
Google+
Jim Morrissey
MAVEN Instrument Systems

1
00:00:00,000 --> 00:00:15,600
and through the door show up

2
00:00:22,570 --> 00:00:19,140
hello and welcome to this NASA Goddard

3
00:00:25,600 --> 00:00:22,580
Google+ Hangout all about the neces next

4
00:00:27,790 --> 00:00:25,610
mars mission it's called maven I'm

5
00:00:29,440 --> 00:00:27,800
joining you here at NASA Goddard and we

6
00:00:30,519 --> 00:00:29,450
have a variety of scientists for joining

7
00:00:33,790 --> 00:00:30,529
us from around the country as they

8
00:00:35,470 --> 00:00:33,800
travel to the launch site of maven it's

9
00:00:38,500 --> 00:00:35,480
going to be launching from florida on

10
00:00:41,080 --> 00:00:38,510
monday out of Cape Canaveral joining us

11
00:00:43,270 --> 00:00:41,090
for this hangout is Jim Morrissey he's

12
00:00:46,360 --> 00:00:43,280
the instrument system manager for nasa

13
00:00:48,250 --> 00:00:46,370

goddard mehdi Benna he's the instrument

14
00:00:50,740 --> 00:00:48,260
scientist for the neutral gas and ion

15
00:00:52,060 --> 00:00:50,750
mass spectrometer at NASA Goddard Mehdi

16
00:00:54,099 --> 00:00:52,070
will be joining us in just a few minutes

17
00:00:56,380 --> 00:00:54,109
Dave brain he's the maven

18
00:00:58,540 --> 00:00:56,390
co-investigator for the laboratory of

19
00:01:00,479 --> 00:00:58,550
atmospheric and space physics out at the

20
00:01:03,009 --> 00:01:00,489
University of Colorado in Boulder and

21
00:01:05,770 --> 00:01:03,019
jasper helices he is the instrument

22
00:01:07,780 --> 00:01:05,780
leader for the solar wind I on analyzer

23
00:01:10,030 --> 00:01:07,790
at the University of California in

24
00:01:11,560 --> 00:01:10,040
Berkeley I Mary's kept here at NASA

25
00:01:13,660 --> 00:01:11,570
Goddard and we're going to be answering

26
00:01:15,700 --> 00:01:13,670
your questions please either put them in

27
00:01:18,039 --> 00:01:15,710
the youtube chat box put them here in

28
00:01:20,050 --> 00:01:18,049
google+ go ahead on twitter using the

29
00:01:22,810 --> 00:01:20,060
hashtag maven and we'll be tracking them

30
00:01:24,609 --> 00:01:22,820
as we go along and you can also ask

31
00:01:25,749 --> 00:01:24,619
those questions on facebook we variety

32
00:01:28,539 --> 00:01:25,759
of people watching all these different

33
00:01:30,340 --> 00:01:28,549
channels for this we're going to go

34
00:01:32,590 --> 00:01:30,350
right to one of the very first questions

35
00:01:35,950 --> 00:01:32,600
probably the very first most obvious

36
00:01:38,319 --> 00:01:35,960
question for this and that is what is

37
00:01:41,469 --> 00:01:38,329
maven and what does may even stand for

38
00:01:44,260 --> 00:01:41,479

as we see if we can lock in Dave brain

39
00:01:46,450 --> 00:01:44,270
i'm going to go ahead and put a gym

40
00:01:50,469 --> 00:01:46,460
morrissey on the spot and have Jim tell

41
00:01:53,080 --> 00:01:50,479
us about move on hi iris I maven is its

42
00:01:55,270 --> 00:01:53,090
products first planetary mission we're

43
00:02:00,340 --> 00:01:55,280
going to be launching on Monday November

44
00:02:03,999 --> 00:02:00,350
18 um this is a Mars mission to go and

45
00:02:06,880 --> 00:02:04,009
study the upper atmosphere of Mars um we

46
00:02:08,740 --> 00:02:06,890
have I can see now we have all our we

47
00:02:12,670 --> 00:02:08,750
have several of our key instrument miss

48
00:02:15,900 --> 00:02:12,680
Ramirez on and these guys are ready to

49
00:02:18,220 --> 00:02:15,910
answer questions about their instruments

50
00:02:20,140 --> 00:02:18,230
thank you so much and I'll see now that

51
00:02:22,660 --> 00:02:20,150
we have many better has joined us and

52
00:02:25,059 --> 00:02:22,670
every angry I'm gonna do

53
00:02:26,860 --> 00:02:25,069
you let us run a little bit more about

54
00:02:29,199 --> 00:02:26,870
what made them stands for about the

55
00:02:30,280 --> 00:02:29,209
mission itself and i want to remind all

56
00:02:35,280 --> 00:02:30,290
of our participants if you're not

57
00:02:46,059 --> 00:02:41,410
so Dave can you hear us how about Mehdi

58
00:02:47,940 --> 00:02:46,069
can you hear us well areas i can go

59
00:02:50,920 --> 00:02:47,950
ahead and answer the question thank you

60
00:02:55,270 --> 00:02:50,930
maven stands for the Mars atmosphere and

61
00:02:58,990 --> 00:02:55,280
volatile evolution mission the the

62
00:03:02,530 --> 00:02:59,000
purpose of the mission is to is to orbit

63
00:03:04,059 --> 00:03:02,540

Mars and in how eccentric orbit where

64
00:03:05,740 --> 00:03:04,069
will what will be studying the

65
00:03:07,330 --> 00:03:05,750
composition of the atmosphere taking

66
00:03:09,930 --> 00:03:07,340
measurements Institute measurements of

67
00:03:13,210 --> 00:03:09,940
the atmosphere near the surface and then

68
00:03:16,030 --> 00:03:13,220
during the times where were higher above

69
00:03:19,330 --> 00:03:16,040
the planet at our Apple apps point will

70
00:03:20,830 --> 00:03:19,340
be taking images of the planet spectral

71
00:03:26,440 --> 00:03:20,840
images to to determine the composition

72
00:03:28,599 --> 00:03:26,450
beyond the script at the same time we we

73
00:03:32,319 --> 00:03:28,609
measure the solar energy coming from the

74
00:03:34,360 --> 00:03:32,329
Sun in order to understand how that

75
00:03:36,310 --> 00:03:34,370
energy affects the composition of the

76
00:03:38,380 --> 00:03:36,320
atmosphere and ultimately all this

77
00:03:41,289 --> 00:03:38,390
information that we that we collect goes

78
00:03:43,180 --> 00:03:41,299
into models that can models of the

79
00:03:46,390 --> 00:03:43,190
atmosphere that we can run forwards or

80
00:03:49,330 --> 00:03:46,400
backwards to understand what the well at

81
00:03:50,620 --> 00:03:49,340
the atmosphere you salute like hundreds

82
00:03:52,990 --> 00:03:50,630
of millions of years ago and what it's

83
00:03:54,190 --> 00:03:53,000
going to look like in the future one of

84
00:03:58,270 --> 00:03:54,200
the interesting things about that is

85
00:04:01,150 --> 00:03:58,280
that other missions have shown surface

86
00:04:02,920 --> 00:04:01,160
missions and admissions I've gone out

87
00:04:06,520 --> 00:04:02,930
and photographed bondage have shown that

88
00:04:08,890 --> 00:04:06,530

there is evidence that was flowing mark

89
00:04:12,220 --> 00:04:08,900
flowing water on the surface of Mars at

90
00:04:14,860 --> 00:04:12,230
one point which is a precursor to life

91
00:04:16,990 --> 00:04:14,870
so we need to enter what maybe we'll do

92
00:04:20,039 --> 00:04:17,000
is to help us understand the

93
00:04:22,900 --> 00:04:20,049
habitability of Mars and in the past and

94
00:04:27,480 --> 00:04:22,910
and was it once capable of supporting

95
00:04:31,450 --> 00:04:30,040
wonderful and I would love to see Mehdi

96
00:04:33,909 --> 00:04:31,460
now that you've we've got you back in

97
00:04:35,320 --> 00:04:33,919
the Hangout can you talk a little bit

98
00:04:37,540 --> 00:04:35,330
about the instrument that you have

99
00:04:39,820 --> 00:04:37,550
helped design for maven why that

100
00:04:41,499 --> 00:04:39,830
instrument ends up telling us all kinds

101
00:04:44,950 --> 00:04:41,509
of solutions or answers about the

102
00:04:47,409 --> 00:04:44,960
Martian atmosphere thank you so the

103
00:04:49,659 --> 00:04:47,419
instrument we have designed at NASA

104
00:04:52,210 --> 00:04:49,669
Goddard is the neutral gas and ion mass

105
00:04:54,640 --> 00:04:52,220
spectrometer it's an instrument that

106
00:04:57,570 --> 00:04:54,650
allow us to measure the composition and

107
00:05:02,890 --> 00:04:57,580
isotopes of neutral gases and ions of

108
00:05:05,920 --> 00:05:02,900
the upper atmosphere of Mars so this

109
00:05:09,520 --> 00:05:05,930
instrument basically look at neutral

110
00:05:11,290 --> 00:05:09,530
particles and turn them into charged

111
00:05:12,969 --> 00:05:11,300
particles by bombarding them by

112
00:05:17,080 --> 00:05:12,979
electrons and then we take them through

113
00:05:19,990 --> 00:05:17,090

a mass analyzer that allow us to not

114
00:05:22,659 --> 00:05:20,000
only separate the species / / the mass

115
00:05:27,430 --> 00:05:22,669
or other wait how heavy they are but

116
00:05:30,790 --> 00:05:27,440
also to look how many of them we we have

117
00:05:33,310 --> 00:05:30,800
in thy gas so this instrument is key for

118
00:05:38,219 --> 00:05:33,320
maven because this is the only

119
00:05:42,520 --> 00:05:38,229
instrument onboard that allow us to see

120
00:05:44,529 --> 00:05:42,530
the to analyze the neutral gas in situ

121
00:05:47,140 --> 00:05:44,539
we have another instrument is the

122
00:05:49,870 --> 00:05:47,150
ultraviolet mass spec ultraviolet

123
00:05:52,779 --> 00:05:49,880
spectrometer that allow us to look at

124
00:05:57,640 --> 00:05:52,789
the same gas but by a remote sensing so

125
00:05:59,529 --> 00:05:57,650
using both to the both of the the two

126
00:06:03,100 --> 00:05:59,539
instruments we can actually analyze

127
00:06:05,589 --> 00:06:03,110
what's what's what's what's local and

128
00:06:10,360 --> 00:06:05,599
also look ahead of the spacecraft and

129
00:06:13,870 --> 00:06:10,370
analyze the gas at distance Mehdi thank

130
00:06:16,809 --> 00:06:13,880
you so much um Jasper I wanted to ask

131
00:06:19,089 --> 00:06:16,819
you to talk a little bit about what your

132
00:06:22,870 --> 00:06:19,099
instrument on maven is going to do once

133
00:06:25,089 --> 00:06:22,880
it goes into orbit around Mars yeah I'd

134
00:06:27,010 --> 00:06:25,099
love to um so my instrument is the solar

135
00:06:28,629 --> 00:06:27,020
wind I had analyzer it's a it's a very

136
00:06:31,450 --> 00:06:28,639
descriptively named instrument because

137
00:06:33,490 --> 00:06:31,460
it measures solar wind ions what are

138
00:06:36,670 --> 00:06:33,500

those they're basically this beam of

139
00:06:38,589 --> 00:06:36,680
very very fast protons fully ionized

140
00:06:40,959 --> 00:06:38,599
hydrogen that's coming out of the Sun at

141
00:06:42,459 --> 00:06:40,969
400 kilometers per second

142
00:06:43,929 --> 00:06:42,469
put that into units that might mean a

143
00:06:46,449 --> 00:06:43,939
little bit more to you that's about a

144
00:06:48,699 --> 00:06:46,459
million miles an hour so my instrument

145
00:06:50,350 --> 00:06:48,709
is tailored to measure that the

146
00:06:52,029 --> 00:06:50,360
instruments on the Maven payload kind of

147
00:06:53,619 --> 00:06:52,039
fall into two or three different

148
00:06:55,449 --> 00:06:53,629
categories depending on how you like to

149
00:06:56,949 --> 00:06:55,459
think about it there's the instruments

150
00:06:58,509 --> 00:06:56,959
like medis instrument that he just

151
00:07:01,600 --> 00:06:58,519
described that measure what's going on

152
00:07:02,979 --> 00:07:01,610
right in the atmosphere of Mars then

153
00:07:05,289 --> 00:07:02,989
there are instruments which measure

154
00:07:08,019 --> 00:07:05,299
what's coming at Mars from the Sun and

155
00:07:09,279 --> 00:07:08,029
my instrument falls into that camp and

156
00:07:11,139 --> 00:07:09,289
then there's a third set of instruments

157
00:07:12,609 --> 00:07:11,149
which measures things which are escaping

158
00:07:14,319 --> 00:07:12,619
from the atmosphere of Mars of course

159
00:07:16,359 --> 00:07:14,329
that's the ultimate goal of the Maven

160
00:07:18,189 --> 00:07:16,369
mission is to understand how those

161
00:07:20,499 --> 00:07:18,199
escaping things from the atmosphere

162
00:07:22,869 --> 00:07:20,509
relate to what's coming at Mars from the

163
00:07:27,909 --> 00:07:22,879

side so that's that's kind of it in a

164
00:07:30,189 --> 00:07:27,919
nutshell excellent and now when it comes

165
00:07:32,589 --> 00:07:30,199
to the total number of instruments on

166
00:07:35,019 --> 00:07:32,599
maven itself as owning many can you

167
00:07:36,789 --> 00:07:35,029
describe a little bit more about how

168
00:07:44,119 --> 00:07:36,799
they all have how many of them there are

169
00:07:49,879 --> 00:07:47,089
oh and quick reminder meta you may have

170
00:07:51,709 --> 00:07:49,889
mute your muted your microphone yes I'm

171
00:07:56,629 --> 00:07:51,719
sorry so it really depends how you look

172
00:08:01,999 --> 00:07:56,639
at it we actually have four packages on

173
00:08:04,429 --> 00:08:02,009
board we have the the plasma package

174
00:08:06,979 --> 00:08:04,439
that allows to plasma fields package

175
00:08:10,639 --> 00:08:06,989
that's composed of multiple sensors that

176
00:08:13,119 --> 00:08:10,649
allows to look at look at the charged

177
00:08:15,919 --> 00:08:13,129
particles look at the magnetic field and

178
00:08:18,669 --> 00:08:15,929
and Jasper talked a little bit about

179
00:08:21,290 --> 00:08:18,679
that we have the ultraviolet

180
00:08:26,059 --> 00:08:21,300
spectrometer that allows to do a remote

181
00:08:28,419 --> 00:08:26,069
sensing and we have the neutral gas and

182
00:08:30,859 --> 00:08:28,429
ion mass spectrometer which is a

183
00:08:33,050 --> 00:08:30,869
separate instrument by itself that allow

184
00:08:35,269 --> 00:08:33,060
us to do in situ so actually there are

185
00:08:37,909 --> 00:08:35,279
three big packages when you count the

186
00:08:39,439 --> 00:08:37,919
number of sensors my colleagues may

187
00:08:45,740 --> 00:08:39,449
correct me but I think we have about

188
00:08:48,350 --> 00:08:45,750

eight or nine sensors on board okay

189
00:08:49,970 --> 00:08:48,360
thank you so much Mehdi I'm wondering it

190
00:08:51,319 --> 00:08:49,980
Dave let's give it a shot i think we've

191
00:08:52,910 --> 00:08:51,329
had Dave go popping it out of this

192
00:08:54,290 --> 00:08:52,920
hangout as we've been going along this

193
00:08:55,879 --> 00:08:54,300
is part of the charm of using a google

194
00:08:57,139 --> 00:08:55,889
plus hangouts we've got these scientists

195
00:08:58,970 --> 00:08:57,149
in their offices while they're getting

196
00:09:00,829 --> 00:08:58,980
ready for a launch so we have them in

197
00:09:03,050 --> 00:09:00,839
all kinds of locations on all kinds of

198
00:09:04,610 --> 00:09:03,060
different Wi-Fi networks but let's see

199
00:09:06,829 --> 00:09:04,620
if this works with Dave brain I'm dick

200
00:09:09,079 --> 00:09:06,839
tell us a little bit about the orbit of

201
00:09:10,699 --> 00:09:09,089
made them and when it actually will

202
00:09:13,129 --> 00:09:10,709
arrive at Mars we've already said that

203
00:09:15,679 --> 00:09:13,139
it's going to launch this Monday knock

204
00:09:18,079 --> 00:09:15,689
wood from Cape Canaveral in Florida how

205
00:09:20,150 --> 00:09:18,089
long will it take maven to make it to

206
00:09:23,830 --> 00:09:20,160
the red planet and what kind of orbit

207
00:09:30,820 --> 00:09:27,280
and that was for Dave brain you might

208
00:09:34,240 --> 00:09:30,830
still have him being held up there dave

209
00:09:35,980 --> 00:09:34,250
is not working favorite record how about

210
00:09:39,730 --> 00:09:35,990
Jim Morrissey would you might go ahead

211
00:09:42,160 --> 00:09:39,740
dripping on that sure is um we're

212
00:09:44,170 --> 00:09:42,170
launching on Monday it takes us about 10

213
00:09:46,770 --> 00:09:44,180

months to get there so we launched on

214
00:09:53,530 --> 00:09:46,780
Monday will be arriving in September of

215
00:09:56,070 --> 00:09:53,540
2004 after we get there we perform a

216
00:10:00,160 --> 00:09:56,080
Mars insertion or Mars insertion

217
00:10:02,290 --> 00:10:00,170
maneuver which which decelerates us so

218
00:10:05,110 --> 00:10:02,300
it'll captured into Mars orbit will

219
00:10:07,990 --> 00:10:05,120
capture it into a lip tickle orbit that

220
00:10:12,010 --> 00:10:08,000
um that we afterwards trimmed down to

221
00:10:14,920 --> 00:10:12,020
the orbit that one our mission will last

222
00:10:18,850 --> 00:10:14,930
for our nominal mission is for one year

223
00:10:22,650 --> 00:10:18,860
we have the capability to extend that to

224
00:10:27,270 --> 00:10:22,660
up to about two more years if needed

225
00:10:32,320 --> 00:10:27,280
after that after that two year period we

226
00:10:35,880 --> 00:10:32,330
we we transition into a into a tell into

227
00:10:39,580 --> 00:10:35,890
a real a mode where we have a Electra

228
00:10:40,900 --> 00:10:39,590
transmitter on board which is a u.s. uhf

229
00:10:43,540 --> 00:10:40,910
transmitter that's capable of

230
00:10:46,330 --> 00:10:43,550
communicating with the Rovers on the

231
00:10:50,020 --> 00:10:46,340
ground so so after our primary mission

232
00:10:54,370 --> 00:10:50,030
we will serve as a as a relay for those

233
00:10:57,000 --> 00:10:54,380
Rovers and future Mars rovers that that

234
00:11:00,550 --> 00:10:57,010
need to communicate through us better

235
00:11:02,110 --> 00:11:00,560
thank you so much Jim um we have a

236
00:11:03,430 --> 00:11:02,120
question that's coming now on google+

237
00:11:05,350 --> 00:11:03,440
and i want to remind everybody that

238
00:11:06,520 --> 00:11:05,360

we're having a little technical issues

239
00:11:07,780 --> 00:11:06,530
with some of the participants dropping

240
00:11:08,680 --> 00:11:07,790
in and out during this hangout it's

241
00:11:10,390 --> 00:11:08,690
because we're reaching all these

242
00:11:11,980 --> 00:11:10,400
scientists as they travel to get ready

243
00:11:13,570 --> 00:11:11,990
for the launch of mavin which is going

244
00:11:15,550 --> 00:11:13,580
to be this coming monday or it's

245
00:11:17,230 --> 00:11:15,560
expected to be this monday we do have a

246
00:11:18,820 --> 00:11:17,240
question from google plus you can ask

247
00:11:21,400 --> 00:11:18,830
questions on twitter using the hashtag

248
00:11:23,440 --> 00:11:21,410
maven in the YouTube Google Hangouts

249
00:11:25,780 --> 00:11:23,450
comments box or in Google+ and I'm going

250
00:11:28,750 --> 00:11:25,790
to look over somebody's shoulder here on

251
00:11:31,120 --> 00:11:28,760
google plus Anders harned all sorry if I

252
00:11:33,760 --> 00:11:31,130
butchered your last name he asked to

253
00:11:36,460 --> 00:11:33,770
what extent would Mars's strong local

254
00:11:37,689 --> 00:11:36,470
magnetic fields offer protection from

255
00:11:39,939 --> 00:11:37,699
solar and

256
00:11:42,669 --> 00:11:39,949
cosmic radiation mehdi would you mind

257
00:11:45,369 --> 00:11:42,679
commenting on that and how r mars is a

258
00:11:47,079 --> 00:11:45,379
strong local magnetic fields in any way

259
00:11:50,559 --> 00:11:47,089
protecting that planet from both solar

260
00:11:56,769 --> 00:11:50,569
and cosmic radiation yes so merciful

261
00:12:01,269 --> 00:11:56,779
really peculiar of the fourth planets

262
00:12:03,609 --> 00:12:01,279
close to the Sun Mars has what we call a

263
00:12:06,429 --> 00:12:03,619

remnant magnetic field so it used to be

264
00:12:09,489 --> 00:12:06,439
have a magnetic field like earth and a

265
00:12:11,169 --> 00:12:09,499
lost somehow and what we see today is a

266
00:12:14,079 --> 00:12:11,179
remnant of a magnetic field so the

267
00:12:18,819 --> 00:12:14,089
magnetic field while it's still strong

268
00:12:21,970 --> 00:12:18,829
to shield the planet from some of the

269
00:12:25,210 --> 00:12:21,980
solar wind and the cosmic radiations

270
00:12:27,669 --> 00:12:25,220
it's actually not efficient enough to

271
00:12:31,210 --> 00:12:27,679
ultimately shell the planet and avoid

272
00:12:34,210 --> 00:12:31,220
its loss of atmosphere so and that's

273
00:12:36,400 --> 00:12:34,220
where where the Maven mission comes to

274
00:12:38,109 --> 00:12:36,410
play because we will be looking at the

275
00:12:40,030 --> 00:12:38,119
magnetic field measuring the magnetic

276
00:12:41,799 --> 00:12:40,040
local magnetic field of the planet but

277
00:12:44,979 --> 00:12:41,809
also look at how charged particles

278
00:12:47,529 --> 00:12:44,989
coming from the Sun interact with this

279
00:12:49,359 --> 00:12:47,539
magnetic field what gets lost and how

280
00:12:52,929 --> 00:12:49,369
the energy is transferred between the

281
00:12:55,809 --> 00:12:52,939
two and many how does can you compare

282
00:12:58,960 --> 00:12:55,819
what Mars is magnetic field is like now

283
00:13:00,189 --> 00:12:58,970
versus what Earth's is like it's kind of

284
00:13:01,569 --> 00:13:00,199
common knowledge here at NASA but

285
00:13:03,009 --> 00:13:01,579
probably not common knowledge everywhere

286
00:13:04,840 --> 00:13:03,019
that Earth has a real strong magnetic

287
00:13:08,769 --> 00:13:04,850
field that manages to protect our planet

288
00:13:10,989 --> 00:13:08,779

in some ways yes so so the the core of

289
00:13:13,499 --> 00:13:10,999
the earth has a has a dynamo that

290
00:13:16,720 --> 00:13:13,509
basically is a big magnet and that

291
00:13:20,229 --> 00:13:16,730
maintains a strong magnetic field around

292
00:13:23,889 --> 00:13:20,239
Earth Mars you we think Mars used to

293
00:13:25,749 --> 00:13:23,899
have that the same structure around it

294
00:13:27,460 --> 00:13:25,759
same magnetic field structure and lots

295
00:13:29,199 --> 00:13:27,470
of the time so what we see today it's

296
00:13:31,389 --> 00:13:29,209
just that magnetic remanence field

297
00:13:34,059 --> 00:13:31,399
that's still embedded on the rocks and

298
00:13:36,999 --> 00:13:34,069
they still have that little magnetic

299
00:13:39,639 --> 00:13:37,009
field left and and and chilled the

300
00:13:41,470 --> 00:13:39,649
planet and on some some of its surface

301
00:13:45,579 --> 00:13:41,480
from the solar wind if we have to

302
00:13:47,710 --> 00:13:45,589
compare I mean let maybe Jasper give you

303
00:13:51,070 --> 00:13:47,720
an accurate number but there is a factor

304
00:13:56,800 --> 00:13:51,080
of a thousand smaller field than

305
00:13:58,750 --> 00:13:56,810
what we see on earth thank you so much

306
00:14:01,930 --> 00:13:58,760
Mehdi and we have a bunch of questions

307
00:14:03,100 --> 00:14:01,940
coming in now on Twitter asking

308
00:14:08,940 --> 00:14:03,110
questions on Twitter please use the

309
00:14:11,680 --> 00:14:08,950
hashtag maven it's hashtag ma vie en and

310
00:14:13,510 --> 00:14:11,690
William bum asks a question that we sort

311
00:14:14,860 --> 00:14:13,520
of may have answered a little bit but

312
00:14:16,330 --> 00:14:14,870
I'd left to throw it to Jim Morrissey to

313
00:14:19,480 --> 00:14:16,340

see if he can expand on this a little

314
00:14:21,280 --> 00:14:19,490
bit Williams question is what kind of

315
00:14:23,980 --> 00:14:21,290
extended science missions will may even

316
00:14:25,540 --> 00:14:23,990
perform while serving as the relay now I

317
00:14:27,460 --> 00:14:25,550
think we William asked that question

318
00:14:30,580 --> 00:14:27,470
before you went into exactly what mavens

319
00:14:32,080 --> 00:14:30,590
going to be tracking but i'd love to see

320
00:14:33,880 --> 00:14:32,090
jim if you could talk a little bit more

321
00:14:36,160 --> 00:14:33,890
about how long each one of those

322
00:14:40,480 --> 00:14:36,170
instruments are expected to run once

323
00:14:45,340 --> 00:14:40,490
maven is in orbit around Mars sure well

324
00:14:47,130 --> 00:14:45,350
the the the extended mission the first

325
00:14:49,510 --> 00:14:47,140
part of our extended mission would be

326
00:14:54,490 --> 00:14:49,520
would be just a continuation of what

327
00:14:58,390 --> 00:14:54,500
we're doing over the first year in that

328
00:15:02,380 --> 00:14:58,400
in that configuration we we come further

329
00:15:04,660 --> 00:15:02,390
we dip down well our periapsis is about

330
00:15:07,030 --> 00:15:04,670
is about 150 kilometers above the

331
00:15:08,680 --> 00:15:07,040
surface of the planet and that even at

332
00:15:10,900 --> 00:15:08,690
that altitude the small atmosphere that

333
00:15:13,710 --> 00:15:10,910
Mars has further Bates our orbit to some

334
00:15:16,450 --> 00:15:13,720
extent so we have to we have to perform

335
00:15:18,400 --> 00:15:16,460
trim maneuvers to to maintain our orbit

336
00:15:20,650 --> 00:15:18,410
so what we do when we get into the relay

337
00:15:23,200 --> 00:15:20,660
mode is that we raise that Perry apps of

338
00:15:25,330 --> 00:15:23,210

altitude to a point where we can we can

339
00:15:27,220 --> 00:15:25,340
continue on indefinitely doing

340
00:15:28,780 --> 00:15:27,230
operations but one of the one of the

341
00:15:31,540 --> 00:15:28,790
drawbacks of that is that we no longer

342
00:15:33,090 --> 00:15:31,550
are able to take those Institute

343
00:15:35,920 --> 00:15:33,100
measurements that may be talked about

344
00:15:38,500 --> 00:15:35,930
close down into the atmosphere but that

345
00:15:40,540 --> 00:15:38,510
doesn't mean we can't do any signs we

346
00:15:43,000 --> 00:15:40,550
can still we still take solar

347
00:15:46,360 --> 00:15:43,010
measurements we can still do some of the

348
00:15:49,570 --> 00:15:46,370
remote sensing imaging with our ultra

349
00:15:53,020 --> 00:15:49,580
violet spectrometer but mostly during

350
00:15:55,300 --> 00:15:53,030
that during that post science part of

351
00:15:58,510 --> 00:15:55,310
our mission we will we will be there

352
00:15:59,800 --> 00:15:58,520
serving as real life but there you know

353
00:16:03,990 --> 00:15:59,810
there is possibility to do science

354
00:16:11,050 --> 00:16:07,690
and Jasper do you had something to add

355
00:16:12,340 --> 00:16:11,060
to that oh yeah just to follow up on the

356
00:16:14,680 --> 00:16:12,350
question about the crystal magnetic

357
00:16:16,540 --> 00:16:14,690
field and their strength I wanted to

358
00:16:19,060 --> 00:16:16,550
point out that actually those fields are

359
00:16:20,560 --> 00:16:19,070
are quite strong in very localized

360
00:16:22,270 --> 00:16:20,570
regions they just don't happen to be

361
00:16:24,460 --> 00:16:22,280
nearly as widespread as the Earth's

362
00:16:27,100 --> 00:16:24,470
field so in the Earth's field right now

363
00:16:29,260 --> 00:16:27,110

most of us are sitting in around 50,000

364
00:16:31,390 --> 00:16:29,270
nano teslas or so to use a canonical

365
00:16:33,130 --> 00:16:31,400
units there actually are fields on the

366
00:16:35,140 --> 00:16:33,140
surface of Mars that probably reach up

367
00:16:37,360 --> 00:16:35,150
into the tens of thousands of mana Tesla

368
00:16:39,580 --> 00:16:37,370
but they just aren't very widespread

369
00:16:41,560 --> 00:16:39,590
they only extend for you know a thousand

370
00:16:43,810 --> 00:16:41,570
kilometers or so so when you look at

371
00:16:45,700 --> 00:16:43,820
Mars from a distance its effect it's

372
00:16:47,560 --> 00:16:45,710
effectively unmagnetized but then when

373
00:16:49,690 --> 00:16:47,570
you get up very very close in one of

374
00:16:51,490 --> 00:16:49,700
these magnetic regions on the fields

375
00:16:54,070 --> 00:16:51,500
could actually be quite strong there and

376
00:16:55,750 --> 00:16:54,080
as these fields rotate around of course

377
00:16:57,700 --> 00:16:55,760
Mars is presenting a different face to

378
00:16:59,620 --> 00:16:57,710
the solar wind into the Sun at all times

379
00:17:01,540 --> 00:16:59,630
you can imagine that there will be some

380
00:17:03,340 --> 00:17:01,550
very dynamic effects as these strong

381
00:17:06,090 --> 00:17:03,350
localized field regions rotate around

382
00:17:09,970 --> 00:17:06,100
and present different faces to the side

383
00:17:11,290 --> 00:17:09,980
and we have a number of videos and

384
00:17:14,770 --> 00:17:11,300
animations that we're going to be able

385
00:17:16,720 --> 00:17:14,780
to show if you go to nasa gov / maven

386
00:17:18,580 --> 00:17:16,730
you'll see many of these animations a

387
00:17:20,170 --> 00:17:18,590
few of them that explains what Jasper

388
00:17:21,730 --> 00:17:20,180

was doing his hands just there which is

389
00:17:24,060 --> 00:17:21,740
how the solar wings whack and the the

390
00:17:26,260 --> 00:17:24,070
magnetic field helps complete cover Mars

391
00:17:28,150 --> 00:17:26,270
we've got a bunch of questions that are

392
00:17:30,430 --> 00:17:28,160
that bring up probably something that

393
00:17:31,960 --> 00:17:30,440
must drive you a little crazy and that a

394
00:17:33,930 --> 00:17:31,970
lot of you are asking all about this new

395
00:17:37,000 --> 00:17:33,940
Rover that we're putting up on Mars

396
00:17:39,100 --> 00:17:37,010
called maven and I'm wondering at Jim

397
00:17:41,380 --> 00:17:39,110
can you talk a little bit about that

398
00:17:43,060 --> 00:17:41,390
underscore that maven is not a rover but

399
00:17:44,350 --> 00:17:43,070
instead will orbit the red planet but

400
00:17:45,790 --> 00:17:44,360
then exactly you talk a little bit how

401
00:17:47,380 --> 00:17:45,800
it's going to serve as a relay but ours

402
00:17:49,630 --> 00:17:47,390
is curiosity going to be able to lean

403
00:17:53,560 --> 00:17:49,640
its head back and see maven as it once

404
00:17:55,660 --> 00:17:53,570
it gets into orbit around Mars um well

405
00:17:57,820 --> 00:17:55,670
that's that's a good question yeah and

406
00:18:00,670 --> 00:17:57,830
you're correct maven is is not a rover

407
00:18:03,910 --> 00:18:00,680
maven is a it is a satellite it will be

408
00:18:05,830 --> 00:18:03,920
orbiting the point of it just to go back

409
00:18:07,780 --> 00:18:05,840
just a little bit on definitions as I

410
00:18:10,000 --> 00:18:07,790
was referring to the Perry apps and the

411
00:18:13,630 --> 00:18:10,010
apple apps and just so everyone knows

412
00:18:15,640 --> 00:18:13,640
the Perry apps is the that that's the

413
00:18:17,529 --> 00:18:15,650

the perhaps is the point in the orbit

414
00:18:19,389 --> 00:18:17,539
where the spacecraft is

415
00:18:21,940 --> 00:18:19,399
it's Louis altitude relative to the

416
00:18:24,099 --> 00:18:21,950
surface of the planet and the Apple apps

417
00:18:27,099 --> 00:18:24,109
is the opposite that's that's where

418
00:18:31,529 --> 00:18:27,109
we're furthest away from the pond but

419
00:18:37,389 --> 00:18:34,210
spacecraft in its orbit it will actually

420
00:18:39,729 --> 00:18:37,399
be too small for for curiosity to to

421
00:18:44,139 --> 00:18:39,739
actually take an image from the from the

422
00:18:45,820 --> 00:18:44,149
surface of the planet but we do you know

423
00:18:48,999 --> 00:18:45,830
we will have this capability of

424
00:18:52,019 --> 00:18:49,009
communicating with curiosity if if we

425
00:18:54,879 --> 00:18:52,029
need to and any information that

426
00:18:56,589 --> 00:18:54,889
curiosity sends us where we sort of

427
00:18:58,389 --> 00:18:56,599
relay directly back to earth so that's

428
00:19:03,070 --> 00:18:58,399
that's one of our secondary functions of

429
00:19:05,229 --> 00:19:03,080
this mission thank you so much good just

430
00:19:07,089 --> 00:19:05,239
to remind everyone I'm this I Mary's

431
00:19:09,700 --> 00:19:07,099
cake here at NASA Goddard and this is a

432
00:19:11,680 --> 00:19:09,710
google plus live hangout about the Maven

433
00:19:13,659 --> 00:19:11,690
mission to mars it's scheduled to launch

434
00:19:15,759 --> 00:19:13,669
this coming Monday if you're watching

435
00:19:18,339 --> 00:19:15,769
this hangout as its archived continue to

436
00:19:21,430 --> 00:19:18,349
ask us questions using the hashtag Navin

437
00:19:23,499 --> 00:19:21,440
on Twitter or any of the NASA channels

438
00:19:25,690 --> 00:19:23,509

or the maven missions if you're watching

439
00:19:27,849 --> 00:19:25,700
it live now go ahead ask questions on

440
00:19:31,180 --> 00:19:27,859
youtube or in Google+ or again using the

441
00:19:33,789 --> 00:19:31,190
hashtag Navin many of the scientists

442
00:19:36,159 --> 00:19:33,799
joining us are traveling for the launch

443
00:19:37,629 --> 00:19:36,169
um on Monday which is why we have some

444
00:19:39,820 --> 00:19:37,639
interesting Wi-Fi issues and things

445
00:19:43,210 --> 00:19:39,830
happening but we do have many benda here

446
00:19:45,039 --> 00:19:43,220
many been ahir and he not only worked

447
00:19:48,249 --> 00:19:45,049
with the Maven mission but helped work

448
00:19:50,529 --> 00:19:48,259
with the Mars Science Laboratory the MSL

449
00:19:52,389 --> 00:19:50,539
that is up on curiosity Mehdi can you

450
00:19:55,869 --> 00:19:52,399
talk a little bit about that and about

451
00:19:59,019 --> 00:19:55,879
how the maven science works together yes

452
00:20:01,019 --> 00:19:59,029
so that currently the Curiosity rover on

453
00:20:04,629 --> 00:20:01,029
the surface of Mars is doing an amazing

454
00:20:06,549 --> 00:20:04,639
work on analyzing rocks but a lot of

455
00:20:09,789 --> 00:20:06,559
people don't know that maybe that nsl

456
00:20:12,549 --> 00:20:09,799
the Curiosity rover also regularly

457
00:20:15,909 --> 00:20:12,559
perform analysis on the atmosphere of

458
00:20:17,460 --> 00:20:15,919
Mars so we have the rover looking at the

459
00:20:23,109 --> 00:20:17,470
composition of the lower atmosphere

460
00:20:26,310 --> 00:20:23,119
locally at on the surface of Mars and we

461
00:20:28,960 --> 00:20:26,320
will have maven flying over and

462
00:20:30,310 --> 00:20:28,970
analyzing the upper atmosphere of Mars

463
00:20:32,409 --> 00:20:30,320

so we

464
00:20:37,240 --> 00:20:32,419
allow us actually to do great science

465
00:20:39,279 --> 00:20:37,250
where we can constrain the processes

466
00:20:41,049 --> 00:20:39,289
that affect in the atmosphere not only

467
00:20:44,230 --> 00:20:41,059
by looking the Opera atmosphere but also

468
00:20:46,090 --> 00:20:44,240
looking at at what's happening at the

469
00:20:49,149 --> 00:20:46,100
surface and when you merge the two

470
00:20:51,430 --> 00:20:49,159
science the two data sets from both

471
00:20:54,610 --> 00:20:51,440
missions together you can really put a

472
00:20:58,840 --> 00:20:54,620
very nice story of how the atmosphere

473
00:21:01,779 --> 00:20:58,850
evolves over geological times and how

474
00:21:05,100 --> 00:21:01,789
the atmosphere escaped and got lost to

475
00:21:07,269 --> 00:21:05,110
space for the last few billion years

476
00:21:09,330 --> 00:21:07,279
thank you so much and we've got a

477
00:21:13,330 --> 00:21:09,340
question coming in from google plus and

478
00:21:14,980 --> 00:21:13,340
it comes from James lund bad and Jim

479
00:21:17,499 --> 00:21:14,990
once James wants to know how do you

480
00:21:19,419 --> 00:21:17,509
learn to design a spacecraft instrument

481
00:21:21,940 --> 00:21:19,429
and are there graduate courses in space

482
00:21:24,999 --> 00:21:21,950
physics instrument design I'm going to

483
00:21:28,180 --> 00:21:25,009
throw that over 2a Jasper to take that

484
00:21:29,409 --> 00:21:28,190
one because how how was if someone's

485
00:21:30,460 --> 00:21:29,419
watching this and what they really want

486
00:21:32,139 --> 00:21:30,470
to do is learn how to design a

487
00:21:33,460 --> 00:21:32,149
spacecraft instrument where do they go

488
00:21:36,129 --> 00:21:33,470

how did they sign up to get those

489
00:21:37,690 --> 00:21:36,139
classes which your first step well

490
00:21:39,940 --> 00:21:37,700
that's a fantastic question and it's

491
00:21:41,259 --> 00:21:39,950
it's particularly apt for me because I

492
00:21:43,629 --> 00:21:41,269
think I'm the youngest and most

493
00:21:45,789 --> 00:21:43,639
inexperienced district lead on maven so

494
00:21:47,110 --> 00:21:45,799
I learned a lot actually in the course

495
00:21:50,379 --> 00:21:47,120
of this project and of the school of

496
00:21:52,299 --> 00:21:50,389
hard knocks my background personally I

497
00:21:54,009 --> 00:21:52,309
was a graduate student in the physics

498
00:21:56,019 --> 00:21:54,019
department here at UC Berkeley and then

499
00:21:57,850 --> 00:21:56,029
I started doing research here at the

500
00:22:01,149 --> 00:21:57,860
space sciences lab at UC Berkeley which

501
00:22:03,610 --> 00:22:01,159
is one of the you know small handful of

502
00:22:05,499 --> 00:22:03,620
institutions across the country that has

503
00:22:07,600 --> 00:22:05,509
the capability to build these things and

504
00:22:09,610 --> 00:22:07,610
I think that's really ultimately the

505
00:22:10,930 --> 00:22:09,620
answer is that you have to go to a place

506
00:22:13,529 --> 00:22:10,940
that has the capability and the

507
00:22:15,460 --> 00:22:13,539
experience to have done these kind of

508
00:22:18,070 --> 00:22:15,470
instruments and spacecraft missions

509
00:22:21,159 --> 00:22:18,080
before because there's just a really a

510
00:22:24,220 --> 00:22:21,169
lot of accumulated knowledge and best

511
00:22:26,499 --> 00:22:24,230
practices and engineering you know not

512
00:22:28,360 --> 00:22:26,509
trade secrets necessarily but lor that's

513
00:22:30,070 --> 00:22:28,370

that's passed down from generation to

514
00:22:31,659 --> 00:22:30,080
generation of engineers and scientists

515
00:22:33,490 --> 00:22:31,669
that goes into designing these things

516
00:22:35,019 --> 00:22:33,500
and you know knowing how to build

517
00:22:37,360 --> 00:22:35,029
something that will actually survive the

518
00:22:40,000 --> 00:22:37,370
rigors of space where it can be you know

519
00:22:42,430 --> 00:22:40,010
50 degrees below zero to 50 degrees

520
00:22:44,649 --> 00:22:42,440
above zero in the blink of an eye where

521
00:22:46,029 --> 00:22:44,659
it's a hard hard vacuum

522
00:22:50,659 --> 00:22:46,039
building things that survived these

523
00:22:54,000 --> 00:22:53,039
thanks so much Jasper reminding

524
00:22:56,010 --> 00:22:54,010
everybody please keep your questions

525
00:22:58,590 --> 00:22:56,020
coming in use the hashtag maven or write

526
00:23:01,649 --> 00:22:58,600
it in the Google+ hangout we're talking

527
00:23:04,279 --> 00:23:01,659
about the NASA's next mission to Mars

528
00:23:06,899 --> 00:23:04,289
and we have a question here on Twitter

529
00:23:09,480 --> 00:23:06,909
from forgive me if I mispronounced your

530
00:23:11,010 --> 00:23:09,490
name at al-azhar tom rot and the

531
00:23:13,919 --> 00:23:11,020
question is why did you choose an

532
00:23:16,130 --> 00:23:13,929
eccentric orbit for the spacecraft Jim

533
00:23:20,610 --> 00:23:16,140
could you comment a little bit of Roy

534
00:23:23,519 --> 00:23:20,620
maven has the orbit it does sure um we

535
00:23:27,840 --> 00:23:23,529
uh the idea is that well for one thing

536
00:23:30,690 --> 00:23:27,850
with the orbit that we have because the

537
00:23:32,930 --> 00:23:30,700
the the surface of the planet or the not

538
00:23:36,000 --> 00:23:32,940

that the fine is not a perfect sphere

539
00:23:39,779 --> 00:23:36,010
the the eccentric orbit that we have

540
00:23:44,600 --> 00:23:39,789
will will move around will rotate around

541
00:23:46,710 --> 00:23:44,610
the planet so um when we're at our lower

542
00:23:50,220 --> 00:23:46,720
and the other reason we have it is

543
00:23:51,690 --> 00:23:50,230
because at lower altitudes we are able

544
00:23:53,279 --> 00:23:51,700
to take the Institute measurements and

545
00:23:54,899 --> 00:23:53,289
then we get higher up in altitude and

546
00:23:59,990 --> 00:23:54,909
we're able to look down and see the

547
00:24:02,639 --> 00:24:00,000
entire planet from afar and take take

548
00:24:06,899 --> 00:24:02,649
ultraviolet spectral images of the

549
00:24:08,250 --> 00:24:06,909
planet and with the with the rotation of

550
00:24:09,950 --> 00:24:08,260
the orbit in the motion of the orbit

551
00:24:13,169 --> 00:24:09,960
around the plan were able to do this

552
00:24:16,230 --> 00:24:13,179
across a large across almost the entire

553
00:24:20,310 --> 00:24:16,240
surface of the time so we're able to get

554
00:24:23,190 --> 00:24:20,320
a really good sample of of measurements

555
00:24:25,590 --> 00:24:23,200
throughout different a wide range of

556
00:24:29,120 --> 00:24:25,600
longitudes and latitudes over that's

557
00:24:32,010 --> 00:24:29,130
that's why we chose to deorbit any chips

558
00:24:33,240 --> 00:24:32,020
thanks so much Tim many I was wondering

559
00:24:35,399 --> 00:24:33,250
if you could talk a little bit more

560
00:24:38,250 --> 00:24:35,409
about the big question everybody wants

561
00:24:40,230 --> 00:24:38,260
to know is is is there life or was there

562
00:24:43,950 --> 00:24:40,240
life on Mars what's the exact current

563
00:24:46,080 --> 00:24:43,960

state of science that what we know of if

564
00:24:51,110 --> 00:24:46,090
there has been any kind of live organism

565
00:24:56,029 --> 00:24:51,120
on Mars well it's it's really a quite a

566
00:25:01,830 --> 00:24:59,970
nurse have been and the International

567
00:25:02,820 --> 00:25:01,840
Science scientific community been trying

568
00:25:04,440 --> 00:25:02,830
to

569
00:25:09,029 --> 00:25:04,450
this question for the last I would say

570
00:25:12,060 --> 00:25:09,039
at least 50 years and we found out that

571
00:25:14,009 --> 00:25:12,070
the best way to answer this question is

572
00:25:19,100 --> 00:25:14,019
not actually to go and look for life

573
00:25:24,060 --> 00:25:21,720
precursors of life thinks that makes

574
00:25:27,630 --> 00:25:24,070
life possible what we call makes the

575
00:25:29,070 --> 00:25:27,640
planet habitable and and that's what

576
00:25:31,649 --> 00:25:29,080
NASA has been doing with all the

577
00:25:33,299 --> 00:25:31,659
missions since the Mars the Viking

578
00:25:37,769 --> 00:25:33,309
initially the Viking missions in the

579
00:25:43,169 --> 00:25:37,779
1970s that the Mars Pathfinder mission

580
00:25:46,799 --> 00:25:43,179
and then coming up to ms l and that's

581
00:25:50,669 --> 00:25:46,809
what we're trying to do with with maven

582
00:25:53,490 --> 00:25:50,679
and the 2020 Rover it's actually not try

583
00:25:56,430 --> 00:25:53,500
to directly tackle the question of there

584
00:26:00,810 --> 00:25:56,440
actually life on Mars but actually look

585
00:26:04,710 --> 00:26:00,820
at the at what makes life thrive in the

586
00:26:06,330 --> 00:26:04,720
in up there a building a building blocks

587
00:26:08,669 --> 00:26:06,340
on the on the surface and the atmosphere

588
00:26:11,730 --> 00:26:08,679

that allows life to emerge or that

589
00:26:15,960 --> 00:26:11,740
allowed life to the allowed life to

590
00:26:19,169 --> 00:26:15,970
emerge many billion years ago so it's

591
00:26:20,190 --> 00:26:19,179
really hard to tell at directly and

592
00:26:22,080 --> 00:26:20,200
answer the question whether there is

593
00:26:25,169 --> 00:26:22,090
today life on Mars but what we know

594
00:26:29,549 --> 00:26:25,179
today from the latest MSL measurements

595
00:26:32,279 --> 00:26:29,559
is that there are building blocks that

596
00:26:38,159 --> 00:26:32,289
are chemicals on the surface that

597
00:26:41,100 --> 00:26:38,169
actually allow life to exist there are

598
00:26:44,070 --> 00:26:41,110
other missions like the European mission

599
00:26:47,430 --> 00:26:44,080
Mars Express and looking for I've been

600
00:26:51,870 --> 00:26:47,440
looking for methane this is another way

601
00:26:55,399 --> 00:26:51,880
to look for signs of a present or past

602
00:26:57,779 --> 00:26:55,409
life but we really have not designed

603
00:26:59,610 --> 00:26:57,789
actually a mission that goes directly

604
00:27:02,700 --> 00:26:59,620
and target and try to find either living

605
00:27:04,799 --> 00:27:02,710
or remaining remains of past life on

606
00:27:07,250 --> 00:27:04,809
Mars it's really really hard to do and

607
00:27:12,210 --> 00:27:07,260
the best way is just to look for these

608
00:27:13,529 --> 00:27:12,220
habitable conditions thank you so much

609
00:27:15,690 --> 00:27:13,539
Mehdi i just want to remind everybody

610
00:27:16,649 --> 00:27:15,700
that was meri behna he is the instrument

611
00:27:18,960 --> 00:27:16,659
scientist for the

612
00:27:20,789 --> 00:27:18,970
neutral gas and ion mass spectrometer

613
00:27:23,909 --> 00:27:20,799

he's from usually here at NASA Goddard

614
00:27:26,159 --> 00:27:23,919
but he's on travel for the launch of a

615
00:27:28,289 --> 00:27:26,169
launch of maven this coming Monday from

616
00:27:31,019 --> 00:27:28,299
Cape Canaveral also joining us for this

617
00:27:33,479 --> 00:27:31,029
head for this NASA hangout is Jim Morsi

618
00:27:35,190 --> 00:27:33,489
he's the instrument system manager he's

619
00:27:37,710 --> 00:27:35,200
also based usually here at NASA Goddard

620
00:27:39,599 --> 00:27:37,720
and then we also have Jasper hey Lucas

621
00:27:42,149 --> 00:27:39,609
he is the instrument leader for the

622
00:27:43,589 --> 00:27:42,159
solar wind I on analyzer and he's

623
00:27:46,589 --> 00:27:43,599
joining us from the university of cali

624
00:27:48,570 --> 00:27:46,599
california out at Berkeley I Mary's kak

625
00:27:50,369 --> 00:27:48,580
here at NASA Goddard and if you have

626
00:27:52,169 --> 00:27:50,379
questions for any of these scientists

627
00:27:54,419 --> 00:27:52,179
about the upcoming maven mission go

628
00:27:55,769 --> 00:27:54,429
ahead and give us a ring we do have a

629
00:27:57,330 --> 00:27:55,779
few questions that have come through on

630
00:27:59,609 --> 00:27:57,340
youtube i'm going to summarize them all

631
00:28:01,320 --> 00:27:59,619
into one question there's questions at

632
00:28:03,269 --> 00:28:01,330
kimmy live stream it who's tweeting from

633
00:28:04,859 --> 00:28:03,279
them from the mission all that stuff I'm

634
00:28:08,249 --> 00:28:04,869
wondering and I'm going to throw this

635
00:28:10,200 --> 00:28:08,259
question to Jim Morsi when it comes to

636
00:28:12,539 --> 00:28:10,210
getting the data in is the data publicly

637
00:28:15,450 --> 00:28:12,549
available can people dial in and see

638
00:28:17,039 --> 00:28:15,460

what maven has been sending us are they

639
00:28:18,779 --> 00:28:17,049
going to have any kind of visuals I know

640
00:28:20,099 --> 00:28:18,789
a lot of people like myself set up

641
00:28:21,989 --> 00:28:20,109
really late that night to see

642
00:28:24,239 --> 00:28:21,999
curiosities very first image and data

643
00:28:25,710 --> 00:28:24,249
coming in is may even have the same kind

644
00:28:29,219 --> 00:28:25,720
of open channel of what it's going to

645
00:28:30,749 --> 00:28:29,229
send back that people can see oh yeah

646
00:28:33,239 --> 00:28:30,759
that's that's a good question one of the

647
00:28:35,700 --> 00:28:33,249
things about maven is that we don't

648
00:28:37,950 --> 00:28:35,710
actually take any we don't take any

649
00:28:39,539 --> 00:28:37,960
photographs because that doesn't we

650
00:28:41,099 --> 00:28:39,549
decided we didn't really need any

651
00:28:43,739 --> 00:28:41,109
photographs and and all the great

652
00:28:46,139 --> 00:28:43,749
photographs from mars reconnaissance

653
00:28:49,889 --> 00:28:46,149
orbiter and honestly and other and

654
00:28:51,960 --> 00:28:49,899
previous missions are out there and we

655
00:28:57,359 --> 00:28:51,970
decided not to go there what we're doing

656
00:28:59,669 --> 00:28:57,369
is is is the side so the instruments

657
00:29:03,180 --> 00:28:59,679
that we have take science science data

658
00:29:07,619 --> 00:29:03,190
and the data doesn't always lend itself

659
00:29:13,259 --> 00:29:07,629
to to a lot of to a lot of visuals but

660
00:29:14,729 --> 00:29:13,269
that being said as things occur and I'm

661
00:29:16,680 --> 00:29:14,739
going to throw this back to MIDI and

662
00:29:17,969 --> 00:29:16,690
Jasper because that they can talk more

663
00:29:20,700 --> 00:29:17,979

about this but you know there is a

664
00:29:23,580 --> 00:29:20,710
process where the information that we we

665
00:29:25,339 --> 00:29:23,590
take is is is disseminated out into the

666
00:29:29,399 --> 00:29:25,349
community so that people can't see it

667
00:29:30,330 --> 00:29:29,409
and then there's also the you know the

668
00:29:32,669 --> 00:29:30,340
NASA website

669
00:29:34,560 --> 00:29:32,679
continue to update people on the

670
00:29:35,820 --> 00:29:34,570
progress of the mission but what do I

671
00:29:39,390 --> 00:29:35,830
have those guys answer that a little bit

672
00:29:40,919 --> 00:29:39,400
more to that sounds great Jasper take it

673
00:29:42,120 --> 00:29:40,929
away when it comes to what's going to

674
00:29:43,740 --> 00:29:42,130
come down for the data for the

675
00:29:45,269 --> 00:29:43,750
instrument that you were involved in and

676
00:29:47,159 --> 00:29:45,279
how people or how other scientists are

677
00:29:50,460 --> 00:29:47,169
going to be able to access that use it

678
00:29:53,310 --> 00:29:50,470
yeah definitely um let me break it down

679
00:29:54,990 --> 00:29:53,320
into a few portions because of course it

680
00:29:57,930 --> 00:29:55,000
takes us a while to actually get to Mars

681
00:30:00,120 --> 00:29:57,940
we turn on the instruments very shortly

682
00:30:01,529 --> 00:30:00,130
after we launch you know within a couple

683
00:30:02,850 --> 00:30:01,539
of weeks after we launched we turn on

684
00:30:04,200 --> 00:30:02,860
the instruments and we check them out

685
00:30:05,760 --> 00:30:04,210
and make sure that everything is working

686
00:30:07,980 --> 00:30:05,770
in the in the real environment of space

687
00:30:09,389 --> 00:30:07,990
which we've tried to simulate on earth

688
00:30:12,600 --> 00:30:09,399

as well as we can but which of course

689
00:30:13,860 --> 00:30:12,610
that we can never simulate perfectly so

690
00:30:15,539 --> 00:30:13,870
that's going to be a really exciting

691
00:30:17,880 --> 00:30:15,549
time turning on the instruments making

692
00:30:19,500 --> 00:30:17,890
sure that they work most of the

693
00:30:21,779 --> 00:30:19,510
instruments however are not going to be

694
00:30:23,519 --> 00:30:21,789
operating full time throughout cruise or

695
00:30:25,799 --> 00:30:23,529
at least not in real they're real Mars

696
00:30:28,710 --> 00:30:25,809
mode some instruments are on booms that

697
00:30:30,510 --> 00:30:28,720
are still stoats other instruments don't

698
00:30:32,549 --> 00:30:30,520
want to put all those operating hours on

699
00:30:34,350 --> 00:30:32,559
their instruments during cruise I fall

700
00:30:35,909 --> 00:30:34,360
into the latter camp I want to make sure

701
00:30:38,580 --> 00:30:35,919
that my detectors are nice and pristine

702
00:30:39,930 --> 00:30:38,590
by the time I actually get to Mars so

703
00:30:41,639 --> 00:30:39,940
most of the instruments are not really

704
00:30:44,430 --> 00:30:41,649
going to be in full operating mode until

705
00:30:46,139 --> 00:30:44,440
we get to Mars also there's going to be

706
00:30:47,310 --> 00:30:46,149
unique things about the Mars environment

707
00:30:49,409 --> 00:30:47,320
that we're going to have to learn once

708
00:30:51,029 --> 00:30:49,419
we get there so when we actually get

709
00:30:53,250 --> 00:30:51,039
into Mars orbit there's going to be a

710
00:30:54,690 --> 00:30:53,260
very intense period of checking out the

711
00:30:56,940 --> 00:30:54,700
instruments making sure they're very

712
00:30:58,769 --> 00:30:56,950
well calibrated making sure that we

713
00:31:00,659 --> 00:30:58,779

understand all of a science data that

714
00:31:03,000 --> 00:31:00,669
we're looking at before we consider

715
00:31:04,980 --> 00:31:03,010
releasing anything to the public so i

716
00:31:07,019 --> 00:31:04,990
think the the soonest that you're going

717
00:31:09,269 --> 00:31:07,029
to see a large amount of data released

718
00:31:11,760 --> 00:31:09,279
to the public is not until after we

719
00:31:13,139 --> 00:31:11,770
actually get to Mars and probably not

720
00:31:15,000 --> 00:31:13,149
for you know at least a month or two

721
00:31:16,350 --> 00:31:15,010
after we get to Mars until we're really

722
00:31:19,470 --> 00:31:16,360
sure that we understand what we're doing

723
00:31:21,029 --> 00:31:19,480
with these instruments after that time

724
00:31:23,120 --> 00:31:21,039
we're going to be releasing data to the

725
00:31:25,769 --> 00:31:23,130
public absolutely as fast as we can

726
00:31:27,600 --> 00:31:25,779
we're contractually required to get it

727
00:31:30,299 --> 00:31:27,610
out within six months of getting to Mars

728
00:31:31,919 --> 00:31:30,309
but you know we certainly would like to

729
00:31:33,560 --> 00:31:31,929
get it out even faster than that if we

730
00:31:36,539 --> 00:31:33,570
can get everything really understood

731
00:31:37,740 --> 00:31:36,549
more quickly and all of the data is

732
00:31:39,450 --> 00:31:37,750
going to be available to the public

733
00:31:42,539 --> 00:31:39,460
it'll all be on the planetary data

734
00:31:44,130 --> 00:31:42,549
system and we absolutely hope the whole

735
00:31:44,250 --> 00:31:44,140
scientific community is going to look at

736
00:31:46,530 --> 00:31:44,260
the

737
00:31:48,210 --> 00:31:46,540
data set because I you know our

738
00:31:49,890 --> 00:31:48,220

experience with these space missions is

739
00:31:52,020 --> 00:31:49,900
that the volume of data that you get

740
00:31:53,580 --> 00:31:52,030
back is such that you just can't have

741
00:31:59,840 --> 00:31:53,590
too many people working on it and not

742
00:32:05,250 --> 00:32:02,340
thanks so much Jasper um we have a

743
00:32:07,380 --> 00:32:05,260
question that has come in looks like

744
00:32:10,800 --> 00:32:07,390
it's from yes from YouTube a question

745
00:32:13,230 --> 00:32:10,810
from YouTube that asked about those smog

746
00:32:15,960 --> 00:32:13,240
magnetic fields that are currently on

747
00:32:19,890 --> 00:32:15,970
Mars the the person who asked one to

748
00:32:22,830 --> 00:32:19,900
know if you could build a station on the

749
00:32:24,870 --> 00:32:22,840
planet Mars within that small magnetic

750
00:32:26,280 --> 00:32:24,880
field would it protect a space station

751
00:32:28,650 --> 00:32:26,290
could you use those little umbrella

752
00:32:30,270 --> 00:32:28,660
areas that we surmise are coming out

753
00:32:32,640 --> 00:32:30,280
from Mars when it comes to its magnetic

754
00:32:34,440 --> 00:32:32,650
field and use that to build human

755
00:32:36,480 --> 00:32:34,450
settlements that would be protected by

756
00:32:37,860 --> 00:32:36,490
that negative net Hank field kind of in

757
00:32:39,920 --> 00:32:37,870
the same way how the entire Earth is

758
00:32:42,150 --> 00:32:39,930
protected by a magnetic field here

759
00:32:43,560 --> 00:32:42,160
Jasper I don't know if you can answer

760
00:32:45,390 --> 00:32:43,570
that I know this asking take a lot of

761
00:32:47,160 --> 00:32:45,400
scientific leaps there about putting

762
00:32:48,840 --> 00:32:47,170
humans on Mars building stuff on Mars

763
00:32:52,380 --> 00:32:48,850

about magnetic field so take it away

764
00:32:54,480 --> 00:32:52,390
sure absolutely um the answer is that

765
00:32:56,550 --> 00:32:54,490
those magnetic fields are not quite

766
00:32:58,140 --> 00:32:56,560
strong enough to really build a base on

767
00:33:01,200 --> 00:32:58,150
during and consider yourself really

768
00:33:03,090 --> 00:33:01,210
protected from a lot of radiation the

769
00:33:05,430 --> 00:33:03,100
the radiation that's really damaging to

770
00:33:07,680 --> 00:33:05,440
humans is actually at a very high energy

771
00:33:09,870 --> 00:33:07,690
you know it's up in the mini mega

772
00:33:12,450 --> 00:33:09,880
electron volts or Giga electron volts to

773
00:33:14,280 --> 00:33:12,460
use the technical units nevermind about

774
00:33:16,020 --> 00:33:14,290
how big that really is it's really big

775
00:33:17,640 --> 00:33:16,030
it's big enough that it's hard to

776
00:33:20,460 --> 00:33:17,650
deflect those particles with a magnetic

777
00:33:23,310 --> 00:33:20,470
field um now all that being said Mars

778
00:33:24,480 --> 00:33:23,320
actually has a pretty decent atmosphere

779
00:33:26,520 --> 00:33:24,490
you know we don't think of Mars as

780
00:33:28,170 --> 00:33:26,530
having much of an atmosphere but it does

781
00:33:30,000 --> 00:33:28,180
have enough of an atmosphere to provide

782
00:33:32,850 --> 00:33:30,010
some shielding against the nasty

783
00:33:34,560 --> 00:33:32,860
radiation that's out there so I wouldn't

784
00:33:36,630 --> 00:33:34,570
completely discount building a base on

785
00:33:38,310 --> 00:33:36,640
Mars because of issues with radiation um

786
00:33:39,780 --> 00:33:38,320
but I don't think you would gain a whole

787
00:33:44,550 --> 00:33:39,790
lot by being in these little magnetic

788
00:33:46,350 --> 00:33:44,560

regions thank you so much for that

789
00:33:47,580 --> 00:33:46,360
Jasper thanks so much for everyone

790
00:33:49,470 --> 00:33:47,590
watching as well keep those questions

791
00:33:51,570 --> 00:33:49,480
coming in both using the hashtag on

792
00:33:55,620 --> 00:33:51,580
twitter with maven and then also in

793
00:33:58,019 --> 00:33:55,630
Google+ James lumba Vlad on Google+ has

794
00:33:59,820 --> 00:33:58,029
a what he calls another geek question

795
00:34:02,190 --> 00:33:59,830
he says what do you use to control your

796
00:34:05,119 --> 00:34:02,200
instruments is it a microcontroller is

797
00:34:07,649 --> 00:34:05,129
it f key gasps I'm going to add my own

798
00:34:09,960 --> 00:34:07,659
less geeky question to that is it a

799
00:34:11,430 --> 00:34:09,970
joystick is it a computer can you do it

800
00:34:14,760 --> 00:34:11,440
from an ipad like how do you actually

801
00:34:17,220 --> 00:34:14,770
control your instrument Jasper yeah so

802
00:34:19,799 --> 00:34:17,230
um I I think what that question was

803
00:34:22,289 --> 00:34:19,809
referring to is an fpga which is a

804
00:34:24,629 --> 00:34:22,299
little little basically a little

805
00:34:27,089 --> 00:34:24,639
processor on a chip and the answer is

806
00:34:29,940 --> 00:34:27,099
yes there are FPGAs in the instrument

807
00:34:32,250 --> 00:34:29,950
there's also for the particle and field

808
00:34:34,740 --> 00:34:32,260
instruments at least there's a data

809
00:34:37,799 --> 00:34:34,750
processing unit that talks to all of the

810
00:34:39,779 --> 00:34:37,809
instruments and helps operate them and

811
00:34:41,539 --> 00:34:39,789
command them and process the data from

812
00:34:44,849 --> 00:34:41,549
them and that actually has a little

813
00:34:47,069 --> 00:34:44,859

microprocessor that runs on an FPGA but

814
00:34:49,440 --> 00:34:47,079
actually the the software is written in

815
00:34:51,269 --> 00:34:49,450
C so it's something that should be very

816
00:34:54,059 --> 00:34:51,279
familiar to any computer science geeks

817
00:34:55,859 --> 00:34:54,069
out there and it really is it's a little

818
00:34:57,630 --> 00:34:55,869
computer that you know talks to the

819
00:35:00,930 --> 00:34:57,640
spacecraft talks to all the instruments

820
00:35:02,519 --> 00:35:00,940
sends commands gets the data back it's

821
00:35:04,230 --> 00:35:02,529
not a super powerful computer you know

822
00:35:06,059 --> 00:35:04,240
it's probably not as even as powerful as

823
00:35:10,380 --> 00:35:06,069
your laptop but it's enough to get the

824
00:35:13,620 --> 00:35:10,390
job done thank you so much Jasper and a

825
00:35:15,329 --> 00:35:13,630
follow up on that for medi I'm wondering

826
00:35:18,150 --> 00:35:15,339
and we've got a few people asking this

827
00:35:19,740 --> 00:35:18,160
as well we know that a lot of the

828
00:35:22,490 --> 00:35:19,750
instruments and things that have been

829
00:35:26,430 --> 00:35:22,500
developed for these space missions their

830
00:35:28,440 --> 00:35:26,440
design was begun years ago and now it's

831
00:35:30,240 --> 00:35:28,450
launching now what if you talk a little

832
00:35:31,890 --> 00:35:30,250
bit how long it took to get the

833
00:35:33,809 --> 00:35:31,900
instruments to the point of lunch and

834
00:35:35,910 --> 00:35:33,819
then does that mean that they're they're

835
00:35:37,470 --> 00:35:35,920
launched with technology that was

836
00:35:39,539 --> 00:35:37,480
actually cutting edge two or three years

837
00:35:41,940 --> 00:35:39,549
ago or are you able to incorporate brand

838
00:35:44,730 --> 00:35:41,950

new technology right before launching

839
00:35:46,559 --> 00:35:44,740
the instruments to Mars a very good

840
00:35:50,460 --> 00:35:46,569
question actually most of the

841
00:35:52,589 --> 00:35:50,470
instruments we build we build for space

842
00:35:55,200 --> 00:35:52,599
applications have some level of heritage

843
00:35:57,150 --> 00:35:55,210
to them we don't come up we don't build

844
00:35:59,970 --> 00:35:57,160
an instrument from scratch as a concept

845
00:36:01,950 --> 00:35:59,980
in the three year three or four years

846
00:36:03,900 --> 00:36:01,960
that takes two to develop a mission

847
00:36:06,589 --> 00:36:03,910
actually when the mission is proposed

848
00:36:08,849 --> 00:36:06,599
initially we propose with it an

849
00:36:11,400 --> 00:36:08,859
instrument package that has some level

850
00:36:11,820 --> 00:36:11,410
of heritage and and there has some level

851
00:36:20,940 --> 00:36:11,830
of

852
00:36:22,740 --> 00:36:20,950
can bring to bear in this in the actual

853
00:36:25,770 --> 00:36:22,750
mission we're proposing in the case for

854
00:36:27,750 --> 00:36:25,780
example for at the Indians instrument it

855
00:36:29,790 --> 00:36:27,760
had the instrument has a very high

856
00:36:33,870 --> 00:36:29,800
heritage from past missions we have an

857
00:36:36,570 --> 00:36:33,880
analog a similar instrument that

858
00:36:39,300 --> 00:36:36,580
actually fly right now on Cassini the

859
00:36:41,250 --> 00:36:39,310
eye and ms mass spectrometer it's at the

860
00:36:45,770 --> 00:36:41,260
grandfather of the Inghams instrument

861
00:36:48,660 --> 00:36:45,780
and then even prior to that we have a

862
00:36:51,660 --> 00:36:48,670
ims have a precursor which is depart the

863
00:36:54,390 --> 00:36:51,670

mass spectrometer the flu on on a

864
00:36:56,580 --> 00:36:54,400
Pioneer Venus orbiter so what we do is

865
00:36:58,350 --> 00:36:56,590
basically between missions as we take an

866
00:37:02,430 --> 00:36:58,360
instrument that worked well in space and

867
00:37:05,340 --> 00:37:02,440
we do little increment incremental

868
00:37:06,900 --> 00:37:05,350
advance advances in both the technology

869
00:37:08,910 --> 00:37:06,910
in the way we operate the instrument and

870
00:37:11,970 --> 00:37:08,920
then we propose that for the following

871
00:37:14,810 --> 00:37:11,980
mission that allow us to keep to have

872
00:37:17,040 --> 00:37:14,820
the confidence that we actually not

873
00:37:21,210 --> 00:37:17,050
making too big of jumps in the

874
00:37:26,010 --> 00:37:21,220
technology that makes it unreliable the

875
00:37:28,710 --> 00:37:26,020
the the level of development we do for

876
00:37:31,590 --> 00:37:28,720
for a mission like maven it's actually

877
00:37:33,570 --> 00:37:31,600
not that big we take we take the the

878
00:37:35,940 --> 00:37:33,580
heritage sensor we have or the heritage

879
00:37:38,730 --> 00:37:35,950
instrument we have and we look what the

880
00:37:41,340 --> 00:37:38,740
mission that the peculiar think that the

881
00:37:43,350 --> 00:37:41,350
mission need and we implement those on

882
00:37:46,140 --> 00:37:43,360
on the new version of the instrument but

883
00:37:49,470 --> 00:37:46,150
ultimately we're not really jumping into

884
00:37:51,930 --> 00:37:49,480
a new development thank you so much

885
00:37:54,090 --> 00:37:51,940
Maddie I have a question for it's coming

886
00:37:56,550 --> 00:37:54,100
for Jim I think it is ideal for Jim and

887
00:37:58,560 --> 00:37:56,560
the question is if you don't mind again

888
00:38:00,000 --> 00:37:58,570

I described that we usually have a bunch

889
00:38:01,740 --> 00:38:00,010
of visuals and things that play in these

890
00:38:04,260 --> 00:38:01,750
hangouts revving some tech issues with

891
00:38:06,090 --> 00:38:04,270
everybody all being all over for this as

892
00:38:08,310 --> 00:38:06,100
Ruben travels for this so there's a lot

893
00:38:10,080 --> 00:38:08,320
of different animations and visuals and

894
00:38:14,130 --> 00:38:10,090
pictures of the spacecraft and how it

895
00:38:15,480 --> 00:38:14,140
gets there at nasa.gov slash maven gym

896
00:38:18,510 --> 00:38:15,490
for the people watching this hangout

897
00:38:20,820 --> 00:38:18,520
though can you describe how large Nathan

898
00:38:22,320 --> 00:38:20,830
actually is does it have solar wings

899
00:38:23,850 --> 00:38:22,330
like so many of the other orbiting

900
00:38:25,590 --> 00:38:23,860
spacecraft reviews to see does it have

901
00:38:27,690 --> 00:38:25,600
anything different on it

902
00:38:31,020 --> 00:38:27,700
does it sort of look like and how big is

903
00:38:33,420 --> 00:38:31,030
it okay that's a great that's a great

904
00:38:34,860 --> 00:38:33,430
great question and I'd also encourage

905
00:38:36,120 --> 00:38:34,870
supposed to look on the NASA site

906
00:38:39,780 --> 00:38:36,130
because there is a lot of good stuff on

907
00:38:42,150 --> 00:38:39,790
there and then also you you know you can

908
00:38:44,820 --> 00:38:42,160
see the spacecraft flying on the screens

909
00:38:46,530 --> 00:38:44,830
behind you there Ares so you get an idea

910
00:38:50,910 --> 00:38:46,540
of what the spacecraft looks like and

911
00:38:54,240 --> 00:38:50,920
I'll say that when the when the arrays

912
00:38:56,910 --> 00:38:54,250
are deployed the spacecraft from from

913
00:38:58,830 --> 00:38:56,920

tip from the tip of one or a to the next

914
00:39:00,840 --> 00:38:58,840
is about the length of a school bus of a

915
00:39:04,740 --> 00:39:00,850
large school of you know standard school

916
00:39:06,750 --> 00:39:04,750
bus that we see the and and the

917
00:39:11,190 --> 00:39:06,760
spacecraft has always about as much as a

918
00:39:12,600 --> 00:39:11,200
little bit more than an SUV so it's it's

919
00:39:15,120 --> 00:39:12,610
a large spacecraft it's not the largest

920
00:39:16,590 --> 00:39:15,130
out there but it's it's it's a pretty

921
00:39:19,770 --> 00:39:16,600
good size especially once those erase

922
00:39:22,830 --> 00:39:19,780
your route and should be closed

923
00:39:25,200 --> 00:39:22,840
allowable about sorry Dario there was

924
00:39:27,090 --> 00:39:25,210
the reverb Oh Tesla bit about how we're

925
00:39:28,770 --> 00:39:27,100
getting maven to Mars you're saying the

926
00:39:30,390 --> 00:39:28,780
size of a small school bus what kind of

927
00:39:32,400 --> 00:39:30,400
rocket is it going to be attached to I

928
00:39:33,960 --> 00:39:32,410
imagine of course it's probably folded

929
00:39:35,520 --> 00:39:33,970
up in some sort of nose cone is that

930
00:39:37,380 --> 00:39:35,530
part of the 10 months it takes to get

931
00:39:41,370 --> 00:39:37,390
there does it unfurl right away or does

932
00:39:43,650 --> 00:39:41,380
it unfold wats on its way there sure the

933
00:39:45,240 --> 00:39:43,660
you can see if you look at the pictures

934
00:39:48,780 --> 00:39:45,250
of the spacecraft there you can see that

935
00:39:51,240 --> 00:39:48,790
the arrays have hinges in them so right

936
00:39:53,880 --> 00:39:51,250
now spacecraft is here at the Kennedy

937
00:39:55,680 --> 00:39:53,890
Space Center and it's folded up and it

938
00:39:58,950 --> 00:39:55,690

basically looks like a boss with the

939
00:40:02,580 --> 00:39:58,960
arrays folded up against the sides and

940
00:40:08,400 --> 00:40:02,590
is it is inside out our launch vehicle

941
00:40:10,460 --> 00:40:08,410
as an atlas 5 of 401 vehicle which post

942
00:40:13,980 --> 00:40:10,470
can look up online and see pictures of

943
00:40:17,010 --> 00:40:13,990
it's a two-stage rocket it it has a

944
00:40:19,440 --> 00:40:17,020
booster stage that gets us up and up

945
00:40:22,170 --> 00:40:19,450
into Earth orbit and then has a second

946
00:40:27,120 --> 00:40:22,180
stage subscribe the Centaur which

947
00:40:28,440 --> 00:40:27,130
carries the spacecraft this and performs

948
00:40:31,830 --> 00:40:28,450
a second burn to get us on a trajectory

949
00:40:34,710 --> 00:40:31,840
of tomorrow's as soon as that burn is

950
00:40:39,590 --> 00:40:34,720
complete the spacecraft is separates

951
00:40:44,900 --> 00:40:42,230
its own the very quickly after that

952
00:40:46,490 --> 00:40:44,910
separation however the arrays do deploy

953
00:40:48,520 --> 00:40:46,500
so that we're able to get the solar

954
00:40:51,530 --> 00:40:48,530
energy we need to charge the batteries

955
00:40:53,630 --> 00:40:51,540
and then we're in our in our cruise

956
00:40:58,220 --> 00:40:53,640
configuration and and on our way to Mars

957
00:41:01,700 --> 00:40:58,230
on that trajectory and then you know ten

958
00:41:04,130 --> 00:41:01,710
months later wrote Mars thanks so much

959
00:41:06,890 --> 00:41:04,140
Jim so many I wonder if you can talk a

960
00:41:08,030 --> 00:41:06,900
little bit about Luke drugs are all the

961
00:41:10,640 --> 00:41:08,040
different instruments that are aboard

962
00:41:11,750 --> 00:41:10,650
maven what kind of power requirements do

963
00:41:13,790 --> 00:41:11,760

they have do you send them up to with

964
00:41:15,890 --> 00:41:13,800
giant batteries do you rely on the solar

965
00:41:17,750 --> 00:41:15,900
array keeping them charged how do you

966
00:41:23,030 --> 00:41:17,760
keep them all powered up the entire time

967
00:41:24,860 --> 00:41:23,040
so all the instruments that usually are

968
00:41:26,660 --> 00:41:24,870
qualified to fly in space one of the

969
00:41:28,340 --> 00:41:26,670
constraints we have on them is to

970
00:41:31,760 --> 00:41:28,350
consume the least amount of power

971
00:41:37,310 --> 00:41:31,770
possible whether the spacecraft have

972
00:41:41,720 --> 00:41:37,320
solar panels or use a radula isotopic

973
00:41:44,090 --> 00:41:41,730
generator like the MSR over we still

974
00:41:48,620 --> 00:41:44,100
need to conserve energy these these

975
00:41:51,320 --> 00:41:48,630
devices don't produce a big an infinite

976
00:41:53,480 --> 00:41:51,330
amount of of energy I think for the

977
00:41:57,680 --> 00:41:53,490
MAVEN spacecraft we have about 1000 watt

978
00:42:00,200 --> 00:41:57,690
hours 1000 watt available at any time

979
00:42:04,600 --> 00:42:00,210
for all the instrumentation and the

980
00:42:08,140 --> 00:42:04,610
spacecraft itself so we decide we try to

981
00:42:10,610 --> 00:42:08,150
design these instrument with the

982
00:42:14,060 --> 00:42:10,620
consumption the energy consumption of

983
00:42:17,030 --> 00:42:14,070
mind for example for the actually one of

984
00:42:18,560 --> 00:42:17,040
the most consuming instrument on the

985
00:42:22,430 --> 00:42:18,570
spacecraft is the Ingram's mass

986
00:42:25,400 --> 00:42:22,440
spectrometer we consume about we consume

987
00:42:30,710 --> 00:42:25,410
about 30 watts that's that's a small

988
00:42:32,630 --> 00:42:30,720

light bulb in any household and and by

989
00:42:35,750 --> 00:42:32,640
even by that measure for space

990
00:42:37,970 --> 00:42:35,760
application that's a lot of power for an

991
00:42:40,730 --> 00:42:37,980
instrument so we try to keep all these

992
00:42:42,920 --> 00:42:40,740
instruments to not consume more than few

993
00:42:45,380 --> 00:42:42,930
hundreds of what so the spacecraft can

994
00:42:47,990 --> 00:42:45,390
actually in the case of maven that

995
00:42:49,700 --> 00:42:48,000
relies on solar panels and the energy

996
00:42:51,980 --> 00:42:49,710
coming from the Sun that keeps the

997
00:42:53,490 --> 00:42:51,990
spacecraft running whether Mars was

998
00:42:58,260 --> 00:42:53,500
closer to the Sun or low

999
00:43:00,090 --> 00:42:58,270
further over the Martian ear thanks so

1000
00:43:02,600 --> 00:43:00,100
much Mehdi I have a follow-up question

1001
00:43:05,130 --> 00:43:02,610
to that that's actually I can imagine

1002
00:43:07,350 --> 00:43:05,140
tree-free you gentlemen it's probably

1003
00:43:10,230 --> 00:43:07,360
quite sad but I'll space oh all

1004
00:43:11,970 --> 00:43:10,240
spacecraft have a life time and a

1005
00:43:15,510 --> 00:43:11,980
recently a spacecraft that orbited earth

1006
00:43:16,650 --> 00:43:15,520
just came down safely and did what it

1007
00:43:18,090 --> 00:43:16,660
was supposed to do sort of burned up

1008
00:43:21,750 --> 00:43:18,100
mostly in atmosphere and then parts of

1009
00:43:23,580 --> 00:43:21,760
if any landed in the ocean when maven

1010
00:43:26,850 --> 00:43:23,590
reaches the end of it hopefully

1011
00:43:28,560 --> 00:43:26,860
incredibly long lifetime what happens to

1012
00:43:30,510 --> 00:43:28,570
it where will it go from there mendy can

1013
00:43:35,250 --> 00:43:30,520

you comment on that well unfortunately

1014
00:43:37,710 --> 00:43:35,260
it's true a most of spacecraft have a

1015
00:43:39,900 --> 00:43:37,720
lifetime on them at some point the

1016
00:43:43,140 --> 00:43:39,910
electronic component the mechanical

1017
00:43:47,070 --> 00:43:43,150
system will fail and the spacecraft will

1018
00:43:49,590 --> 00:43:47,080
will cease being an operation it depends

1019
00:43:52,050 --> 00:43:49,600
what's the where that spacecraft is for

1020
00:43:56,310 --> 00:43:52,060
a case of rover the rover basically will

1021
00:43:59,130 --> 00:43:56,320
stop moving or we'll stop sending data

1022
00:44:01,980 --> 00:43:59,140
that's the case for example for one of

1023
00:44:06,000 --> 00:44:01,990
the Mars exploration Rovers the rover

1024
00:44:07,980 --> 00:44:06,010
spirit that's going to happen also for

1025
00:44:10,110 --> 00:44:07,990
the MSR over at some point after a long

1026
00:44:12,660 --> 00:44:10,120
long time and a lot of science the lover

1027
00:44:14,580 --> 00:44:12,670
to to us it also is going to happen to

1028
00:44:16,980 --> 00:44:14,590
maven so that's part of the strategy

1029
00:44:19,350 --> 00:44:16,990
that Jim was talking about earlier after

1030
00:44:22,350 --> 00:44:19,360
the nominal science mission we will be a

1031
00:44:25,290 --> 00:44:22,360
relay we provide we will provide relay

1032
00:44:27,750 --> 00:44:25,300
to the surface assets and then allow us

1033
00:44:29,850 --> 00:44:27,760
to actually change our orbits and not

1034
00:44:31,980 --> 00:44:29,860
have to dip that deep in the atmosphere

1035
00:44:35,340 --> 00:44:31,990
which allow us to last little longer and

1036
00:44:39,150 --> 00:44:35,350
conserve fuel but even with that at some

1037
00:44:41,820 --> 00:44:39,160
point the either the instruments will

1038
00:44:43,110 --> 00:44:41,830

will cease functioning or the spacecraft

1039
00:44:46,200 --> 00:44:43,120
itself will cease functioning though

1040
00:44:49,140 --> 00:44:46,210
what will happen to it the orbit will

1041
00:44:51,000 --> 00:44:49,150
slowly decay and will get lower and

1042
00:44:53,720 --> 00:44:51,010
lower and lower at some point the

1043
00:44:56,370 --> 00:44:53,730
spacecraft will start feeling the

1044
00:44:59,430 --> 00:44:56,380
resistance of the upper atmosphere of

1045
00:45:02,550 --> 00:44:59,440
Mars and at and and in one of its orbit

1046
00:45:04,830 --> 00:45:02,560
it will actually re-enter will enter the

1047
00:45:08,690 --> 00:45:04,840
atmosphere and will burn into the

1048
00:45:13,170 --> 00:45:11,520
let's hope it does that long after it

1049
00:45:15,329 --> 00:45:13,180
can't access horrendous amount of

1050
00:45:18,569 --> 00:45:15,339
science data and all of your instruments

1051
00:45:21,690 --> 00:45:18,579
work beautifully I'd love to know we

1052
00:45:24,150 --> 00:45:21,700
have just a little bit longer to go Jim

1053
00:45:26,250 --> 00:45:24,160
I was wondering if you could tell us two

1054
00:45:29,390 --> 00:45:26,260
things one where you're going to be on

1055
00:45:32,910 --> 00:45:29,400
Monday when hopefully mated launches and

1056
00:45:34,650 --> 00:45:32,920
for you what's going to be the first

1057
00:45:36,180 --> 00:45:34,660
time that you stop biting your nails is

1058
00:45:38,400 --> 00:45:36,190
that when you first see data is and when

1059
00:45:39,540 --> 00:45:38,410
the rocket leaves the pad what is that

1060
00:45:41,069 --> 00:45:39,550
where are you going to be on Monday and

1061
00:45:45,270 --> 00:45:41,079
when do you actually sort of relax and

1062
00:45:47,099 --> 00:45:45,280
start enjoying the mission well on

1063
00:45:49,980 --> 00:45:47,109

monday i'll be here at Kennedy in the

1064
00:45:54,720 --> 00:45:49,990
Operations Center watching the launch

1065
00:45:57,750 --> 00:45:54,730
and and yeah dub and white there'll be a

1066
00:45:59,430 --> 00:45:57,760
little bit of by the nails it's it's

1067
00:46:02,430 --> 00:45:59,440
it's it's an exciting it's exciting

1068
00:46:06,720 --> 00:46:02,440
thing to see that the the mission take

1069
00:46:09,780 --> 00:46:06,730
off the as far as when I'll relax well I

1070
00:46:11,609 --> 00:46:09,790
you know we there's a couple of times

1071
00:46:15,630 --> 00:46:11,619
where you know we're going to going to

1072
00:46:17,040 --> 00:46:15,640
be very busy and very very focused on

1073
00:46:18,420 --> 00:46:17,050
what would you know very focused and

1074
00:46:19,829 --> 00:46:18,430
that's going to be you know at

1075
00:46:21,240 --> 00:46:19,839
separation when we separate the

1076
00:46:23,309 --> 00:46:21,250
spacecraft making sure that the

1077
00:46:25,380 --> 00:46:23,319
spacecraft is healthy that that the

1078
00:46:27,690 --> 00:46:25,390
function system starts up correctly that

1079
00:46:29,819 --> 00:46:27,700
the arrays come out and then you know

1080
00:46:31,710 --> 00:46:29,829
we'll be then you know later on during

1081
00:46:34,170 --> 00:46:31,720
it while we're on the way to Mars be

1082
00:46:36,000 --> 00:46:34,180
working with Jasper Nettie and many

1083
00:46:38,609 --> 00:46:36,010
others to make sure that the instruments

1084
00:46:41,640 --> 00:46:38,619
are all operating correctly but then the

1085
00:46:43,680 --> 00:46:41,650
next big thing look that that is that is

1086
00:46:45,450 --> 00:46:43,690
a very intense operation will be the

1087
00:46:48,480 --> 00:46:45,460
Mars orbit insertion and that's when we

1088
00:46:52,400 --> 00:46:48,490

fire our main engine that's it's a

1089
00:46:55,470 --> 00:46:52,410
biggest maneuver and it's it's it's it's

1090
00:46:57,930 --> 00:46:55,480
it's the most exciting part of the

1091
00:47:00,000 --> 00:46:57,940
mission getting up to into orbit so it

1092
00:47:02,220 --> 00:47:00,010
be that Mars orbit insertion will also

1093
00:47:05,220 --> 00:47:02,230
be a big time and then after that we

1094
00:47:06,870 --> 00:47:05,230
start doing science and you know you

1095
00:47:08,849 --> 00:47:06,880
know if we all are everything all our

1096
00:47:10,680 --> 00:47:08,859
instruments will be working properly in

1097
00:47:15,390 --> 00:47:10,690
and that's probably when I roll accident

1098
00:47:18,809 --> 00:47:15,400
about a year as well as euphemism of it

1099
00:47:20,550 --> 00:47:18,819
earlier how is it how is that controlled

1100
00:47:20,819 --> 00:47:20,560
when it is inserted into orbit is there

1101
00:47:22,140 --> 00:47:20,829
something

1102
00:47:23,519 --> 00:47:22,150
automatically going to happen that maybe

1103
00:47:24,870 --> 00:47:23,529
is going to do it on its own or is

1104
00:47:26,849 --> 00:47:24,880
someone here on the ground going to be

1105
00:47:31,620 --> 00:47:26,859
like fire the thrusters how does that

1106
00:47:35,549 --> 00:47:31,630
get work well as we as we get closer to

1107
00:47:39,539 --> 00:47:35,559
Mars we'll have that planned but because

1108
00:47:42,029 --> 00:47:39,549
there's a there's a there's a up to an

1109
00:47:43,709 --> 00:47:42,039
eight minute delay there's a significant

1110
00:47:45,150 --> 00:47:43,719
time delay in our communications because

1111
00:47:49,739 --> 00:47:45,160
the speed of light and because Mars is

1112
00:47:52,140 --> 00:47:49,749
so far away we have to we have to load

1113
00:47:54,269 --> 00:47:52,150

the what we do as we load in the script

1114
00:47:56,219 --> 00:47:54,279
into the spacecraft's computer that

1115
00:47:59,670 --> 00:47:56,229
executes Saul the steps and ultimately

1116
00:48:02,009 --> 00:47:59,680
the insertion burn and that's all done

1117
00:48:03,749 --> 00:48:02,019
autonomously on the spacecraft but

1118
00:48:05,519 --> 00:48:03,759
there's a lot there's also a lot of sort

1119
00:48:08,039 --> 00:48:05,529
of failsafe things going on at the same

1120
00:48:09,599 --> 00:48:08,049
time to make sure that that even though

1121
00:48:12,900 --> 00:48:09,609
we're not seeing they're controlling it

1122
00:48:14,940 --> 00:48:12,910
directly and we do have this delay in

1123
00:48:16,890 --> 00:48:14,950
seeing you know how things are going the

1124
00:48:19,229 --> 00:48:16,900
spacecraft has some smarts so that it

1125
00:48:21,930 --> 00:48:19,239
knows it can do Corrections and they

1126
00:48:24,630 --> 00:48:21,940
could if something isn't working right

1127
00:48:26,189 --> 00:48:24,640
it can it has sort of failsafe in it

1128
00:48:31,060 --> 00:48:26,199
that will that will keep the burn going

1129
00:48:34,940 --> 00:48:33,320
thanks so much Jim I know we only moved

1130
00:48:36,620 --> 00:48:34,950
a little bit longer I want to get to

1131
00:48:39,530 --> 00:48:36,630
Jasper Jasper where are you going to be

1132
00:48:41,540 --> 00:48:39,540
when maiden launches on monday hopefully

1133
00:48:43,160 --> 00:48:41,550
and then is it the same for you do you

1134
00:48:44,870 --> 00:48:43,170
have the same sort of long delay of

1135
00:48:48,440 --> 00:48:44,880
waiting and then years of work ahead of

1136
00:48:49,700 --> 00:48:48,450
you yeah so um where am I going to be

1137
00:48:51,230 --> 00:48:49,710
watching the lodge that's actually a

1138
00:48:53,960 --> 00:48:51,240

great question i haven't quite figured

1139
00:48:55,520 --> 00:48:53,970
it out yet the reason that is i'm going

1140
00:48:57,530 --> 00:48:55,530
to have a two-year-old with me so i have

1141
00:48:59,180 --> 00:48:57,540
to find someplace where I can both see

1142
00:49:01,730 --> 00:48:59,190
the the launch and entertain a

1143
00:49:03,290 --> 00:49:01,740
two-year-old so that's a somewhat

1144
00:49:06,320 --> 00:49:03,300
conflicting set of requirements that I'm

1145
00:49:07,820 --> 00:49:06,330
gonna have to satisfy I think I have an

1146
00:49:09,320 --> 00:49:07,830
idea of where that's gonna be but I'm

1147
00:49:11,270 --> 00:49:09,330
not 100 for century and I have to

1148
00:49:12,680 --> 00:49:11,280
negotiate with my wife my parents and

1149
00:49:14,390 --> 00:49:12,690
you know all my family is going to be

1150
00:49:16,460 --> 00:49:14,400
there and figure this out to the

1151
00:49:19,370 --> 00:49:16,470
satisfaction of of them and my

1152
00:49:24,200 --> 00:49:19,380
two-year-old the question of when I'm

1153
00:49:26,690 --> 00:49:24,210
gonna relax boy um I don't know never I

1154
00:49:28,430 --> 00:49:26,700
mean my answer is about the same as Jim

1155
00:49:30,140 --> 00:49:28,440
there's there's some big milestones that

1156
00:49:31,340 --> 00:49:30,150
are going to be kind of nail biters you

1157
00:49:33,200 --> 00:49:31,350
know there's there's obviously launch

1158
00:49:34,730 --> 00:49:33,210
their separation there's turning on the

1159
00:49:37,910 --> 00:49:34,740
instruments in space for the first time

1160
00:49:39,290 --> 00:49:37,920
there's getting into Mars orbit but even

1161
00:49:40,760 --> 00:49:39,300
after that there will be a couple of

1162
00:49:43,070 --> 00:49:40,770
events that are going to be pretty

1163
00:49:44,390 --> 00:49:43,080

exciting and I'm not too scared of them

1164
00:49:46,520 --> 00:49:44,400
but I'll probably still be biting my

1165
00:49:48,200 --> 00:49:46,530
nails a bit and I'll be biting my nails

1166
00:49:51,740 --> 00:49:48,210
in particular when we do these deep

1167
00:49:54,620 --> 00:49:51,750
depths our nominal orbit goes down to

1168
00:49:56,120 --> 00:49:54,630
about 150 kilometers but five times

1169
00:49:58,700 --> 00:49:56,130
during the mission we're going to lower

1170
00:50:01,010 --> 00:49:58,710
that closest approach down to 110

1171
00:50:03,200 --> 00:50:01,020
hundred twenty kilometers so we can kind

1172
00:50:05,420 --> 00:50:03,210
of do a do a toe dip down into the deep

1173
00:50:08,600 --> 00:50:05,430
atmosphere and sniff it and look at

1174
00:50:10,580 --> 00:50:08,610
what's going on there and that's that's

1175
00:50:13,370 --> 00:50:10,590
going to be a little exciting and fun to

1176
00:50:17,230 --> 00:50:13,380
watch too so I probably won't completely

1177
00:50:23,150 --> 00:50:20,360
that sounds absolutely harrowing I don't

1178
00:50:25,790 --> 00:50:23,160
marry a last question for you where are

1179
00:50:27,320 --> 00:50:25,800
you going to be on on monday i know i

1180
00:50:28,580 --> 00:50:27,330
know but tell our viewers where you're

1181
00:50:31,640 --> 00:50:28,590
going to be on monday for watching the

1182
00:50:33,260 --> 00:50:31,650
launch and then also at what point do

1183
00:50:35,360 --> 00:50:33,270
you do you go on vacation then to the

1184
00:50:38,540 --> 00:50:35,370
instruments kick on and then what's the

1185
00:50:41,600 --> 00:50:38,550
next step for you i would be at the

1186
00:50:44,450 --> 00:50:41,610
Kennedy Space Center Cape Canaveral to

1187
00:50:44,780 --> 00:50:44,460
watch the launch and it's it's obviously

1188
00:50:47,150 --> 00:50:44,790

the

1189
00:50:49,580 --> 00:50:47,160
relation of many many years of work but

1190
00:50:52,430 --> 00:50:49,590
like Jasper and Jim said it's just the

1191
00:50:55,750 --> 00:50:52,440
start of a long mission so we still have

1192
00:51:01,280 --> 00:50:55,760
a lot of milestones to meet and to

1193
00:51:02,840 --> 00:51:01,290
successfully accomplish really the we're

1194
00:51:05,120 --> 00:51:02,850
not going to be able to take vacations

1195
00:51:06,800 --> 00:51:05,130
right away because as soon as a few

1196
00:51:08,570 --> 00:51:06,810
weeks after lunch we will have to turn

1197
00:51:10,880 --> 00:51:08,580
on start turning on the instruments

1198
00:51:13,310 --> 00:51:10,890
making sure that all survived the launch

1199
00:51:16,760 --> 00:51:13,320
environment and they're good to go for

1200
00:51:21,680 --> 00:51:16,770
long mission and maybe after that we'll

1201
00:51:23,570 --> 00:51:21,690
we'll take a week or so thank you all so

1202
00:51:27,470 --> 00:51:23,580
much for joining us and this has been a

1203
00:51:31,400 --> 00:51:27,480
obviously live google+ hangout chat

1204
00:51:33,020 --> 00:51:31,410
about the upcoming mars mission maven if

1205
00:51:34,340 --> 00:51:33,030
you've been watching this thank you so

1206
00:51:36,230 --> 00:51:34,350
much if you're watching us in the

1207
00:51:38,150 --> 00:51:36,240
archive version thank you as well and

1208
00:51:40,460 --> 00:51:38,160
you also get all kinds of additional

1209
00:51:43,700 --> 00:51:40,470
animations videos details about the

1210
00:51:49,280 --> 00:51:43,710
mission up to and after monday if you go

1211
00:51:53,170 --> 00:51:49,290
to ww NSA govt / maven again that nasa's

1212
00:51:55,400 --> 00:51:53,180
website nasa gov and then go / maven I

1213
00:51:57,380 --> 00:51:55,410

imagine that's going to be the top thing

1214
00:51:58,850 --> 00:51:57,390
on the NASA bag of pages as well so you

1215
00:52:00,830 --> 00:51:58,860
may not have to worry about negotiating

1216
00:52:02,480 --> 00:52:00,840
around in there and I want to thank the

1217
00:52:04,460 --> 00:52:02,490
gentleman for joining us and I'm very

1218
00:52:07,220 --> 00:52:04,470
sorry that David brain wasn't able to

1219
00:52:09,260 --> 00:52:07,230
stay in the Hangout it was completely a

1220
00:52:12,590 --> 00:52:09,270
technical issue and we'll have some

1221
00:52:15,530 --> 00:52:12,600
information from Dave out both on the

1222
00:52:16,880 --> 00:52:15,540
NASA gov page and then also along in

1223
00:52:19,520 --> 00:52:16,890
this YouTube hang out in the comments

1224
00:52:20,870 --> 00:52:19,530
and things like that Davis was joining

1225
00:52:23,240 --> 00:52:20,880
us from the laboratory for atmospheric

1226
00:52:25,100 --> 00:52:23,250
and space physics at the University of

1227
00:52:27,290 --> 00:52:25,110
Colorado in Boulder and then also

1228
00:52:29,420 --> 00:52:27,300
joining us from a university is Jasper

1229
00:52:31,430 --> 00:52:29,430
helices he's the instrument leader for

1230
00:52:32,630 --> 00:52:31,440
the solar wind I on analyzer at the

1231
00:52:35,510 --> 00:52:32,640
University of California in Berkeley

1232
00:52:37,490 --> 00:52:35,520
thanks so much Jasper also then are two

1233
00:52:39,380 --> 00:52:37,500
people from Goddard as the medi Benna

1234
00:52:41,720 --> 00:52:39,390
he's the instrument scientists for the

1235
00:52:43,700 --> 00:52:41,730
neutral gas and ion mass spectrometer

1236
00:52:45,110 --> 00:52:43,710
and then also jim moore see the

1237
00:52:47,000 --> 00:52:45,120
instrument system manager at NASA