

690
00:27:31,339 --> 00:27:35,569
in the red spot sure it's been primarily

691
00:27:33,650 --> 00:27:38,090
ground-based data and as I was saying

692
00:27:35,569 --> 00:27:40,849
John Rogers has it in his book and and

693
00:27:38,089 --> 00:27:43,519
piqué also has it in his book so 1950s

694
00:27:40,849 --> 00:27:45,199
in the 1995 so just from ground-based

695
00:27:43,519 --> 00:27:47,359
telescopes backyard telescopes we've

696
00:27:45,200 --> 00:27:49,910
been able to document the shrinking yeah

697
00:27:47,359 --> 00:27:52,039
it's it's the anomalous shrinking that

698
00:27:49,910 --> 00:27:53,390
accelerated shrinking actually it's an

699
00:27:52,039 --> 00:27:56,389
amateur observation that God is

700
00:27:53,390 --> 00:27:58,190
interested isn't it for sorwe so we rely

701
00:27:56,390 --> 00:27:59,810
to a large extent sometimes on the

702
00:27:58,190 --> 00:28:02,029
amateur community for information about

703
00:27:59,809 --> 00:28:04,609
what's going on yes--we we welcome

704
00:28:02,029 --> 00:28:06,980
citizen science yeah this is that's this

705
00:28:04,609 --> 00:28:09,229
is a good area where people can really

706
00:28:06,980 --> 00:28:11,599
contribute well I would imagine so Tony

707
00:28:09,230 --> 00:28:14,539
Michael is asking to give perspective on

708
00:28:11,599 --> 00:28:17,719
how big Jupiter is how many earths could

709
00:28:14,539 --> 00:28:21,879
fit inside inside all of Jupiter or the

710
00:28:17,720 --> 00:28:24,500
great all right let's just do red spot

711
00:28:21,880 --> 00:28:26,360
back when Voyager flew by and the Great

712
00:28:24,500 --> 00:28:28,339
Red Spot is bigger we used to say three

713

00:28:26,359 --> 00:28:32,029
Earth's and it's now more like

714
00:28:28,339 --> 00:28:35,659
one-and-a-half it's quite substantially

715
00:28:32,029 --> 00:28:38,119
smaller mm-hmm okay and here's from Hans

716
00:28:35,660 --> 00:28:39,430
milling is asking is the red spot always

717
00:28:38,119 --> 00:28:43,059
facing earth

718
00:28:39,430 --> 00:28:45,580
no she rotates very quickly about 10

719
00:28:43,059 --> 00:28:47,109
hours so we have to time it so the great

720
00:28:45,579 --> 00:28:50,049
red spots on the right side when we look

721
00:28:47,109 --> 00:28:52,029
but the red spot also moves it's not a

722
00:28:50,049 --> 00:28:53,710
fixed feature like a mountain so we have

723
00:28:52,029 --> 00:28:55,690
to track very carefully when we want to

724
00:28:53,710 --> 00:28:58,840
target with something like Hubble yeah I

725
00:28:55,690 --> 00:29:00,430
wish I there's a really nice animating

726
00:28:58,839 --> 00:29:02,649
you can get online where you could see

727
00:29:00,430 --> 00:29:05,700

the motions of the planet in its

728

00:29:02,650 --> 00:29:07,870

entirety both from Voyager as well as

729

00:29:05,700 --> 00:29:09,549

other animations and other observations

730

00:29:07,869 --> 00:29:10,719

that are really amazing to look at so

731

00:29:09,549 --> 00:29:14,409

you can definitely do a search on those

732

00:29:10,720 --> 00:29:15,970

and find out and virtual start party

733

00:29:14,410 --> 00:29:18,550

mode my other shows we're always trying

734

00:29:15,970 --> 00:29:20,620

to be able to see it it's never remember

735

00:29:18,549 --> 00:29:22,089

able to see it when we're observing live

736

00:29:20,619 --> 00:29:23,709

we always get it maybe half hour

737

00:29:22,089 --> 00:29:26,109

afterwards something that like that

738

00:29:23,710 --> 00:29:29,079

because it rotates so quickly and it's a

739

00:29:26,109 --> 00:29:31,179

moving target but it is a fun planet to

740

00:29:29,079 --> 00:29:34,629

look at that's fish you know

741

00:29:31,180 --> 00:29:36,160

ground-based amateur telescope well it's

742
00:29:34,630 --> 00:29:39,940
like Mike Wang has joined us hi Mike

743
00:29:36,160 --> 00:29:41,440
welcome hi thanks Mike is as I started

744
00:29:39,940 --> 00:29:42,880
to say before he's a research scientist

745
00:29:41,440 --> 00:29:46,000
at University of California at Berkeley

746
00:29:42,880 --> 00:29:49,300
he works on the Sam instrument onboard

747
00:29:46,000 --> 00:29:51,609
curiosity and you apparently are

748
00:29:49,299 --> 00:29:55,089
interested in the Great Red Spot as well

749
00:29:51,609 --> 00:30:01,029
correct right Mike yeah I'm I'm really a

750
00:29:55,089 --> 00:30:03,129
Jupiter guy but I started working with

751
00:30:01,029 --> 00:30:05,500
the Galileo probe mass spectrometer

752
00:30:03,130 --> 00:30:08,280
which you know took measurements as a

753
00:30:05,500 --> 00:30:10,569
definitive into Jupiter's atmosphere and

754
00:30:08,279 --> 00:30:13,329
the same team built this mass

755
00:30:10,569 --> 00:30:15,429
spectrometer that's on Mars so I working

756
00:30:13,329 --> 00:30:17,470
with them now okay well I've always

757
00:30:15,430 --> 00:30:18,580
wanted to do a curiosity hangout so I'm

758
00:30:17,470 --> 00:30:20,740
gonna have to bother you again at some

759
00:30:18,579 --> 00:30:22,149
point and I get you on on a Mars and

760
00:30:20,740 --> 00:30:24,789
curiosity hang on we talk about that a

761
00:30:22,150 --> 00:30:27,040
little bit but so yeah we just got

762
00:30:24,789 --> 00:30:29,859
through talking about some of the some

763
00:30:27,039 --> 00:30:34,119
of the things that was learned when we

764
00:30:29,859 --> 00:30:36,250
put when the probe went into Jupiter's

765
00:30:34,119 --> 00:30:40,569
atmosphere and Glenn was telling us that

766
00:30:36,250 --> 00:30:43,900
if we sent it into a pretty quiet part

767
00:30:40,569 --> 00:30:47,679
of a via of Jupiter and Hubble was

768
00:30:43,900 --> 00:30:50,050
watching when that happened the it

769
00:30:47,680 --> 00:30:52,120
didn't really give us any insights nor

770

00:30:50,049 --> 00:30:53,349
was it designed to I don't think to give

771
00:30:52,119 --> 00:30:55,898
us any insights into

772
00:30:53,349 --> 00:30:57,519
the great red spot itself but I thought

773
00:30:55,898 --> 00:31:01,928
I would ask now that you're here and you

774
00:30:57,519 --> 00:31:03,880
worked on the mission what what were

775
00:31:01,929 --> 00:31:05,889
there any things that stood out to you

776
00:31:03,880 --> 00:31:12,519
with the Jupiter or with the Galileo

777
00:31:05,888 --> 00:31:13,898
probe mission well actually one of the

778
00:31:12,519 --> 00:31:17,589
main goals was to figure out how much

779
00:31:13,898 --> 00:31:19,178
water is on Jupiter and and that did you

780
00:31:17,589 --> 00:31:25,148
guys talk about how that didn't work out

781
00:31:19,179 --> 00:31:26,970
so well the Juno mission no yeah well

782
00:31:25,148 --> 00:31:29,979
we'll get it a different way

783
00:31:26,970 --> 00:31:33,639
but actually some of the research we're

784
00:31:29,980 --> 00:31:37,000

doing uses vortices like the Great Red

785

00:31:33,638 --> 00:31:39,668

Spot and oval ba to figure out how much

786

00:31:37,000 --> 00:31:43,720

water is on Jupiter because when water

787

00:31:39,669 --> 00:31:46,720

clouds form this creates what some of us

788

00:31:43,720 --> 00:31:49,210

think this creates a stable layer and by

789

00:31:46,720 --> 00:31:51,490

figuring out how stable that layer is

790

00:31:49,210 --> 00:31:52,679

like kind of like an inversion that we

791

00:31:51,490 --> 00:31:56,829

talked about in the Earth's atmosphere

792

00:31:52,679 --> 00:31:59,019

we can we can use these vortices to

793

00:31:56,829 --> 00:32:00,638

figure out how stable that that air is

794

00:31:59,019 --> 00:32:02,849

and that gives you a clue about how much

795

00:32:00,638 --> 00:32:02,849

Oh

796

00:32:06,240 --> 00:32:12,009

are you there Mike yeah did you yeah I

797

00:32:10,839 --> 00:32:14,079

lost you where you said he gives us a

798

00:32:12,009 --> 00:32:16,450

clue about and presumably it was about

799
00:32:14,079 --> 00:32:18,638
how much water vapors there yeah yeah

800
00:32:16,450 --> 00:32:19,808
okay all right yeah so yeah your

801
00:32:18,638 --> 00:32:25,329
connections a little bit a little bit

802
00:32:19,808 --> 00:32:27,668
jittery but all right about that okay so

803
00:32:25,329 --> 00:32:30,189
but actually Hubble did not observe

804
00:32:27,669 --> 00:32:32,830
right when the probe went in right

805
00:32:30,190 --> 00:32:34,210
there's all the biggest year okay I'm

806
00:32:32,829 --> 00:32:36,878
sorry I misunderstood what Amy said then

807
00:32:34,210 --> 00:32:39,250
I thought I thought I observed the spot

808
00:32:36,878 --> 00:32:41,619
it went into the opening it went into

809
00:32:39,250 --> 00:32:43,898
but not at the same time oh okay yeah

810
00:32:41,619 --> 00:32:49,449
Jupiter was Jupiter was really close to

811
00:32:43,898 --> 00:32:51,459
the Sun and Glenn actually he did some

812
00:32:49,450 --> 00:32:54,370
really fancy tricks to observe it from

813
00:32:51,460 --> 00:32:56,759
the ground yeah we the entire NASA and

814
00:32:54,369 --> 00:32:59,109
for a telescope facility with the

815
00:32:56,759 --> 00:33:02,308
largest filter I've ever seen which is

816
00:32:59,109 --> 00:33:04,990
three meters in size and it admitted the

817
00:33:02,308 --> 00:33:06,879
radiation at and greater than five

818
00:33:04,990 --> 00:33:09,460
microns and cut out everything else

819
00:33:06,880 --> 00:33:11,560
visible sort of like you know potato

820
00:33:09,460 --> 00:33:14,319
chip bag over the telescope and so we

821
00:33:11,559 --> 00:33:16,990
had did that and discovered there is a 5

822
00:33:14,319 --> 00:33:19,059
micron hot spot right where the probe

823
00:33:16,990 --> 00:33:21,849
was goes to go in and everything that we

824
00:33:19,059 --> 00:33:23,889
got from the probe coincided with the

825
00:33:21,849 --> 00:33:25,779
idea that this was in fact the kind of

826
00:33:23,890 --> 00:33:28,360
dry and cloudless area we expected from

827

00:33:25,779 --> 00:33:32,470
that kind of region that was a kind of

828
00:33:28,359 --> 00:33:34,419
strange it's also a Kudo in the to the

829
00:33:32,470 --> 00:33:38,589
need and the importance of ground-based

830
00:33:34,420 --> 00:33:41,890
observations of planets when missions go

831
00:33:38,589 --> 00:33:45,429
by and don't have all the resources they

832
00:33:41,890 --> 00:33:47,020
wouldn't like ok I want to get to

833
00:33:45,430 --> 00:33:48,340
another another question real quick that

834
00:33:47,019 --> 00:33:50,410
I don't think we answered this

835
00:33:48,339 --> 00:33:53,980
specifically but Hans milling is asking

836
00:33:50,410 --> 00:33:55,900
are the wind speeds the same around the

837
00:33:53,980 --> 00:34:01,680
Great Red Spot of presumably even though

838
00:33:55,900 --> 00:34:03,820
the red spot is shrinking so hey Hans

839
00:34:01,680 --> 00:34:06,910
actually we're still looking into that

840
00:34:03,819 --> 00:34:08,710
we just got the data and this is the

841
00:34:06,910 --> 00:34:11,320

main reason one of the main reasons why

842

00:34:08,710 --> 00:34:16,059

we went to Hubble to do this so we don't

843

00:34:11,320 --> 00:34:19,929

want to spill those beans quite yet stay

844

00:34:16,059 --> 00:34:22,690

tuned stay tuned I see presumably you're

845

00:34:19,929 --> 00:34:24,090

working on your paper now right well

846

00:34:22,690 --> 00:34:31,269

right

847

00:34:24,090 --> 00:34:33,419

Pancho's pitch okay so let's go let's

848

00:34:31,269 --> 00:34:33,418

see

849

00:34:34,869 --> 00:34:41,269

are the just scroll past how long has

850

00:34:39,230 --> 00:34:43,099

the red has a red spot been on Jupiter

851

00:34:41,269 --> 00:34:45,349

and how long do you suppose it will last

852

00:34:43,099 --> 00:34:48,349

estimated time of course as from Tony

853

00:34:45,349 --> 00:34:50,210

Michael and I think we we've touched on

854

00:34:48,349 --> 00:34:51,980

this already a little bit amy said that

855

00:34:50,210 --> 00:34:55,400

we have observations of it going back at

856
00:34:51,980 --> 00:34:59,090
least 150 years and as far as the

857
00:34:55,400 --> 00:35:02,210
estimated time remaining as Amy also

858
00:34:59,090 --> 00:35:04,039
said we don't know what's driving it yet

859
00:35:02,210 --> 00:35:06,260
so it's hard to answer that question

860
00:35:04,039 --> 00:35:08,679
that we need to understand more of the

861
00:35:06,260 --> 00:35:11,660
dynamics of the red spot and you know

862
00:35:08,679 --> 00:35:13,969
this just highlights something that I

863
00:35:11,659 --> 00:35:14,779
find you know it's it's also true in

864
00:35:13,969 --> 00:35:17,000
solar physics

865
00:35:14,780 --> 00:35:19,130
it's amazing what we're still learning

866
00:35:17,000 --> 00:35:21,139
about the things very close to us like

867
00:35:19,130 --> 00:35:22,700
there's a lot about the Sun we don't

868
00:35:21,139 --> 00:35:25,190
know there's a lot about the planets

869
00:35:22,699 --> 00:35:26,329
we're still learning and so a lot of

870
00:35:25,190 --> 00:35:27,700
this stuff is coming out with

871
00:35:26,329 --> 00:35:29,329
observations like the tumble but

872
00:35:27,699 --> 00:35:31,519
unfortunately the answers to those

873
00:35:29,329 --> 00:35:33,199
questions aren't there's nothing

874
00:35:31,519 --> 00:35:34,480
definite there yet do you guys want to

875
00:35:33,199 --> 00:35:37,039
add anything to that

876
00:35:34,480 --> 00:35:43,579
yeah I actually want to add to that

877
00:35:37,039 --> 00:35:45,860
question because Amy and Glen so I

878
00:35:43,579 --> 00:35:49,969
thought that the Great Red Spot may have

879
00:35:45,860 --> 00:35:51,860
been seen by a Cassini in the 1600s what

880
00:35:49,969 --> 00:35:54,109
are the views about whether that's the

881
00:35:51,860 --> 00:35:56,120
same spot or not yeah we mentioned that

882
00:35:54,110 --> 00:35:57,550
briefly part of it is of course you know

883
00:35:56,119 --> 00:36:00,469
we know the optics weren't that great

884

00:35:57,550 --> 00:36:02,960
the original papers which I did go back

885
00:36:00,469 --> 00:36:05,839
and look up which were challenging to

886
00:36:02,960 --> 00:36:08,150
read to say the least it's not clear if

887
00:36:05,840 --> 00:36:09,410
it's the same latitude it might have

888
00:36:08,150 --> 00:36:11,750
even been the northern hemisphere not

889
00:36:09,409 --> 00:36:13,489
the southern and some of the

890
00:36:11,750 --> 00:36:14,840
descriptions don't seem to quite match

891
00:36:13,489 --> 00:36:16,099
up and the fact that we know that it's

892
00:36:14,840 --> 00:36:18,829
shrinking it would have been quite big

893
00:36:16,099 --> 00:36:22,309
back then so it may not be the same

894
00:36:18,829 --> 00:36:23,809
storm and you know as Glen also said

895
00:36:22,309 --> 00:36:25,250
earlier there's there's a picture that

896
00:36:23,809 --> 00:36:27,980
was found in the Vatican that showed

897
00:36:25,250 --> 00:36:29,510
Jupiter with a spot on it but it's kind

898
00:36:27,980 --> 00:36:31,039

of anecdotal evidence at this point we

899

00:36:29,510 --> 00:36:33,350

don't have enough to say for a fact that

900

00:36:31,039 --> 00:36:35,539

it's the same thing but it might be well

901

00:36:33,349 --> 00:36:36,319

I'm going in my TARDIS later this

902

00:36:35,539 --> 00:36:38,029

afternoon

903

00:36:36,320 --> 00:36:40,400

and I will take some pictures for you

904

00:36:38,030 --> 00:36:44,200

guys and beam them back and we will know

905

00:36:40,400 --> 00:36:44,200

for sure let me get back to us on that

906

00:36:44,349 --> 00:36:48,619

pictures in in John's book

907

00:36:47,449 --> 00:36:51,489

or any of the pictures might get

908

00:36:48,619 --> 00:36:54,380

elsewhere on that show Jupiter in the

909

00:36:51,489 --> 00:36:56,629

1880s 1890's that show the red spot you

910

00:36:54,380 --> 00:36:58,789

can express the great red sausage this

911

00:36:56,630 --> 00:37:01,730

is three degrees of longitude the thing

912

00:36:58,789 --> 00:37:05,029

is big and if this isn't dropping down

913
00:37:01,730 --> 00:37:09,530
since then I think the idea the great

914
00:37:05,030 --> 00:37:18,830
rate of sausages and sausage yeah that's

915
00:37:09,530 --> 00:37:22,670
good okay let me move on Jan Kellner is

916
00:37:18,829 --> 00:37:25,909
asking does Jupiter have a solid core

917
00:37:22,670 --> 00:37:35,360
and if so how big is it and what's it

918
00:37:25,909 --> 00:37:40,309
made of anybody there's probably some

919
00:37:35,360 --> 00:37:42,620
heavy material metal silicon heavy

920
00:37:40,309 --> 00:37:44,570
things that form a core as they do in

921
00:37:42,619 --> 00:37:46,389
the pores of all the giant planets

922
00:37:44,570 --> 00:37:49,519
that's because Italy we presume that

923
00:37:46,389 --> 00:37:52,460
there is a mixture of solar like

924
00:37:49,519 --> 00:37:54,259
elements everywhere they were added to

925
00:37:52,460 --> 00:37:57,800
afterward nuts and the mysteries of how

926
00:37:54,260 --> 00:37:59,300
things formed there are theories and

927
00:37:57,800 --> 00:38:01,310
without direct evidence but there are

928
00:37:59,300 --> 00:38:03,740
theories on how much there is in each of

929
00:38:01,309 --> 00:38:06,049
these planets and that's about it it's

930
00:38:03,739 --> 00:38:09,079
not very big for Jupiter or Saturn and

931
00:38:06,050 --> 00:38:13,580
we measure in terms of several earths in

932
00:38:09,079 --> 00:38:17,299
terms of mass as I recall I'm quite

933
00:38:13,579 --> 00:38:18,829
happy to be corrected on any day now

934
00:38:17,300 --> 00:38:20,960
that's that's about what I would say to

935
00:38:18,829 --> 00:38:23,659
the best guess at the moment is two to

936
00:38:20,960 --> 00:38:27,440
three earth masses of heavy elements

937
00:38:23,659 --> 00:38:31,429
yeah okay okay now here's a here's a

938
00:38:27,440 --> 00:38:34,070
loaded question art and this comes from

939
00:38:31,429 --> 00:38:36,529
Chris Marshall are there any experiments

940
00:38:34,070 --> 00:38:39,680
that could provide more information on

941

00:38:36,530 --> 00:38:44,090
what's powering the Great Red Spot if

942
00:38:39,679 --> 00:38:46,549
money wasn't a limiter oh oh we're no

943
00:38:44,090 --> 00:38:50,840
object guys and send a lot of probes

944
00:38:46,550 --> 00:38:53,060
into Jupiter I mean it would it seems

945
00:38:50,840 --> 00:38:56,750
sort of ironic that's all do the money

946
00:38:53,059 --> 00:38:58,759
that mean send many probes into the

947
00:38:56,750 --> 00:39:00,469
aperture Venus which has in some ways

948
00:38:58,760 --> 00:39:01,310
that one of those homogeneous we know

949
00:39:00,469 --> 00:39:03,889
about

950
00:39:01,309 --> 00:39:06,670
I mean send one folder with most in

951
00:39:03,889 --> 00:39:09,529
homogeneous form that we see visually

952
00:39:06,670 --> 00:39:12,289
but that's life it stupid is pretty far

953
00:39:09,530 --> 00:39:13,610
away and he this is a lot closer there's

954
00:39:12,289 --> 00:39:16,309
a lot of challenges I would imagine and

955
00:39:13,610 --> 00:39:17,599

getting their wind speed all around the

956

00:39:16,309 --> 00:39:20,539

roads flying like send something into

957

00:39:17,599 --> 00:39:22,159

the red spot yeah probes well maybe you

958

00:39:20,539 --> 00:39:25,239

could send balloons that could get wind

959

00:39:22,159 --> 00:39:29,659

speeds rogue would give you maybe

960

00:39:25,239 --> 00:39:30,799

composition you know cloud densities at

961

00:39:29,659 --> 00:39:33,589

that location

962

00:39:30,800 --> 00:39:38,510

another great thing would be weather

963

00:39:33,590 --> 00:39:42,160

satellite around Jupiter mm-hmm that's

964

00:39:38,510 --> 00:39:44,480

because we've sent spacecraft there a

965

00:39:42,159 --> 00:39:46,309

you know they can't take images all the

966

00:39:44,480 --> 00:39:48,260

time and so we get bits and pieces here

967

00:39:46,309 --> 00:39:50,509

and there but a dedicated what a weather

968

00:39:48,260 --> 00:39:51,770

satellite around Jupiter or hey even

969

00:39:50,510 --> 00:39:54,050

around the earth but with a powerful

970
00:39:51,769 --> 00:39:55,610
telescope could get that job done Mike

971
00:39:54,050 --> 00:40:00,130
and I would both like a dedicated Hubble

972
00:39:55,610 --> 00:40:02,780
of our on yeah one of those two actually

973
00:40:00,130 --> 00:40:04,910
like my own Hubble Space Telescope to

974
00:40:02,780 --> 00:40:06,710
I'll get on that ground as well let's

975
00:40:04,909 --> 00:40:16,629
just yeah I'm sure if they mass mass

976
00:40:06,710 --> 00:40:19,150
produced it'll be cheaper right okay so

977
00:40:16,630 --> 00:40:24,260
here is one that's getting a lot of plus

978
00:40:19,150 --> 00:40:26,570
pluses here from Craig Landon are there

979
00:40:24,260 --> 00:40:29,150
any known similarities atmospherically

980
00:40:26,570 --> 00:40:32,090
between the Great Red Spot and a hexagon

981
00:40:29,150 --> 00:40:33,920
at the poles of Saturn similar

982
00:40:32,090 --> 00:40:37,160
composition different location due to

983
00:40:33,920 --> 00:40:39,500
weather factors well on Saturn the

984
00:40:37,159 --> 00:40:41,239
hexagon is part of a whole polar vortex

985
00:40:39,500 --> 00:40:43,579
polar flows are a little more

986
00:40:41,239 --> 00:40:46,129
complicated it's so it is still a vortex

987
00:40:43,579 --> 00:40:48,049
a storm that rotates and in that same

988
00:40:46,130 --> 00:40:50,539
sense but the polar regions are a little

989
00:40:48,050 --> 00:40:53,630
special they can actually make hexagons

990
00:40:50,539 --> 00:40:55,969
in a lab with rotating fluids and it

991
00:40:53,630 --> 00:40:59,329
just has to do with how winds move

992
00:40:55,969 --> 00:41:01,209
around flow moves around a pole in the

993
00:40:59,329 --> 00:41:03,920
case of the red spot it's not the pole

994
00:41:01,210 --> 00:41:05,269
okay yeah I'm glad you've been glad you

995
00:41:03,920 --> 00:41:06,349
sort of explain what that was because

996
00:41:05,269 --> 00:41:09,199
gonna ask you to tell us what the

997
00:41:06,349 --> 00:41:11,779
hexagon is so it's a polar flow whereas

998

00:41:09,199 --> 00:41:14,059
the red spot is is something much

999
00:41:11,780 --> 00:41:15,260
further down on the latitude scales yeah

1000
00:41:14,059 --> 00:41:18,799
and it is similar

1001
00:41:15,260 --> 00:41:20,780
the what we call the polar hexagon those

1002
00:41:18,800 --> 00:41:24,130
who were experiencing pretty cold

1003
00:41:20,780 --> 00:41:28,630
winters in the in the US this past yeah

1004
00:41:24,130 --> 00:41:33,380
the polar hexagon is you know it's also

1005
00:41:28,630 --> 00:41:36,890
a wind belt that's encircling the vortex

1006
00:41:33,380 --> 00:41:38,690
and it has waves on it and so in the

1007
00:41:36,889 --> 00:41:41,210
case of Jupiter and Saturn those waves

1008
00:41:38,690 --> 00:41:43,670
can become stable enough so that they

1009
00:41:41,210 --> 00:41:47,750
look like the sides of a hexagon and

1010
00:41:43,670 --> 00:41:52,570
also in labs you can get a Pentagon or a

1011
00:41:47,750 --> 00:41:56,210
septagon other other shapes as well okay

1012
00:41:52,570 --> 00:42:11,690

let's see and here's one from that's

1013

00:41:56,210 --> 00:42:13,639

good question Craig thank you we also

1014

00:42:11,690 --> 00:42:15,619

know that Jupiter has very strong

1015

00:42:13,639 --> 00:42:19,629

magnetic fields and that the magnetic

1016

00:42:15,619 --> 00:42:23,059

fields interact with its moon system and

1017

00:42:19,630 --> 00:42:25,010

the surrounding area does the magnetic

1018

00:42:23,059 --> 00:42:27,529

field have anything to do with or

1019

00:42:25,010 --> 00:42:30,260

influence the red spot that you know of

1020

00:42:27,530 --> 00:42:32,269

or any of these spots well the the

1021

00:42:30,260 --> 00:42:34,160

magnetic fields of course Drive Aurora's

1022

00:42:32,269 --> 00:42:36,530

on earth and on the other planets we do

1023

00:42:34,159 --> 00:42:39,589

see aurora on Jupiter and we can

1024

00:42:36,530 --> 00:42:41,869

actually see the magnetic footprint of

1025

00:42:39,590 --> 00:42:44,119

IO in the atmosphere as well so

1026

00:42:41,869 --> 00:42:47,300

basically wherever the medic medic field

1027
00:42:44,119 --> 00:42:49,608
intersects a planet or a moon rather it

1028
00:42:47,300 --> 00:42:52,670
can actually bring a footprint down on

1029
00:42:49,608 --> 00:42:54,139
to the Jupiter itself but it tends to be

1030
00:42:52,670 --> 00:42:55,519
very high up in the atmosphere that you

1031
00:42:54,139 --> 00:42:57,858
see it you see very localized heating

1032
00:42:55,519 --> 00:43:00,230
and so on but it's extremely high up in

1033
00:42:57,858 --> 00:43:01,909
the atmosphere I'm glad I don't know if

1034
00:43:00,230 --> 00:43:05,119
you want to add to that you know we can

1035
00:43:01,909 --> 00:43:06,349
if we look at wavelengths like 899 a

1036
00:43:05,119 --> 00:43:10,280
meter so we have a lot of methane

1037
00:43:06,349 --> 00:43:14,500
absorption like like 300 or further in

1038
00:43:10,280 --> 00:43:17,150
the infrared from ground we are

1039
00:43:14,500 --> 00:43:18,679
susceptible to seeing particles very

1040
00:43:17,150 --> 00:43:20,840
high in the atmosphere because there's

1041
00:43:18,679 --> 00:43:24,349
methane and hydrogen gas that are

1042
00:43:20,840 --> 00:43:26,539
absorbing all the photons before then

1043
00:43:24,349 --> 00:43:28,279
get flicked it back to us when we look

1044
00:43:26,539 --> 00:43:29,139
at the planet there we see one of the

1045
00:43:28,280 --> 00:43:32,570
highest things

1046
00:43:29,139 --> 00:43:36,379
brightest parts is the great red spot or

1047
00:43:32,570 --> 00:43:39,260
red spot jr. but other than that the

1048
00:43:36,380 --> 00:43:41,780
poles actually one of the most striking

1049
00:43:39,260 --> 00:43:44,780
parts of the planet because we presume

1050
00:43:41,780 --> 00:43:47,000
that particles are being created by this

1051
00:43:44,780 --> 00:43:48,560
interaction though chemistry driven by

1052
00:43:47,000 --> 00:43:52,099
energetic particles flowing down

1053
00:43:48,559 --> 00:43:54,739
magnetic field and is overall oval and

1054
00:43:52,099 --> 00:43:56,539
Morris I got a feel the derivative

1055

00:43:54,739 --> 00:43:58,519
displace compared with the rotation axis

1056
00:43:56,539 --> 00:44:02,000
so they can be streaming out onto the

1057
00:43:58,519 --> 00:44:04,130
edges of the polar vortex itself some of

1058
00:44:02,000 --> 00:44:06,320
them hit and train that is corralled

1059
00:44:04,130 --> 00:44:10,519
into that polar vortex and some spread

1060
00:44:06,320 --> 00:44:13,370
outward more of them get pardon the

1061
00:44:10,519 --> 00:44:16,309
phrase sequestered inside the southern

1062
00:44:13,369 --> 00:44:18,579
polar vortex and in the north some of

1063
00:44:16,309 --> 00:44:22,699
them spill out so have this these two

1064
00:44:18,579 --> 00:44:26,360
very well defined vortices putting

1065
00:44:22,699 --> 00:44:28,730
Jupiter's sometimes has a not quite as

1066
00:44:26,360 --> 00:44:31,309
stable as a hexagon and Saturn but

1067
00:44:28,730 --> 00:44:34,070
Jupiter's polar vortex as boundaries and

1068
00:44:31,309 --> 00:44:36,469
waves that can move a bit more maybe you

1069
00:44:34,070 --> 00:44:41,630

know by sight either is excited from 20

1070

00:44:36,469 --> 00:44:42,889

million Brook and that this pollen would

1071

00:44:41,630 --> 00:44:45,230

what the amateurs would call a polar

1072

00:44:42,889 --> 00:44:47,359

hood but there's some stuff spreading

1073

00:44:45,230 --> 00:44:49,579

out because the vortex print me being

1074

00:44:47,360 --> 00:44:51,230

immoral local actually / sense that

1075

00:44:49,579 --> 00:44:53,000

boundary like spending things out in

1076

00:44:51,230 --> 00:44:56,090

that the keys for their software the

1077

00:44:53,000 --> 00:44:59,300

planet but direct influences on on the

1078

00:44:56,090 --> 00:45:01,660

right spot itself not so much as in none

1079

00:44:59,300 --> 00:45:04,430

that I know of

1080

00:45:01,659 --> 00:45:06,889

okay let's just take one more question

1081

00:45:04,429 --> 00:45:08,210

here that I we've already talked about

1082

00:45:06,889 --> 00:45:10,400

this just a little bit of a world will

1083

00:45:08,210 --> 00:45:12,829

address it directly from Jeff kesner

1084
00:45:10,400 --> 00:45:14,360
who's going I about the information I I

1085
00:45:12,829 --> 00:45:16,880
interesting information that came out of

1086
00:45:14,360 --> 00:45:20,480
the study of clouds generated when comet

1087
00:45:16,880 --> 00:45:22,369
shoemaker 9 levy levy 9 I impacted I

1088
00:45:20,480 --> 00:45:24,530
believe we you know we talked about you

1089
00:45:22,369 --> 00:45:26,509
know Glenn it said that was basically an

1090
00:45:24,530 --> 00:45:27,470
amazing event in all respects but Mike

1091
00:45:26,510 --> 00:45:28,460
you weren't here when we talked about

1092
00:45:27,469 --> 00:45:30,559
that do you have anything to add about

1093
00:45:28,460 --> 00:45:37,599
that impact did you learn anything new

1094
00:45:30,559 --> 00:45:37,599
from that hello yes

1095
00:45:40,889 --> 00:45:46,949
oh dude okay can you hear me now yeah I

1096
00:45:45,539 --> 00:45:47,660
can hear you know yeah yeah okay I'm

1097
00:45:46,949 --> 00:45:51,989
sorry

1098
00:45:47,659 --> 00:45:54,318
um well that I'm sure you guys covered

1099
00:45:51,989 --> 00:45:57,389
most of the stuff I would say like

1100
00:45:54,318 --> 00:46:00,929
mainly that this may have been an

1101
00:45:57,389 --> 00:46:08,219
asteroid it that hit the planet instead

1102
00:46:00,929 --> 00:46:09,480
of a comet in 2009 you mean yeah it was

1103
00:46:08,219 --> 00:46:11,399
that the question or what are we talking

1104
00:46:09,480 --> 00:46:13,650
about she make her look 9 did we learn

1105
00:46:11,400 --> 00:46:15,660
anything more about the what was it you

1106
00:46:13,650 --> 00:46:20,910
thought you learned about the planet if

1107
00:46:15,659 --> 00:46:25,278
the movie impact well actually at that

1108
00:46:20,909 --> 00:46:29,639
time I was a radio astronomer and so

1109
00:46:25,278 --> 00:46:32,730
totally make West Virginia know a lot of

1110
00:46:29,639 --> 00:46:34,768
exciting stuff happened the comet

1111
00:46:32,730 --> 00:46:37,559
brought a bunch of dust into the system

1112

00:46:34,768 --> 00:46:39,988
and you just talked about Aurora's well

1113
00:46:37,559 --> 00:46:42,630
Aurora's are caused when these charged

1114
00:46:39,989 --> 00:46:44,068
particles in the magnetosphere smashed

1115
00:46:42,630 --> 00:46:46,588
into the atmosphere at really high

1116
00:46:44,068 --> 00:46:48,509
velocities so you introduced a bunch of

1117
00:46:46,588 --> 00:46:51,389
dust into the system and that can soak

1118
00:46:48,509 --> 00:46:54,900
up some of these electrons and we saw

1119
00:46:51,389 --> 00:46:58,139
massive changes in the in the radiation

1120
00:46:54,900 --> 00:46:59,940
environment around Jupiter so that was

1121
00:46:58,139 --> 00:47:02,038
pretty cool and it gave me a one-week

1122
00:46:59,940 --> 00:47:08,608
trip into the remote mountains of West

1123
00:47:02,039 --> 00:47:10,890
Virginia where I mountain-bike okay it

1124
00:47:08,608 --> 00:47:13,650
did also deliver stuff into the upper

1125
00:47:10,889 --> 00:47:16,739
atmosphere and the first time in so it

1126
00:47:13,650 --> 00:47:19,259

created markers that we could use as we

1127

00:47:16,739 --> 00:47:21,480

watch the flow north-south which we

1128

00:47:19,259 --> 00:47:23,818

don't usually get to see visit so slow

1129

00:47:21,480 --> 00:47:25,619

and see things start to circulate so we

1130

00:47:23,818 --> 00:47:27,480

our first indications about the

1131

00:47:25,619 --> 00:47:29,548

circulation of berdiana north-south

1132

00:47:27,480 --> 00:47:31,409

circulation the planet starting to

1133

00:47:29,548 --> 00:47:34,949

gotten rid of but a little bit of

1134

00:47:31,409 --> 00:47:36,989

actually observational constraints and

1135

00:47:34,949 --> 00:47:39,048

that was from carbon monoxide is that

1136

00:47:36,989 --> 00:47:42,150

right

1137

00:47:39,048 --> 00:47:47,130

also there dis particularly well that's

1138

00:47:42,150 --> 00:47:48,420

right alright so what's what's coming up

1139

00:47:47,130 --> 00:47:50,640

or do you guys I mean I know you guys

1140

00:47:48,420 --> 00:47:52,048

are working on your your paper now for

1141
00:47:50,639 --> 00:47:54,659
based on the observations that were

1142
00:47:52,048 --> 00:47:56,460
taken any plans any

1143
00:47:54,659 --> 00:47:59,219
any future observations with Hubble

1144
00:47:56,460 --> 00:48:04,019
planned or is this pretty much it for

1145
00:47:59,219 --> 00:48:05,309
now we're at the mercy of the science

1146
00:48:04,019 --> 00:48:07,800
community right now we've submitted

1147
00:48:05,309 --> 00:48:10,920
proposals to to look some more of course

1148
00:48:07,800 --> 00:48:14,700
so well we'll just see if they they get

1149
00:48:10,920 --> 00:48:18,090
time Mike you have proposed for more

1150
00:48:14,699 --> 00:48:20,339
Hubble time then yes yes oh yeah and I

1151
00:48:18,090 --> 00:48:21,809
mean both sir archive time as well they

1152
00:48:20,340 --> 00:48:26,990
start looking a bit more carefully at

1153
00:48:21,809 --> 00:48:30,509
the past Great Red Spot it's a grid and

1154
00:48:26,989 --> 00:48:32,609
I jump off from that we will be looking

1155
00:48:30,510 --> 00:48:35,940
at Hubble I'll be applying for Hubble

1156
00:48:32,610 --> 00:48:38,490
data to be supporting the Juno mission

1157
00:48:35,940 --> 00:48:44,329
when that arrives as well and what's the

1158
00:48:38,489 --> 00:48:47,459
timeline for that mid 2016 too late 2017

1159
00:48:44,329 --> 00:48:49,309
a lot of the designated remote sensing

1160
00:48:47,460 --> 00:48:52,199
orbital and fairly early in the mission

1161
00:48:49,309 --> 00:48:53,579
unfortunately which is not very far from

1162
00:48:52,199 --> 00:48:56,489
the Sun so they're third from the

1163
00:48:53,579 --> 00:48:59,940
exclusion zone so exclusion zone but

1164
00:48:56,489 --> 00:49:02,759
we'll be looking for time Junior will be

1165
00:48:59,940 --> 00:49:06,360
looking into very narrow swathe launched

1166
00:49:02,760 --> 00:49:11,550
if it's a polar orbit ER and it's spin

1167
00:49:06,360 --> 00:49:13,530
stabilized so looking at the narrow

1168
00:49:11,550 --> 00:49:16,470
strip in longitude that grows a bit

1169

00:49:13,530 --> 00:49:18,150
wider toward the pole so we want to use

1170
00:49:16,469 --> 00:49:21,689
Hubble and other toss groups to provide

1171
00:49:18,150 --> 00:49:24,510
one context to that as well Jonah has

1172
00:49:21,690 --> 00:49:27,539
one camera and it simply is a methane

1173
00:49:24,510 --> 00:49:30,600
filter and wideband red-green-blue it's

1174
00:49:27,539 --> 00:49:32,550
largely education public outreach camera

1175
00:49:30,599 --> 00:49:34,699
we use it for scientific purposes but

1176
00:49:32,550 --> 00:49:38,310
it's not considered a space grade

1177
00:49:34,699 --> 00:49:44,189
instrument so and so as I heard the

1178
00:49:38,309 --> 00:49:46,380
white field camera 3 is okay alright

1179
00:49:44,190 --> 00:49:48,750
great well good luck on the proposal I

1180
00:49:46,380 --> 00:49:51,660
hope to get more Jupiter observations

1181
00:49:48,750 --> 00:49:53,489
from Hubble are these all the the three

1182
00:49:51,659 --> 00:49:55,829
epochs that we talked about already is

1183
00:49:53,489 --> 00:49:58,019

that been the three main times Carroll

1184

00:49:55,829 --> 00:50:03,329

that Hubble has looked at Jupiter do you

1185

00:49:58,019 --> 00:50:06,750

know of any others there's a lot no yeah

1186

00:50:03,329 --> 00:50:08,078

there are enough by Google's point is

1187

00:50:06,750 --> 00:50:12,759

that it does

1188

00:50:08,079 --> 00:50:14,769

help the archival observations and I'm

1189

00:50:12,759 --> 00:50:16,690

speaking for our guests but I would

1190

00:50:14,768 --> 00:50:19,058

guess that not only looking at the red

1191

00:50:16,690 --> 00:50:21,548

spot but looking at the rest of Jupiter

1192

00:50:19,059 --> 00:50:23,319

even when it doesn't have the red spot

1193

00:50:21,548 --> 00:50:24,969

in the field of view could be very

1194

00:50:23,318 --> 00:50:26,558

informative about the bands and the

1195

00:50:24,969 --> 00:50:28,509

circulation patterns because you have to

1196

00:50:26,559 --> 00:50:30,640

look at that as well so we've actually

1197

00:50:28,509 --> 00:50:32,949

looked at you quite a lot I mean we

1198
00:50:30,639 --> 00:50:35,949
looked at a lot of solar system objects

1199
00:50:32,949 --> 00:50:38,528
quite a lot couple there's always

1200
00:50:35,949 --> 00:50:41,798
changes in some often very surprising

1201
00:50:38,528 --> 00:50:44,130
ways yes and pretty much every every

1202
00:50:41,798 --> 00:50:47,998
imaging instrument on Hubble has

1203
00:50:44,130 --> 00:50:50,140
collected data on the Great Red Spot so

1204
00:50:47,998 --> 00:50:52,358
ideally we would like to compare data

1205
00:50:50,139 --> 00:50:54,940
from all these different instruments so

1206
00:50:52,358 --> 00:50:57,608
we can cover as much of its history as

1207
00:50:54,940 --> 00:50:59,499
we can at high resolution yeah one of

1208
00:50:57,608 --> 00:51:03,429
the things that interests me as much as

1209
00:50:59,498 --> 00:51:07,538
the dynamics and north-south east-west

1210
00:51:03,429 --> 00:51:09,248
flow is the color which is called both

1211
00:51:07,539 --> 00:51:11,140
Amy and Mike as well and it's

1212
00:51:09,248 --> 00:51:15,728
interesting that we see the red spot

1213
00:51:11,139 --> 00:51:17,259
that's buried deep color most often when

1214
00:51:15,728 --> 00:51:18,879
the rest of the material around it is

1215
00:51:17,259 --> 00:51:21,248
light in color which is kind of

1216
00:51:18,880 --> 00:51:26,199
anomalous I'm glad that this is one of

1217
00:51:21,248 --> 00:51:28,268
those which was say during Pioneer 1970s

1218
00:51:26,199 --> 00:51:30,309
you look at pioneer images and you see

1219
00:51:28,268 --> 00:51:32,588
the very white South Equatorial belt

1220
00:51:30,309 --> 00:51:36,729
because normally dark and the red spot

1221
00:51:32,588 --> 00:51:38,528
is very deep red toward Voyager the red

1222
00:51:36,728 --> 00:51:40,328
spots not quite so red and the material

1223
00:51:38,528 --> 00:51:42,670
around it is dark which is kind of

1224
00:51:40,329 --> 00:51:44,048
usually it is right now is really

1225
00:51:42,670 --> 00:51:46,119
interesting because in the tool around

1226

00:51:44,048 --> 00:51:48,548
it is dark and the red spot is really

1227
00:51:46,119 --> 00:51:49,959
really gray which is a little bit

1228
00:51:48,548 --> 00:51:52,028
different from any other time you've

1229
00:51:49,958 --> 00:51:56,318
looked at it so we're in an intriguing

1230
00:51:52,028 --> 00:51:58,028
epoch right now yeah it sounds like a

1231
00:51:56,318 --> 00:52:01,058
lot is going on with with with respect

1232
00:51:58,028 --> 00:52:02,679
to Jupiter right now so okay

1233
00:52:01,059 --> 00:52:05,759
well I guess we're about out of time now

1234
00:52:02,679 --> 00:52:07,538
I want to thank everybody for for

1235
00:52:05,759 --> 00:52:08,858
participating in this hangout this was

1236
00:52:07,539 --> 00:52:09,849
really interesting I really got a lot

1237
00:52:08,858 --> 00:52:11,400
out of it

1238
00:52:09,849 --> 00:52:14,440
we'll look for your paper hopefully

1239
00:52:11,400 --> 00:52:15,999
hopefully we'll be able to talk about a

1240
00:52:14,440 --> 00:52:17,889

few more things we didn't bring up here

1241

00:52:15,998 --> 00:52:19,629

at this particular time but there you

1242

00:52:17,889 --> 00:52:21,789

have it folks the Great Red Spot it's

1243

00:52:19,630 --> 00:52:24,700

shrinking its

1244

00:52:21,789 --> 00:52:26,349

getting rounder it's changing as we

1245

00:52:24,699 --> 00:52:29,799

speaking and Hubble has been looking at it

1246

00:52:26,349 --> 00:52:31,299

and these all of these really very smart

1247

00:52:29,800 --> 00:52:33,250

people have been looking at Jupiter and

1248

00:52:31,300 --> 00:52:34,750

and telling us you know what they're

1249

00:52:33,250 --> 00:52:37,119

finding out so I hope you enjoyed this

1250

00:52:34,750 --> 00:52:39,219

hangout I want to thank you Amy Glenn

1251

00:52:37,119 --> 00:52:41,559

and Mike for joining us thank you all

1252

00:52:39,219 --> 00:52:44,649

very much and Carol Scott it's been a

1253

00:52:41,559 --> 00:52:48,070

lot of fun we're gonna be back for quick

1254

00:52:44,650 --> 00:52:50,500

programming notes Carol and Scott and I

1255
00:52:48,070 --> 00:52:52,690
will be doing these hangouts on a more

1256
00:52:50,500 --> 00:52:54,699
regular basis starting in June our next

1257
00:52:52,690 --> 00:52:56,590
hangout is June 12th we're gonna be

1258
00:52:54,699 --> 00:52:59,019
giving you guys a frontier fields update

1259
00:52:56,590 --> 00:53:01,750
on the frontier fields program so I hope

1260
00:52:59,019 --> 00:53:04,840
you guys can make it there and the time

1261
00:53:01,750 --> 00:53:08,590
will be 3 p.m. Eastern instead of 4 p.m.

1262
00:53:04,840 --> 00:53:12,670
Eastern which makes that seven o'clock

1263
00:53:08,590 --> 00:53:14,530
Greenwich Mean Time and so we hope you

1264
00:53:12,670 --> 00:53:16,510
guys can make it and we will see you

1265
00:53:14,530 --> 00:53:22,110
next time I want to thank you all for

1266
00:53:16,510 --> 00:53:22,110
watching and keep looking up Thanks