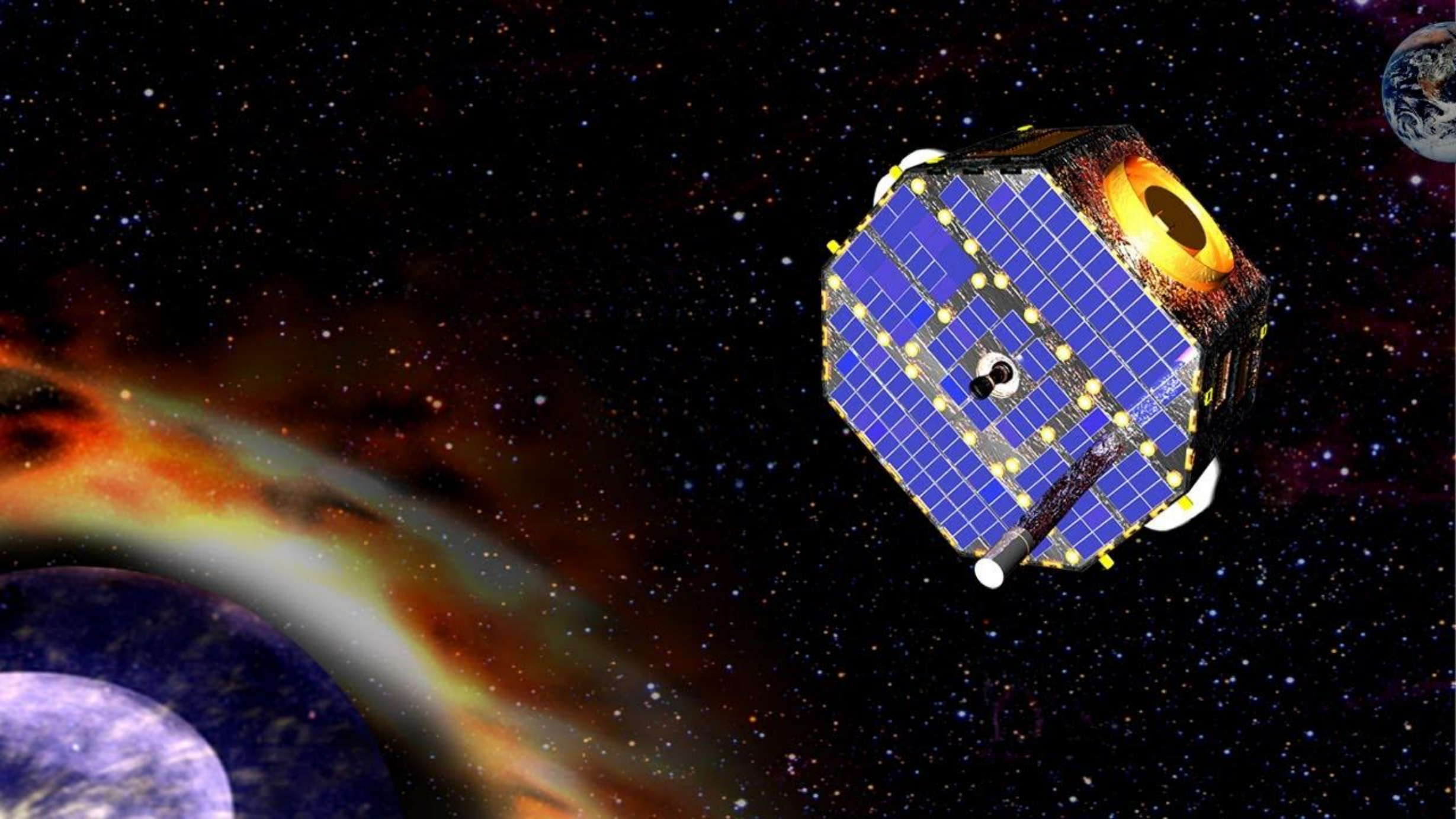

1
00:00:10,629 --> 00:00:07,909
good afternoon and welcome to this nasa

2
00:00:12,709 --> 00:00:10,639
media briefing on an exciting new

3
00:00:14,789 --> 00:00:12,719
discovery at the edge of our solar

4
00:00:17,109 --> 00:00:14,799
system this is steve cole from nasa

5
00:00:18,630 --> 00:00:17,119
headquarters in washington dc

6
00:00:20,630 --> 00:00:18,640
today we're bringing you the latest

7
00:00:22,310 --> 00:00:20,640
results from our interstellar boundary

8
00:00:24,390 --> 00:00:22,320
explorer mission

9
00:00:27,670 --> 00:00:24,400
ibex has been exploring the outer

10
00:00:29,509 --> 00:00:27,680
reaches of our solar system since 2008.

11
00:00:31,429 --> 00:00:29,519
the finding you're about to hear about

12
00:00:33,510 --> 00:00:31,439
today has just been published in the

13
00:00:35,350 --> 00:00:33,520

astrophysical journal

14
00:00:37,510 --> 00:00:35,360
we have four scientists here today to

15
00:00:39,110 --> 00:00:37,520
talk to you about the new results let me

16
00:00:41,990 --> 00:00:39,120
introduce them to you

17
00:00:43,590 --> 00:00:42,000
our first speaker will be dave mccomas

18
00:00:44,389 --> 00:00:43,600
who is the lead author of this new

19
00:00:47,430 --> 00:00:44,399
research

20
00:00:49,750 --> 00:00:47,440
and ibex principal investigator from the

21
00:00:51,750 --> 00:00:49,760
southwest research institute in san

22
00:00:54,869 --> 00:00:51,760
antonio texas

23
00:00:57,270 --> 00:00:54,879
our second speaker is eric christian

24
00:00:59,750 --> 00:00:57,280
who's ibex mission scientist from

25
00:01:01,189 --> 00:00:59,760
goddard space flight center in greenbelt

26
00:01:04,549 --> 00:01:01,199
maryland

27
00:01:07,750 --> 00:01:04,559
our third speaker will be brenda dingus

28
00:01:11,030 --> 00:01:07,760
an astrophysicist at los alamos national

29
00:01:13,670 --> 00:01:11,040
laboratory in los alamos new mexico

30
00:01:16,310 --> 00:01:13,680
and our first speaker is eric posner

31
00:01:18,230 --> 00:01:16,320
who's ibex program scientist here at

32
00:01:19,910 --> 00:01:18,240
nasa headquarters

33
00:01:21,749 --> 00:01:19,920
we'll start with remarks from each of

34
00:01:24,950 --> 00:01:21,759
our panelists and then open it up for a

35
00:01:27,910 --> 00:01:24,960
conversation with those watching online

36
00:01:29,990 --> 00:01:27,920
and media who are on the phone lines

37
00:01:33,429 --> 00:01:30,000
if you have a question and are watching

38
00:01:36,230 --> 00:01:33,439

online you can post it on google plus

39
00:01:37,270 --> 00:01:36,240
on facebook and youtube as well as on

40
00:01:41,270 --> 00:01:37,280
twitter

41
00:01:43,590 --> 00:01:41,280
using this hashtag ask nasa

42
00:01:45,109 --> 00:01:43,600
okay let's start with our first speaker

43
00:01:47,030 --> 00:01:45,119
dave

44
00:01:49,749 --> 00:01:47,040
yes thanks steve so we're going to talk

45
00:01:52,389 --> 00:01:49,759
about something really exciting today

46
00:01:54,950 --> 00:01:52,399
fundamentally like a comet our solar

47
00:01:56,789 --> 00:01:54,960
system has a tail if we can go to the

48
00:01:59,830 --> 00:01:56,799
first graphic you'll see a beautiful

49
00:02:01,590 --> 00:01:59,840
picture of comic comet ison

50
00:02:03,590 --> 00:02:01,600
and the reason that comets have tails is

51
00:02:05,910 --> 00:02:03,600
because there's a million mile an hour

52
00:02:07,910 --> 00:02:05,920
solar wind blowing outward from the sun

53
00:02:10,229 --> 00:02:07,920
all the time in all directions and it

54
00:02:12,229 --> 00:02:10,239
blows material from the comet that's

55
00:02:15,830 --> 00:02:12,239
coming off the comet away from the sun

56
00:02:17,670 --> 00:02:15,840
into this taillight configuration

57
00:02:20,390 --> 00:02:17,680
in addition to that the solar wind

58
00:02:21,910 --> 00:02:20,400
inflates the area around the sun

59
00:02:23,510 --> 00:02:21,920
something we call the heliosphere so if

60
00:02:25,430 --> 00:02:23,520
we can move to my second graphic about

61
00:02:27,190 --> 00:02:25,440
the heliosphere

62
00:02:28,150 --> 00:02:27,200
you'll see what this configuration looks

63
00:02:30,070 --> 00:02:28,160

like

64
00:02:31,510 --> 00:02:30,080
so we're all the way on the inside there

65
00:02:33,430 --> 00:02:31,520
where you can see the sun in the middle

66
00:02:34,949 --> 00:02:33,440
from the ibex spacecraft that took the

67
00:02:36,949 --> 00:02:34,959
data we're going to talk about today is

68
00:02:37,830 --> 00:02:36,959
orbiting the earth in very close to the

69
00:02:39,670 --> 00:02:37,840
sun

70
00:02:41,350 --> 00:02:39,680
but out a hundred to a couple hundred

71
00:02:43,030 --> 00:02:41,360
times as far away as the earth is from

72
00:02:45,030 --> 00:02:43,040
the sun are the boundaries of our

73
00:02:47,270 --> 00:02:45,040
heliosphere with the solar wind

74
00:02:49,430 --> 00:02:47,280
inflating the inside and filling the

75
00:02:51,110 --> 00:02:49,440
inside with material from the sun and

76
00:02:53,190 --> 00:02:51,120
material from the rest of the galaxy on

77
00:02:54,630 --> 00:02:53,200
the outside you can also see the two

78
00:02:56,229 --> 00:02:54,640
voyager spacecraft there which are

79
00:02:59,910 --> 00:02:56,239
heavily heading towards the interstellar

80
00:03:01,430 --> 00:02:59,920
medium but haven't gotten there yet

81
00:03:02,869 --> 00:03:01,440
now if you go to the third graphic

82
00:03:05,430 --> 00:03:02,879
you'll see that we're not alone in

83
00:03:07,670 --> 00:03:05,440
having things like a heliosphere

84
00:03:09,990 --> 00:03:07,680
when it's our own sun we use the the

85
00:03:11,430 --> 00:03:10,000
greek word helios and heliosphere but

86
00:03:13,110 --> 00:03:11,440
when we have these structures around

87
00:03:15,190 --> 00:03:13,120
other stars we call them astrospheres

88
00:03:17,990 --> 00:03:15,200

and here are three beautiful pictures of

89
00:03:19,190 --> 00:03:18,000
astrospheres around other stars and what

90
00:03:20,390 --> 00:03:19,200
you'll see here is that there's a lot of

91
00:03:21,990 --> 00:03:20,400
variation

92
00:03:24,309 --> 00:03:22,000
in the types of structures that we see

93
00:03:26,309 --> 00:03:24,319
around astrospheres some of them have

94
00:03:28,710 --> 00:03:26,319
very strong shocks in front some of them

95
00:03:30,869 --> 00:03:28,720
are misshapen and asymmetric and in

96
00:03:32,710 --> 00:03:30,879
particular the one on the bottom which

97
00:03:34,869 --> 00:03:32,720
is a mira

98
00:03:37,430 --> 00:03:34,879
has this very long and naughty tail

99
00:03:40,550 --> 00:03:37,440
which extends many many light years away

100
00:03:42,390 --> 00:03:40,560
behind uh behind that star

101
00:03:44,149 --> 00:03:42,400
and so the real question is what's our

102
00:03:45,589 --> 00:03:44,159
own interaction look like and do we have

103
00:03:47,350 --> 00:03:45,599
a heliotail

104
00:03:48,789 --> 00:03:47,360
so the heliosphere have a heliotel if so

105
00:03:50,869 --> 00:03:48,799
what does it look like

106
00:03:52,869 --> 00:03:50,879
so moving on to the video

107
00:03:55,830 --> 00:03:52,879
i'll show you a visual visualization of

108
00:03:58,470 --> 00:03:55,840
this that ends in our data so ibex is in

109
00:04:00,630 --> 00:03:58,480
orbit around the earth as we back away

110
00:04:03,429 --> 00:04:00,640
you can see the flow of the solar wind

111
00:04:05,429 --> 00:04:03,439
outward and then back down the tail and

112
00:04:07,589 --> 00:04:05,439
the solar wind is colored two different

113
00:04:09,350 --> 00:04:07,599

colors here red for high speed solar

114
00:04:11,190 --> 00:04:09,360
wind at high latitudes and white for

115
00:04:13,350 --> 00:04:11,200
lower speed solar wind at lower

116
00:04:15,030 --> 00:04:13,360
latitudes so that's being pushed back

117
00:04:16,949 --> 00:04:15,040
around by our motion through the

118
00:04:18,469 --> 00:04:16,959
interstellar medium there's also a

119
00:04:20,629 --> 00:04:18,479
magnetic field in the interstellar

120
00:04:23,909 --> 00:04:20,639
medium shown by these blue lines which

121
00:04:25,749 --> 00:04:23,919
squeezes and misshapes our heliosphere

122
00:04:27,590 --> 00:04:25,759
and the heliotail actually more than

123
00:04:29,350 --> 00:04:27,600
other parts of the heliosphere

124
00:04:31,270 --> 00:04:29,360
so let's have a look at what the data

125
00:04:33,670 --> 00:04:31,280
looks like we'll move back into the

126
00:04:35,510 --> 00:04:33,680
earth and if we were able to see

127
00:04:37,110 --> 00:04:35,520
these structures

128
00:04:38,710 --> 00:04:37,120
with our eyes

129
00:04:41,749 --> 00:04:38,720
as we can in particles that we're able

130
00:04:43,189 --> 00:04:41,759
to measure with ibex it looks like this

131
00:04:45,749 --> 00:04:43,199
and what you see here at low and mid

132
00:04:47,270 --> 00:04:45,759
latitudes are these two structures we

133
00:04:49,350 --> 00:04:47,280
call lobes they're sort of red and

134
00:04:51,749 --> 00:04:49,360
yellow on the left hand and right hand

135
00:04:54,550 --> 00:04:51,759
sides and then at the top and the bottom

136
00:04:57,270 --> 00:04:54,560
the blue regions is a faster solar wind

137
00:04:58,790 --> 00:04:57,280
high speed solar wind and so the tail is

138
00:05:01,270 --> 00:04:58,800

full of solar wind material that came

139
00:05:04,310 --> 00:05:01,280
from the sun got bent back around and

140
00:05:06,310 --> 00:05:04,320
goes down a long heliotail um but it's

141
00:05:08,310 --> 00:05:06,320
ordered in this very interesting way

142
00:05:10,150 --> 00:05:08,320
with the lower energy low speed wind at

143
00:05:12,390 --> 00:05:10,160
low latitudes and the higher energy high

144
00:05:13,990 --> 00:05:12,400
speed wind at high latitudes and i think

145
00:05:15,430 --> 00:05:14,000
you can even see a little bit of a tilt

146
00:05:17,350 --> 00:05:15,440
in the data here but we're going to come

147
00:05:19,110 --> 00:05:17,360
back to that topic at the end

148
00:05:20,150 --> 00:05:19,120
so with that i i would like to pass it

149
00:05:21,830 --> 00:05:20,160
over to eric christian who's going to

150
00:05:23,590 --> 00:05:21,840
tell you how ibex makes these incredible

151
00:05:24,870 --> 00:05:23,600
measurements eric

152
00:05:25,990 --> 00:05:24,880
thanks dave

153
00:05:27,029 --> 00:05:26,000
so

154
00:05:30,629 --> 00:05:27,039
most

155
00:05:32,710 --> 00:05:30,639
images you see coming from nasa and from

156
00:05:34,790 --> 00:05:32,720
things in space or make pictures with

157
00:05:35,670 --> 00:05:34,800
light that's what you expect a camera to

158
00:05:36,469 --> 00:05:35,680
do

159
00:05:39,189 --> 00:05:36,479
but

160
00:05:41,909 --> 00:05:39,199
ibex uses an interesting thing called an

161
00:05:43,990 --> 00:05:41,919
energetic neutral atom

162
00:05:45,670 --> 00:05:44,000
most of the matter in the universe is

163
00:05:48,150 --> 00:05:45,680

charged it has an electric charge on it

164
00:05:51,430 --> 00:05:48,160
it's called plasma

165
00:05:53,510 --> 00:05:51,440
and especially when it's moving fast and

166
00:05:55,270 --> 00:05:53,520
or is very hot

167
00:05:58,310 --> 00:05:55,280
but if you go to the

168
00:06:00,390 --> 00:05:58,320
neutral particles video

169
00:06:02,390 --> 00:06:00,400
when these charged particles which get

170
00:06:03,830 --> 00:06:02,400
messed up by the solar magnetic field

171
00:06:05,670 --> 00:06:03,840
the earth's magnetic field the galactic

172
00:06:07,029 --> 00:06:05,680
magnetic field so you can't trace their

173
00:06:08,950 --> 00:06:07,039
direction back

174
00:06:10,950 --> 00:06:08,960
but when they travel all the way out to

175
00:06:12,950 --> 00:06:10,960
the edge of our solar system starting at

176
00:06:14,070 --> 00:06:12,960
the solar wind

177
00:06:17,029 --> 00:06:14,080
some of them

178
00:06:20,230 --> 00:06:17,039
moving very fast charged particles

179
00:06:21,990 --> 00:06:20,240
pick up an electron from

180
00:06:25,110 --> 00:06:22,000
neutral gas that's out in interstellar

181
00:06:25,990 --> 00:06:25,120
space or in the outer heliosphere

182
00:06:32,309 --> 00:06:26,000
and

183
00:06:34,950 --> 00:06:32,319
once it picks up an electron it becomes

184
00:06:35,990 --> 00:06:34,960
an atom a neutral atom it travels

185
00:06:38,469 --> 00:06:36,000
straight

186
00:06:41,510 --> 00:06:38,479
some of those are pointed back at the

187
00:06:44,790 --> 00:06:41,520
earth and come in and actually hit the

188
00:06:46,469 --> 00:06:44,800

ibex spacecraft and get detected so you

189
00:06:48,390 --> 00:06:46,479
can because they travel pretty much

190
00:06:50,950 --> 00:06:48,400
straight you can trace them back to

191
00:06:53,670 --> 00:06:50,960
where they came from and make a picture

192
00:06:55,830 --> 00:06:53,680
with these atoms instead of light and

193
00:06:58,950 --> 00:06:55,840
that's what ibex does

194
00:07:00,790 --> 00:06:58,960
to tell us a little bit more about why

195
00:07:02,629 --> 00:07:00,800
understanding the shape of the

196
00:07:08,790 --> 00:07:02,639
heliosphere is important i'm going to

197
00:07:11,270 --> 00:07:09,990
thank you eric

198
00:07:14,070 --> 00:07:11,280
so i'm going to tell you a little bit

199
00:07:16,950 --> 00:07:14,080
about um the importance of understanding

200
00:07:19,670 --> 00:07:16,960
this bubble that the sun creates around

201
00:07:22,150 --> 00:07:19,680
around the solar system um that he that

202
00:07:23,909 --> 00:07:22,160
ibex has been uh teaching us about

203
00:07:25,110 --> 00:07:23,919
basically um

204
00:07:27,029 --> 00:07:25,120
this bubble

205
00:07:29,350 --> 00:07:27,039
it is a

206
00:07:31,990 --> 00:07:29,360
shield for cosmic rays so cosmic rays

207
00:07:34,230 --> 00:07:32,000
are actually what i principally study

208
00:07:35,990 --> 00:07:34,240
and cosmic rays are radiation of very

209
00:07:38,550 --> 00:07:36,000
very high energy particles these high

210
00:07:41,589 --> 00:07:38,560
energy particles are

211
00:07:43,670 --> 00:07:41,599
made in probably in supernova remnants

212
00:07:44,550 --> 00:07:43,680
so this is the explosion of a massive

213
00:07:46,070 --> 00:07:44,560

star

214
00:07:47,830 --> 00:07:46,080
and it creates a shock wave and

215
00:07:50,469 --> 00:07:47,840
accelerates particles to energies much

216
00:07:52,550 --> 00:07:50,479
higher than we can make on earth in

217
00:07:55,110 --> 00:07:52,560
man-made accelerators

218
00:07:56,869 --> 00:07:55,120
but those cosmic rays when they hit this

219
00:07:58,550 --> 00:07:56,879
bubble they're

220
00:07:59,909 --> 00:07:58,560
frequently deflected by the magnetic

221
00:08:02,469 --> 00:07:59,919
fields in the bubble because they are

222
00:08:04,950 --> 00:08:02,479
also charged particles as um

223
00:08:07,270 --> 00:08:04,960
similar to what eric was talking about

224
00:08:09,029 --> 00:08:07,280
so in the graphic it shows as you get

225
00:08:11,110 --> 00:08:09,039
closer and closer to the sun that line

226
00:08:13,029 --> 00:08:11,120
shows the fraction of the cosmic rays

227
00:08:15,350 --> 00:08:13,039
that actually make it into earth this

228
00:08:17,189 --> 00:08:15,360
depends on the energy of the cosmic ray

229
00:08:18,629 --> 00:08:17,199
as to how much the magnetic field

230
00:08:21,029 --> 00:08:18,639
influences it

231
00:08:23,110 --> 00:08:21,039
and so you can see that a lot of the

232
00:08:24,550 --> 00:08:23,120
cosmic rays are actually shielded by by

233
00:08:26,390 --> 00:08:24,560
this bubble

234
00:08:28,390 --> 00:08:26,400
that ibex has measured

235
00:08:29,350 --> 00:08:28,400
and in particular um

236
00:08:32,310 --> 00:08:29,360
what we

237
00:08:33,829 --> 00:08:32,320
are seeing in high energy cosmic rays is

238
00:08:36,550 --> 00:08:33,839

that there's something funny about the

239
00:08:38,149 --> 00:08:36,560
tail region about the region

240
00:08:40,469 --> 00:08:38,159
opposite to the direction of the motion

241
00:08:42,870 --> 00:08:40,479
of the sun and in that region we have a

242
00:08:44,870 --> 00:08:42,880
slight fractional excess of cosmic rays

243
00:08:46,949 --> 00:08:44,880
even from that direction at higher

244
00:08:49,829 --> 00:08:46,959
energies than we think that the the sun

245
00:08:51,350 --> 00:08:49,839
should influence it and so um i'm

246
00:08:53,350 --> 00:08:51,360
principally interested in this result to

247
00:08:54,710 --> 00:08:53,360
try and understand if the sun could

248
00:08:56,470 --> 00:08:54,720
possibly

249
00:08:58,949 --> 00:08:56,480
influence these cosmic rays at higher

250
00:08:59,990 --> 00:08:58,959
energies and how that actually works

251
00:09:01,750 --> 00:09:00,000
um

252
00:09:03,590 --> 00:09:01,760
and in particular this region in the

253
00:09:05,750 --> 00:09:03,600
tail where the sun's influence is the

254
00:09:09,030 --> 00:09:05,760
least could that somehow let in more

255
00:09:10,949 --> 00:09:09,040
cosmic rays or maybe focus um cosmic

256
00:09:12,870 --> 00:09:10,959
rays from that direction but it's a very

257
00:09:15,509 --> 00:09:12,880
small fractional increase that we're

258
00:09:16,710 --> 00:09:15,519
looking for there anyway um

259
00:09:18,389 --> 00:09:16,720
just

260
00:09:20,550 --> 00:09:18,399
in general i think if this is an

261
00:09:22,150 --> 00:09:20,560
exciting result that we are

262
00:09:24,470 --> 00:09:22,160
looking forward to thinking more about

263
00:09:26,070 --> 00:09:24,480

in its application to the study of

264
00:09:28,870 --> 00:09:26,080
cosmic rays too

265
00:09:30,070 --> 00:09:28,880
so i'll pass it on now to arc um posner

266
00:09:33,350 --> 00:09:30,080
who will tell you a little bit more

267
00:09:36,389 --> 00:09:33,360
about the uh ibex mission

268
00:09:38,310 --> 00:09:36,399
uh thank you brenda so just as a context

269
00:09:40,790 --> 00:09:38,320
the interstellar boundary explorer is

270
00:09:43,030 --> 00:09:40,800
one of a long line of very successful

271
00:09:44,870 --> 00:09:43,040
uh explorer missions the explorer

272
00:09:47,910 --> 00:09:44,880
mission line actually started as you can

273
00:09:49,990 --> 00:09:47,920
see here in in the movie in 1958 and

274
00:09:52,150 --> 00:09:50,000
predates the agency

275
00:09:54,070 --> 00:09:52,160
the very first

276
00:09:56,310 --> 00:09:54,080
discovery from space has been made with

277
00:09:59,269 --> 00:09:56,320
explorer one networthy radiation belts

278
00:10:01,269 --> 00:09:59,279
are now called van allen belts

279
00:10:03,030 --> 00:10:01,279
there was a long line of these rather

280
00:10:06,550 --> 00:10:03,040
inexpensive missions

281
00:10:08,790 --> 00:10:06,560
for example uh kobe as you will see here

282
00:10:10,790 --> 00:10:08,800
uh the cosmic background explorer which

283
00:10:12,550 --> 00:10:10,800
actually gained one of nasa's scientists

284
00:10:15,030 --> 00:10:12,560
a share of the nobel prize a few years

285
00:10:18,230 --> 00:10:15,040
back and ibex is one of the rather

286
00:10:21,030 --> 00:10:18,240
recent editions i think number 91 in a

287
00:10:21,990 --> 00:10:21,040
total of 94 explorer spacecraft and as

288
00:10:25,030 --> 00:10:22,000

such

289
00:10:27,030 --> 00:10:25,040
as this low-cost inexpensive mission has

290
00:10:29,030 --> 00:10:27,040
has made remarkable discoveries

291
00:10:31,509 --> 00:10:29,040
including now the heliotail

292
00:10:33,030 --> 00:10:31,519
here you see ibex let me just add one

293
00:10:35,430 --> 00:10:33,040
more uh

294
00:10:36,870 --> 00:10:35,440
word iris uh the uh

295
00:10:38,949 --> 00:10:36,880
interface region image imaging

296
00:10:40,710 --> 00:10:38,959
spectrograph is our latest edition just

297
00:10:43,350 --> 00:10:40,720
launched two weeks ago it's such a baby

298
00:10:44,949 --> 00:10:43,360
that it hasn't even opened its uh its

299
00:10:47,590 --> 00:10:44,959
eyes yet looking at the sun and we

300
00:10:49,750 --> 00:10:47,600
expect new discoveries from iris as well

301
00:10:52,230 --> 00:10:49,760
with that i give back to uh

302
00:10:55,430 --> 00:10:52,240
david commerce the ibex pi to tell us

303
00:10:57,269 --> 00:10:55,440
more about the twist of the heliotape

304
00:10:59,269 --> 00:10:57,279
well thank you very much eric

305
00:11:01,269 --> 00:10:59,279
um yeah i'd like to come back to the

306
00:11:03,590 --> 00:11:01,279
issue that i i mentioned earlier which

307
00:11:05,590 --> 00:11:03,600
is if you look at our data uh and here's

308
00:11:07,509 --> 00:11:05,600
a another version of the data what i

309
00:11:10,710 --> 00:11:07,519
showed previously is sort of the central

310
00:11:13,110 --> 00:11:10,720
circle uh in the top part of this figure

311
00:11:15,430 --> 00:11:13,120
um this this figure actually shows the

312
00:11:18,550 --> 00:11:15,440
entire uh map of the sky in these

313
00:11:21,030 --> 00:11:18,560

energetic neutral atoms um just like a

314
00:11:23,190 --> 00:11:21,040
globe can be made into a representation

315
00:11:24,870 --> 00:11:23,200
on a flat map on the wall you can also

316
00:11:27,190 --> 00:11:24,880
take an all sky map and make a

317
00:11:28,870 --> 00:11:27,200
representation like that and so that's

318
00:11:30,310 --> 00:11:28,880
the representation you see at the top

319
00:11:32,310 --> 00:11:30,320
but if you just sort of think about the

320
00:11:33,829 --> 00:11:32,320
middle part where the circle is as being

321
00:11:35,990 --> 00:11:33,839
on earth and looking back down towards

322
00:11:38,710 --> 00:11:36,000
the tail you see these two lobes with

323
00:11:40,949 --> 00:11:38,720
the red and yellow regions and you see

324
00:11:42,630 --> 00:11:40,959
how there's a little tilt to them it's

325
00:11:44,949 --> 00:11:42,640
not horizontal if you connect the

326
00:11:46,470 --> 00:11:44,959
centers of those and that that little

327
00:11:48,710 --> 00:11:46,480
tilt is a little easier to see in the

328
00:11:50,630 --> 00:11:48,720
bottom uh where we've smoothed the data

329
00:11:52,389 --> 00:11:50,640
because uh the statistics aren't that

330
00:11:54,630 --> 00:11:52,399
great once you smooth the data i think

331
00:11:56,949 --> 00:11:54,640
you can see very clearly this tilt um

332
00:11:59,030 --> 00:11:56,959
that tilt is a really interesting aspect

333
00:12:00,870 --> 00:11:59,040
of the observations it has to be caused

334
00:12:03,110 --> 00:12:00,880
by something and it can't be caused by

335
00:12:05,670 --> 00:12:03,120
the sun which is basically symmetric

336
00:12:08,150 --> 00:12:05,680
with its own uh rotation axis and so if

337
00:12:10,710 --> 00:12:08,160
you move on to the next graphic here uh

338
00:12:13,190 --> 00:12:10,720

the twisted tail you'll see how we think

339
00:12:15,110 --> 00:12:13,200
this this twist is coming to to be you

340
00:12:17,430 --> 00:12:15,120
see the external magnetic field from the

341
00:12:19,269 --> 00:12:17,440
local interstellar medium it wraps

342
00:12:21,430 --> 00:12:19,279
around the heliosphere and around the

343
00:12:24,310 --> 00:12:21,440
heliotail and

344
00:12:26,550 --> 00:12:24,320
i like to think of this as sort of a a

345
00:12:29,430 --> 00:12:26,560
beach ball and bungee cords if you

346
00:12:31,110 --> 00:12:29,440
imagine uh putting bungee cords you know

347
00:12:33,110 --> 00:12:31,120
part way around a beach ball or pulling

348
00:12:34,949 --> 00:12:33,120
on you know pulling on them they exert a

349
00:12:36,550 --> 00:12:34,959
force and that's exactly the same sort

350
00:12:38,389 --> 00:12:36,560
of thing that a magnetic field line does

351
00:12:40,150 --> 00:12:38,399
it actually exerts a force

352
00:12:42,150 --> 00:12:40,160
it exerts a force on the outer boundary

353
00:12:44,710 --> 00:12:42,160
of our heliosphere that force both

354
00:12:46,790 --> 00:12:44,720
squeezes the heliotail so that it's no

355
00:12:49,269 --> 00:12:46,800
longer circular in cross-section but is

356
00:12:52,550 --> 00:12:49,279
actually flattened like an oval or an

357
00:12:54,389 --> 00:12:52,560
egg but it also twists it and starts to

358
00:12:56,470 --> 00:12:54,399
turn it in the direction in which the

359
00:12:58,389 --> 00:12:56,480
forces are are strongest which is to

360
00:13:00,310 --> 00:12:58,399
align with the magnetic field and so

361
00:13:02,949 --> 00:13:00,320
this schematic that we're showing here

362
00:13:04,870 --> 00:13:02,959
uh gives you an idea of how the strong

363
00:13:06,949 --> 00:13:04,880

interplanetary magnetic field

364
00:13:09,910 --> 00:13:06,959
interstellar magnetic field can actually

365
00:13:11,670 --> 00:13:09,920
twist and squeeze our heliotail

366
00:13:14,310 --> 00:13:11,680
and so with that i think we'll go back

367
00:13:15,990 --> 00:13:14,320
to steve and take any questions

368
00:13:18,150 --> 00:13:16,000
okay thank you dave and thanks to all

369
00:13:20,710 --> 00:13:18,160
our panelists and as dave said we'll

370
00:13:23,829 --> 00:13:20,720
take questions now for media that are on

371
00:13:25,910 --> 00:13:23,839
the phone lines to ask a question just

372
00:13:27,590 --> 00:13:25,920
press star one

373
00:13:29,430 --> 00:13:27,600
you'll get in a queue to ask a question

374
00:13:31,910 --> 00:13:29,440
and for those watching

375
00:13:35,190 --> 00:13:31,920
online uh all you have to do is on

376
00:13:37,030 --> 00:13:35,200
twitter use the hashtag asknasa we'll

377
00:13:38,550 --> 00:13:37,040
also be checking the google plus

378
00:13:40,629 --> 00:13:38,560
facebook

379
00:13:43,110 --> 00:13:40,639
pages for your comments that you're

380
00:13:45,110 --> 00:13:43,120
posting there

381
00:13:46,230 --> 00:13:45,120
okay our first question from the phone

382
00:13:48,629 --> 00:13:46,240
lines

383
00:13:50,550 --> 00:13:48,639
is from ivorine klotz irene you can go

384
00:13:52,150 --> 00:13:50,560
ahead

385
00:13:54,069 --> 00:13:52,160
thanks steve um

386
00:13:55,430 --> 00:13:54,079
thank you for the briefing i just was

387
00:13:57,990 --> 00:13:55,440
wondering if someone could please

388
00:14:01,030 --> 00:13:58,000

discuss what is new about

389
00:14:03,509 --> 00:14:01,040
these findings of the um heliotel

390
00:14:05,110 --> 00:14:03,519
compared to what was known previously

391
00:14:07,829 --> 00:14:05,120
and also if you could specifically

392
00:14:08,710 --> 00:14:07,839
address this four leaf clover structure

393
00:14:09,509 --> 00:14:08,720
and

394
00:14:11,990 --> 00:14:09,519
um

395
00:14:13,269 --> 00:14:12,000
how that in particular might have been

396
00:14:15,750 --> 00:14:13,279
shaped by the

397
00:14:18,710 --> 00:14:15,760
magnetic field lines that you were just

398
00:14:20,629 --> 00:14:18,720
discussing thanks

399
00:14:22,230 --> 00:14:20,639
sure this is dave maybe i'll take a cut

400
00:14:24,550 --> 00:14:22,240
at that and then others may have more to

401
00:14:27,430 --> 00:14:24,560
say um if we could go back to the

402
00:14:30,550 --> 00:14:27,440
heliosphere number two uh

403
00:14:32,389 --> 00:14:30,560
figure that we had um

404
00:14:34,550 --> 00:14:32,399
so

405
00:14:36,470 --> 00:14:34,560
what's new about this is that we were

406
00:14:39,350 --> 00:14:36,480
never able to really look

407
00:14:40,949 --> 00:14:39,360
in the direction away from

408
00:14:43,189 --> 00:14:40,959
that the direction that we're moving

409
00:14:45,509 --> 00:14:43,199
through the interstellar medium and so

410
00:14:47,670 --> 00:14:45,519
uh in this graphic here you see us there

411
00:14:49,670 --> 00:14:47,680
at the sun in the center and imagine the

412
00:14:51,189 --> 00:14:49,680
sun is not moving and we'll just take

413
00:14:52,710 --> 00:14:51,199

all the motion from the local

414
00:14:54,389 --> 00:14:52,720
interstellar medium that would be

415
00:14:56,550 --> 00:14:54,399
flowing in from the left side in this

416
00:14:58,389 --> 00:14:56,560
figure and and making the sort of bullet

417
00:15:00,949 --> 00:14:58,399
shape one structure that you see here

418
00:15:03,269 --> 00:15:00,959
for the heliosphere

419
00:15:05,590 --> 00:15:03,279
we've had good statistics in ibex over

420
00:15:07,590 --> 00:15:05,600
the last three years of observations and

421
00:15:09,590 --> 00:15:07,600
we've filled in most of the sky map but

422
00:15:11,829 --> 00:15:09,600
for reasons related to how we take our

423
00:15:14,230 --> 00:15:11,839
observations there's been very poor

424
00:15:15,829 --> 00:15:14,240
statistics in in in one part of the sky

425
00:15:18,310 --> 00:15:15,839
and that's the direction back down

426
00:15:20,310 --> 00:15:18,320
towards the heliotail by very carefully

427
00:15:22,790 --> 00:15:20,320
assembling uh the statistical

428
00:15:24,790 --> 00:15:22,800
observations from the full first three

429
00:15:26,389 --> 00:15:24,800
years of ibex data we've been able to

430
00:15:28,310 --> 00:15:26,399
fill in that direction

431
00:15:29,430 --> 00:15:28,320
um and in fact it's an interesting story

432
00:15:31,590 --> 00:15:29,440
because

433
00:15:33,189 --> 00:15:31,600
not knowing what was back there we'd

434
00:15:34,790 --> 00:15:33,199
seen a small structure that we were

435
00:15:36,470 --> 00:15:34,800
thinking might be the heliotail a very

436
00:15:38,629 --> 00:15:36,480
small structure that was offset to the

437
00:15:40,790 --> 00:15:38,639
side and we started studying that what

438
00:15:42,230 --> 00:15:40,800

we learned was in reality once you had

439
00:15:44,310 --> 00:15:42,240
all the observations the first three

440
00:15:46,069 --> 00:15:44,320
years of observations and you filled in

441
00:15:48,150 --> 00:15:46,079
the hole that we'd had in previous sky

442
00:15:49,670 --> 00:15:48,160
maps that actually the heliotel was a

443
00:15:51,590 --> 00:15:49,680
much larger structure with this much

444
00:15:53,110 --> 00:15:51,600
more interesting uh sort of

445
00:15:54,629 --> 00:15:53,120
configuration

446
00:15:55,749 --> 00:15:54,639
and that brings us to kind of the clover

447
00:15:58,790 --> 00:15:55,759
shape

448
00:16:01,990 --> 00:15:58,800
again maybe we'll go to the ibex data

449
00:16:06,629 --> 00:16:04,230
plot for that so again looking in the

450
00:16:09,110 --> 00:16:06,639
center portion of this plot

451
00:16:11,430 --> 00:16:09,120
this is really not expected uh what we

452
00:16:13,749 --> 00:16:11,440
see here with the two lobes at low to

453
00:16:16,150 --> 00:16:13,759
mid latitudes the yellow and red regions

454
00:16:18,389 --> 00:16:16,160
is we see slow solar wind very low

455
00:16:20,069 --> 00:16:18,399
energy particles and energetic neutral

456
00:16:21,269 --> 00:16:20,079
atoms coming back towards earth and

457
00:16:24,389 --> 00:16:21,279
coming back towards ibex from the

458
00:16:27,670 --> 00:16:24,399
heliotail and we see this uh

459
00:16:29,910 --> 00:16:27,680
high latitude uh faster solar wind and

460
00:16:31,910 --> 00:16:29,920
and higher energy enas coming back

461
00:16:33,670 --> 00:16:31,920
towards us i think we can understand

462
00:16:36,150 --> 00:16:33,680
that in terms of the ordering of the

463
00:16:38,069 --> 00:16:36,160

solar wind around solar minimum which

464
00:16:40,389 --> 00:16:38,079
has slower speed solar wind at low

465
00:16:42,790 --> 00:16:40,399
latitudes and higher speed solar winds

466
00:16:45,509 --> 00:16:42,800
at high latitudes uh ibex is actually

467
00:16:47,350 --> 00:16:45,519
observing enas that were probably born

468
00:16:49,269 --> 00:16:47,360
as solar wind particles

469
00:16:51,269 --> 00:16:49,279
three to five years ago

470
00:16:53,430 --> 00:16:51,279
in the heliotone maybe even longer and

471
00:16:56,150 --> 00:16:53,440
so they represent an earlier time in the

472
00:16:57,430 --> 00:16:56,160
solar cycle back more closer to solar

473
00:16:59,590 --> 00:16:57,440
minimum than the current than the

474
00:17:01,110 --> 00:16:59,600
current solar maximum

475
00:17:03,509 --> 00:17:01,120
so with that was there anybody else who

476
00:17:04,949 --> 00:17:03,519
wanted to yeah i'd like to add something

477
00:17:07,429 --> 00:17:04,959
so um

478
00:17:09,590 --> 00:17:07,439
what i think is really new about this is

479
00:17:11,750 --> 00:17:09,600
that scientists had always presumed that

480
00:17:14,150 --> 00:17:11,760
the heliosphere had a tail we've seen it

481
00:17:16,949 --> 00:17:14,160
around other stars we know that the sun

482
00:17:19,429 --> 00:17:16,959
is moving relative to interstellar gas

483
00:17:21,669 --> 00:17:19,439
and so we presume there was a tail but

484
00:17:23,750 --> 00:17:21,679
this is actually the first real data

485
00:17:26,230 --> 00:17:23,760
that we have that gives us the shape of

486
00:17:27,750 --> 00:17:26,240
the tail we've never taken a picture of

487
00:17:29,909 --> 00:17:27,760
it we've never re there are no

488
00:17:31,590 --> 00:17:29,919

spacecraft that are going down the tail

489
00:17:33,590 --> 00:17:31,600
uh pioneer 10 is heading in that

490
00:17:37,270 --> 00:17:33,600
direction but got turned off because it

491
00:17:39,669 --> 00:17:37,280
ran out of power years ago um so this is

492
00:17:43,510 --> 00:17:39,679
really the first time that we have data

493
00:17:48,070 --> 00:17:45,270
okay thank you both uh a follow-on

494
00:17:50,870 --> 00:17:48,080
question uh is the heliotail what do we

495
00:17:54,789 --> 00:17:50,880
know about how long it is how big it is

496
00:17:57,789 --> 00:17:56,310
so the length of the tail is one of the

497
00:17:59,909 --> 00:17:57,799
things that we don't measure

498
00:18:02,230 --> 00:17:59,919
particularly well

499
00:18:04,789 --> 00:18:02,240
because we make line of sight integrated

500
00:18:06,710 --> 00:18:04,799
measurements from the inside looking out

501
00:18:08,789 --> 00:18:06,720
they're not fundamentally

502
00:18:11,110 --> 00:18:08,799
easy to get to get the length on the

503
00:18:13,430 --> 00:18:11,120
other hand once you have

504
00:18:15,270 --> 00:18:13,440
direct observations of the tail as we do

505
00:18:16,470 --> 00:18:15,280
now and you know the energies of the

506
00:18:18,310 --> 00:18:16,480
particles

507
00:18:21,350 --> 00:18:18,320
um you're able to do some simple

508
00:18:22,870 --> 00:18:21,360
calculations of of the length and when

509
00:18:24,870 --> 00:18:22,880
we do that it looks like the the

510
00:18:26,549 --> 00:18:24,880
heliotail is probably evaporating

511
00:18:28,870 --> 00:18:26,559
through this charge exchange process

512
00:18:30,549 --> 00:18:28,880
that produces neutral atoms the ones

513
00:18:32,789 --> 00:18:30,559

that we observe when we look back at the

514
00:18:34,230 --> 00:18:32,799
heliotail those also go off in other

515
00:18:36,789 --> 00:18:34,240
directions and so the sort of

516
00:18:38,870 --> 00:18:36,799
evaporation of the charged particles

517
00:18:40,950 --> 00:18:38,880
occurs over probably something like a

518
00:18:42,470 --> 00:18:40,960
thousand times the distance between the

519
00:18:43,990 --> 00:18:42,480
earth and the sun

520
00:18:45,590 --> 00:18:44,000
that's some number like a hundred

521
00:18:48,310 --> 00:18:45,600
billion miles

522
00:18:50,470 --> 00:18:48,320
uh and so unlike the the very long tail

523
00:18:52,870 --> 00:18:50,480
that we saw with myra the the actual

524
00:18:55,110 --> 00:18:52,880
tail especially the charged particles uh

525
00:18:56,789 --> 00:18:55,120
behind the heliosphere is probably

526
00:18:59,270 --> 00:18:56,799
significantly shorter

527
00:19:01,190 --> 00:18:59,280
um that said there's probably a much

528
00:19:02,870 --> 00:19:01,200
longer wake region where particles

529
00:19:05,270 --> 00:19:02,880
charge exchange back and forth and you

530
00:19:06,789 --> 00:19:05,280
get coupling between uh the solar mix

531
00:19:08,470 --> 00:19:06,799
what was originally solar material from

532
00:19:10,710 --> 00:19:08,480
the heliosphere and the local

533
00:19:12,150 --> 00:19:10,720
interstellar medium

534
00:19:14,549 --> 00:19:12,160
okay we've got a number of questions

535
00:19:17,430 --> 00:19:14,559
from online here's the first one has

536
00:19:23,029 --> 00:19:17,440
ibex data shed any light on what voyager

537
00:19:28,390 --> 00:19:25,430
uh wow i i guess i'll start this is dave

538
00:19:29,909 --> 00:19:28,400

again i'll start on that one um

539
00:19:31,990 --> 00:19:29,919
i think i think ibex has shed a

540
00:19:34,549 --> 00:19:32,000
tremendous amount of light on what

541
00:19:35,669 --> 00:19:34,559
voyager may find um the original

542
00:19:39,750 --> 00:19:35,679
discovery

543
00:19:41,909 --> 00:19:39,760
this ribbon of enhanced energetic

544
00:19:43,750 --> 00:19:41,919
neutral atoms and emissions which

545
00:19:45,190 --> 00:19:43,760
appears to be uh

546
00:19:46,870 --> 00:19:45,200
determined by

547
00:19:49,110 --> 00:19:46,880
the external magnetic field that's

548
00:19:50,710 --> 00:19:49,120
draped around the heliosphere uh that

549
00:19:52,390 --> 00:19:50,720
direction that magnetic field

550
00:19:54,070 --> 00:19:52,400
orientation wasn't well known before

551
00:19:55,750 --> 00:19:54,080
ibex i think we've now made the best

552
00:19:57,350 --> 00:19:55,760
measurements of that uh when the

553
00:19:59,909 --> 00:19:57,360
voyagers finally get out into that

554
00:20:01,590 --> 00:19:59,919
region uh i expect that we know a lot

555
00:20:02,470 --> 00:20:01,600
more than we did about

556
00:20:04,310 --> 00:20:02,480
about

557
00:20:05,990 --> 00:20:04,320
what that magnetic field orientation

558
00:20:07,350 --> 00:20:06,000
will be i think we also know a lot more

559
00:20:08,549 --> 00:20:07,360
about the strength of that magnetic

560
00:20:10,150 --> 00:20:08,559
field

561
00:20:12,549 --> 00:20:10,160
prior to ibex

562
00:20:14,070 --> 00:20:12,559
uh pretty much the entire heliospheric

563
00:20:16,150 --> 00:20:14,080

community believes that there was a bow

564
00:20:18,070 --> 00:20:16,160
shock in front of the heliosphere

565
00:20:21,110 --> 00:20:18,080
observations from ibex both related to

566
00:20:24,310 --> 00:20:21,120
the magnetic field strength um in the

567
00:20:26,150 --> 00:20:24,320
interstellar medium and uh also new

568
00:20:27,909 --> 00:20:26,160
measurements from ibex about how fast

569
00:20:29,909 --> 00:20:27,919
we're traveling with respect to the

570
00:20:31,270 --> 00:20:29,919
interstellar medium have basically

571
00:20:32,710 --> 00:20:31,280
allowed us to conclude that there

572
00:20:35,430 --> 00:20:32,720
probably is no bioshock in front of the

573
00:20:37,590 --> 00:20:35,440
heliosphere and so the sort of

574
00:20:39,510 --> 00:20:37,600
material that voyagers should find when

575
00:20:41,270 --> 00:20:39,520
they cross the heliopause is somewhat

576
00:20:42,549 --> 00:20:41,280
different than than people had predicted

577
00:20:43,990 --> 00:20:42,559
back when they thought there was a bow

578
00:20:45,750 --> 00:20:44,000
shot

579
00:20:46,710 --> 00:20:45,760
yeah

580
00:20:49,430 --> 00:20:46,720
sorry

581
00:20:51,990 --> 00:20:49,440
that's okay eric do you have a follow-up

582
00:20:54,470 --> 00:20:52,000
okay here's a related question uh that

583
00:20:56,470 --> 00:20:54,480
came in from online as well uh will the

584
00:20:59,110 --> 00:20:56,480
ibex and voyager teams be working

585
00:21:01,830 --> 00:20:59,120
together sharing data after voyager

586
00:21:04,390 --> 00:21:01,840
leaves the solar

587
00:21:07,270 --> 00:21:04,400
uh absolutely and in fact

588
00:21:09,430 --> 00:21:07,280

um a couple of people on this uh press

589
00:21:11,750 --> 00:21:09,440
conference are involved with both of the

590
00:21:14,070 --> 00:21:11,760
teams so maybe eric or ark would like to

591
00:21:16,149 --> 00:21:14,080
to comment about that yeah let me let me

592
00:21:19,110 --> 00:21:16,159
uh just mention mentioned heliophysics

593
00:21:21,270 --> 00:21:19,120
has an open data policy that means after

594
00:21:23,990 --> 00:21:21,280
allowing the teams the necessary amount

595
00:21:25,990 --> 00:21:24,000
of time we expect them to make all data

596
00:21:27,669 --> 00:21:26,000
public to everyone on the web so

597
00:21:29,909 --> 00:21:27,679
everybody can can look at the data and

598
00:21:32,390 --> 00:21:29,919
everybody can use it and of course that

599
00:21:34,149 --> 00:21:32,400
way there are lots of collaborations now

600
00:21:36,230 --> 00:21:34,159
already between the teams also

601
00:21:38,710 --> 00:21:36,240
independent researchers we have a number

602
00:21:40,950 --> 00:21:38,720
of grants programs that fund for example

603
00:21:43,029 --> 00:21:40,960
modeling of this interstellar

604
00:21:44,789 --> 00:21:43,039
interaction and with all the data

605
00:21:47,430 --> 00:21:44,799
combined they have a much better idea

606
00:21:50,070 --> 00:21:47,440
now than five or ten years ago

607
00:21:53,270 --> 00:21:50,080
um how the physics of this interaction

608
00:21:58,870 --> 00:21:55,430
and if i can add something i mean i i

609
00:22:00,630 --> 00:21:58,880
did my phd thesis using the voyager data

610
00:22:03,350 --> 00:22:00,640
and still work very closely with the

611
00:22:04,630 --> 00:22:03,360
project scientist for voyager dr edward

612
00:22:06,710 --> 00:22:04,640
stone

613
00:22:08,310 --> 00:22:06,720

and there are goddard scientists who

614
00:22:11,110 --> 00:22:08,320
look at the voyager magnetometer data so

615
00:22:13,270 --> 00:22:11,120
we talk with them regularly and so this

616
00:22:15,669 --> 00:22:13,280
this is important to both missions and

617
00:22:17,110 --> 00:22:15,679
so they're there's pretty close contact

618
00:22:18,549 --> 00:22:17,120
yeah i guess i might just add one more

619
00:22:22,470 --> 00:22:18,559
thing we've already had one joint

620
00:22:24,310 --> 00:22:22,480
meeting um i think it was back in 2009

621
00:22:27,190 --> 00:22:24,320
shortly after the first ibex results

622
00:22:28,789 --> 00:22:27,200
came out and uh ed and i've talked about

623
00:22:30,870 --> 00:22:28,799
having another meeting

624
00:22:32,630 --> 00:22:30,880
where we put the two teams together and

625
00:22:34,390 --> 00:22:32,640
see what synergies come out of that

626
00:22:37,669 --> 00:22:34,400
combination

627
00:22:39,510 --> 00:22:37,679
maybe i had another thought here um

628
00:22:41,430 --> 00:22:39,520
it's maybe not that clear but

629
00:22:43,590 --> 00:22:41,440
heliophysics is actually a system

630
00:22:45,750 --> 00:22:43,600
science so you don't only have ibex and

631
00:22:47,270 --> 00:22:45,760
the voyagers you also have continuous

632
00:22:49,510 --> 00:22:47,280
surveillance of the sun actually when

633
00:22:52,070 --> 00:22:49,520
the sun coughs or has any

634
00:22:54,149 --> 00:22:52,080
sort of eruptions we now can see it from

635
00:22:55,990 --> 00:22:54,159
all sides we have the stereos from the

636
00:22:58,549 --> 00:22:56,000
backside and these actually have

637
00:23:01,430 --> 00:22:58,559
influence on the interactions with the

638
00:23:03,350 --> 00:23:01,440

interstellar medium so we really have a

639
00:23:05,190 --> 00:23:03,360
systems view that we can put together

640
00:23:06,950 --> 00:23:05,200
that the scientists can put together and

641
00:23:08,630 --> 00:23:06,960
really advance the understanding of this

642
00:23:10,549 --> 00:23:08,640
entire region from the sun from the core

643
00:23:12,630 --> 00:23:10,559
of the sun out to the interstellar

644
00:23:14,470 --> 00:23:12,640
medium

645
00:23:16,549 --> 00:23:14,480
okay thank you a reminder for those

646
00:23:17,990 --> 00:23:16,559
watching online and for the media the

647
00:23:20,870 --> 00:23:18,000
media on the phone lines if you'd like

648
00:23:23,669 --> 00:23:20,880
to ask a question just press start one

649
00:23:25,830 --> 00:23:23,679
and if you're watching online and want

650
00:23:29,270 --> 00:23:25,840
to ask a question just use the twitter

651
00:23:31,029 --> 00:23:29,280
hashtag ask nasa we have a number

652
00:23:32,870 --> 00:23:31,039
several more questions here let me go to

653
00:23:35,029 --> 00:23:32,880
the next one uh this is uh i guess for

654
00:23:37,669 --> 00:23:35,039
eric how long is the ibex mission

655
00:23:39,669 --> 00:23:37,679
expected to last

656
00:23:42,950 --> 00:23:39,679
uh you mean alright this time sorry eric

657
00:23:45,590 --> 00:23:42,960
yes eric i'm sorry um we we have regular

658
00:23:46,630 --> 00:23:45,600
senior reviews as they are mandated uh

659
00:23:48,870 --> 00:23:46,640
to us

660
00:23:50,950 --> 00:23:48,880
which look into the performance of the

661
00:23:53,510 --> 00:23:50,960
mission teams and their assigned

662
00:23:56,070 --> 00:23:53,520
strategy for the next two or three years

663
00:23:57,590 --> 00:23:56,080

and we just completed one the results

664
00:23:59,669 --> 00:23:57,600
have been published and ibex has been

665
00:24:00,789 --> 00:23:59,679
extended by two years so i think

666
00:24:04,630 --> 00:24:00,799
currently

667
00:24:06,470 --> 00:24:04,640
it will run through 2015 or 2016 and

668
00:24:08,310 --> 00:24:06,480
then we will have another evaluation and

669
00:24:09,590 --> 00:24:08,320
see whether the performance stays up or

670
00:24:11,750 --> 00:24:09,600
there are new opportunities we can

671
00:24:13,669 --> 00:24:11,760
pursue

672
00:24:15,590 --> 00:24:13,679
okay thank you

673
00:24:17,590 --> 00:24:15,600
here's another question from online what

674
00:24:19,909 --> 00:24:17,600
are the physical properties of the

675
00:24:21,830 --> 00:24:19,919
heliosphere as compared to the

676
00:24:26,310 --> 00:24:21,840
interstellar space how how do you

677
00:24:30,870 --> 00:24:28,789
eric christian maybe take a first cut at

678
00:24:33,269 --> 00:24:30,880
that sure so

679
00:24:35,269 --> 00:24:33,279
um the

680
00:24:38,470 --> 00:24:35,279
this is a really interesting topic at

681
00:24:40,549 --> 00:24:38,480
this time because voyager is on the very

682
00:24:42,630 --> 00:24:40,559
edge of our solar system going up

683
00:24:44,830 --> 00:24:42,640
towards the nose towards the direction

684
00:24:48,390 --> 00:24:44,840
that the sun is traveling

685
00:24:51,269 --> 00:24:48,400
and we were expecting one sort of edge

686
00:24:53,669 --> 00:24:51,279
and we're not quite seeing that

687
00:24:55,430 --> 00:24:53,679
there are particles that come from the

688
00:24:57,590 --> 00:24:55,440

sun there's a magnetic field that comes

689
00:24:59,269 --> 00:24:57,600
from the sun and there are energetic

690
00:25:02,549 --> 00:24:59,279
particles that are generated in the

691
00:25:04,710 --> 00:25:02,559
outer heliosphere that we expect to all

692
00:25:05,669 --> 00:25:04,720
fade away and what you're going to see

693
00:25:07,430 --> 00:25:05,679
are the

694
00:25:10,310 --> 00:25:07,440
particles and magnetic field of the

695
00:25:12,149 --> 00:25:10,320
galaxy interstellar space voyager one is

696
00:25:14,870 --> 00:25:12,159
almost certainly going to be our first

697
00:25:17,269 --> 00:25:14,880
interstellar probe uh

698
00:25:21,669 --> 00:25:17,279
but this boundary is a lot more

699
00:25:26,149 --> 00:25:24,390
i think it looks like we've lost eric

700
00:25:29,430 --> 00:25:26,159
but maybe i can

701
00:25:32,230 --> 00:25:29,440
maybe yeah dave please pick it up

702
00:25:35,110 --> 00:25:32,240
that's okay eric's back he can take it

703
00:25:36,149 --> 00:25:35,120
eric are you back and

704
00:25:36,950 --> 00:25:36,159
eric you're

705
00:25:37,909 --> 00:25:36,960
married

706
00:25:39,830 --> 00:25:37,919
yep

707
00:25:43,350 --> 00:25:39,840
so

708
00:25:45,750 --> 00:25:43,360
why

709
00:25:48,549 --> 00:25:45,760
we think that voyagers is still

710
00:25:50,789 --> 00:25:48,559
inside the heliosphere despite the fact

711
00:25:53,029 --> 00:25:50,799
that the particles actually look more

712
00:25:55,909 --> 00:25:53,039
like interstellar space than

713
00:25:58,230 --> 00:25:55,919

solar system but the magnetic field that

714
00:26:00,470 --> 00:25:58,240
voyager seeing currently still looks

715
00:26:02,870 --> 00:26:00,480
very much like a solar magnetic field

716
00:26:04,950 --> 00:26:02,880
the direction the strength or match what

717
00:26:06,870 --> 00:26:04,960
we expect the sun and what it's been

718
00:26:09,269 --> 00:26:06,880
seeing since it got launched more than

719
00:26:13,029 --> 00:26:09,279
35 years ago so

720
00:26:15,269 --> 00:26:13,039
the the big clue to when voyager leaves

721
00:26:17,590 --> 00:26:15,279
the solar system and enters into speller

722
00:26:19,990 --> 00:26:17,600
interstellar space we expect is the

723
00:26:23,110 --> 00:26:20,000
magnetic field and ibex has been an

724
00:26:27,590 --> 00:26:23,120
important part of knowing what sort of

725
00:26:32,630 --> 00:26:31,029
i guess i'd make a further comment

726
00:26:35,909 --> 00:26:32,640
since a number of the questions have

727
00:26:37,830 --> 00:26:35,919
sort of been related to voyager and ibex

728
00:26:41,190 --> 00:26:37,840
and how they interact we go back to the

729
00:26:42,070 --> 00:26:41,200
heliosphere uh graphic number two

730
00:26:43,669 --> 00:26:42,080
um

731
00:26:50,390 --> 00:26:43,679
i

732
00:26:53,029 --> 00:26:50,400
fact the

733
00:26:54,710 --> 00:26:53,039
analogy that that i always think of is

734
00:26:56,470 --> 00:26:54,720
ibex is really like

735
00:26:59,430 --> 00:26:56,480
you know in a medical situation like an

736
00:27:01,029 --> 00:26:59,440
mri where you can take a an image of the

737
00:27:02,710 --> 00:27:01,039
entire part of the body that there may

738
00:27:04,789 --> 00:27:02,720

be something going on with them

739
00:27:07,110 --> 00:27:04,799
understand the big picture of it whereas

740
00:27:08,789 --> 00:27:07,120
the voyagers are very much like biopsies

741
00:27:10,549 --> 00:27:08,799
they're extremely

742
00:27:11,350 --> 00:27:10,559
precise local measurements but they're

743
00:27:14,149 --> 00:27:11,360
only

744
00:27:15,269 --> 00:27:14,159
at one or two very specific locations if

745
00:27:16,789 --> 00:27:15,279
you look at this graphic of the

746
00:27:19,590 --> 00:27:16,799
heliosphere you can see what i'm talking

747
00:27:21,430 --> 00:27:19,600
about um voyager 1 and voyager 2 are

748
00:27:23,510 --> 00:27:21,440
headed out towards the nose one's about

749
00:27:25,590 --> 00:27:23,520
30 degrees north one's about 30 degrees

750
00:27:27,669 --> 00:27:25,600
south and a little bit off to the side

751
00:27:29,909 --> 00:27:27,679
um but neither goes at all back towards

752
00:27:31,430 --> 00:27:29,919
the heliotail let alone

753
00:27:33,110 --> 00:27:31,440
or the flanks or any of these other

754
00:27:35,269 --> 00:27:33,120
directions and so while we have

755
00:27:36,950 --> 00:27:35,279
incredibly good and valuable information

756
00:27:39,750 --> 00:27:36,960
from those two locations where we have

757
00:27:42,390 --> 00:27:39,760
the spacecraft uh how you put those into

758
00:27:43,830 --> 00:27:42,400
a global context and understand the the

759
00:27:46,630 --> 00:27:43,840
really three-dimensional global

760
00:27:48,789 --> 00:27:46,640
interaction of of of the sun with the

761
00:27:51,430 --> 00:27:48,799
with the local part of the galaxy is you

762
00:27:53,350 --> 00:27:51,440
know is really more a job for ibex uh

763
00:27:56,070 --> 00:27:53,360

which looks out all directions in space

764
00:27:57,590 --> 00:27:56,080
and takes the the entire global image

765
00:27:59,029 --> 00:27:57,600
admittedly from the inside looking

766
00:28:00,710 --> 00:27:59,039
outward but still takes the entire

767
00:28:03,430 --> 00:28:00,720
global image and so it's really the

768
00:28:05,430 --> 00:28:03,440
combination of those two together um

769
00:28:07,909 --> 00:28:05,440
this dynamite in terms of really

770
00:28:09,990 --> 00:28:07,919
figuring out uh this very complicated

771
00:28:12,950 --> 00:28:10,000
and difficult interaction and allowing

772
00:28:14,950 --> 00:28:12,960
us to explore both directly within situ

773
00:28:16,549 --> 00:28:14,960
measurements and remotely with these

774
00:28:18,630 --> 00:28:16,559
global observations

775
00:28:22,870 --> 00:28:18,640
uh are our place in the galaxy in our

776
00:28:28,710 --> 00:28:25,750
maybe i can add a few words to that um

777
00:28:30,549 --> 00:28:28,720
last year 2012 was a very big year for

778
00:28:32,310 --> 00:28:30,559
heliophysics at nasa

779
00:28:34,070 --> 00:28:32,320
the national academy of sciences has

780
00:28:36,549 --> 00:28:34,080
published its

781
00:28:40,549 --> 00:28:36,559
10-year or decadal survey report on the

782
00:28:42,870 --> 00:28:40,559
strategic outlook for for our science

783
00:28:45,350 --> 00:28:42,880
and it recognized actually the progress

784
00:28:47,350 --> 00:28:45,360
being made in the understanding of the

785
00:28:49,590 --> 00:28:47,360
interstellar medium interaction with the

786
00:28:52,070 --> 00:28:49,600
heliosphere as one of the four major

787
00:28:54,630 --> 00:28:52,080
science goals that they expect to

788
00:28:56,950 --> 00:28:54,640

nasa look into in more detail

789
00:28:59,269 --> 00:28:56,960
and one of the outcomes of this decado

790
00:29:00,950 --> 00:28:59,279
survey and here at smd at nasa

791
00:29:02,149 --> 00:29:00,960
headquarters we take this advice very

792
00:29:05,750 --> 00:29:02,159
seriously

793
00:29:07,750 --> 00:29:05,760
is a recommendation of a future beyond

794
00:29:10,230 --> 00:29:07,760
the current program possibly a future

795
00:29:11,350 --> 00:29:10,240
mission that would

796
00:29:13,590 --> 00:29:11,360
actually

797
00:29:14,870 --> 00:29:13,600
take a little larger scope than ibex as

798
00:29:17,590 --> 00:29:14,880
i mentioned ibex was a rather

799
00:29:18,549 --> 00:29:17,600
inexpensive mission um uh

800
00:29:20,789 --> 00:29:18,559
it's in

801
00:29:22,870 --> 00:29:20,799
an earth orbit to go a little further

802
00:29:24,950 --> 00:29:22,880
take the next step uh build uh

803
00:29:27,190 --> 00:29:24,960
additional or or

804
00:29:29,269 --> 00:29:27,200
complementary uh

805
00:29:31,590 --> 00:29:29,279
instruments and and uh place it

806
00:29:34,070 --> 00:29:31,600
somewhere uh where it's a better suited

807
00:29:36,789 --> 00:29:34,080
to to even look into this interaction in

808
00:29:38,870 --> 00:29:36,799
more detail um and actually it might be

809
00:29:40,789 --> 00:29:38,880
possible with with that new mission in

810
00:29:42,230 --> 00:29:40,799
the next decade or so

811
00:29:44,630 --> 00:29:42,240
to uh see

812
00:29:47,430 --> 00:29:44,640
the changes also not only a picture like

813
00:29:49,430 --> 00:29:47,440

we just did now but the actual changes

814
00:29:51,510 --> 00:29:49,440
driven by the sun or other interactions

815
00:29:52,830 --> 00:29:51,520
from maybe from the outside and see the

816
00:29:55,430 --> 00:29:52,840
evolution of this

817
00:29:58,310 --> 00:29:55,440
interplanetary interaction with the with

818
00:30:00,230 --> 00:29:58,320
the interstellar medium

819
00:30:02,789 --> 00:30:00,240
okay thank you uh uh getting back to

820
00:30:06,149 --> 00:30:02,799
ibex a question about the uh the mission

821
00:30:08,389 --> 00:30:06,159
and its future um this result is based

822
00:30:11,590 --> 00:30:08,399
on the first few years i think the

823
00:30:13,830 --> 00:30:11,600
several years of data from ibex

824
00:30:15,029 --> 00:30:13,840
dave what do you expect to learn

825
00:30:18,149 --> 00:30:15,039
about the

826
00:30:19,750 --> 00:30:18,159
heliotail from continued observations

827
00:30:21,510 --> 00:30:19,760
going forward

828
00:30:22,870 --> 00:30:21,520
from ibex

829
00:30:23,669 --> 00:30:22,880
sure

830
00:30:27,029 --> 00:30:23,679
so

831
00:30:28,389 --> 00:30:27,039
as i mentioned earlier ibex basically

832
00:30:31,029 --> 00:30:28,399
sees

833
00:30:34,470 --> 00:30:31,039
solar wind that was produced years

834
00:30:36,950 --> 00:30:34,480
earlier traveled outward from the sun

835
00:30:39,269 --> 00:30:36,960
got bent back around from whatever

836
00:30:41,190 --> 00:30:39,279
directions it was traveling towards the

837
00:30:43,830 --> 00:30:41,200
heliotail into the heliotail and down

838
00:30:46,710 --> 00:30:43,840

the heliotail so we're sampling

839
00:30:49,669 --> 00:30:46,720
much older times um and we see evidence

840
00:30:52,149 --> 00:30:49,679
in our data of the structuring which

841
00:30:54,549 --> 00:30:52,159
occurs at the minimum of the solar

842
00:30:56,789 --> 00:30:54,559
activity cycle where you have fast solar

843
00:30:58,789 --> 00:30:56,799
end at high latitudes and slow slower

844
00:31:01,430 --> 00:30:58,799
solar wind at low latitudes

845
00:31:02,710 --> 00:31:01,440
uh during solar maximum that structure

846
00:31:05,029 --> 00:31:02,720
breaks down and we're going through

847
00:31:06,950 --> 00:31:05,039
solar maximum now basically the

848
00:31:09,669 --> 00:31:06,960
last year this year maybe next year we

849
00:31:11,909 --> 00:31:09,679
don't really know um but that structure

850
00:31:13,990 --> 00:31:11,919
basically breaks down uh the inclination

851
00:31:16,310 --> 00:31:14,000
of the heliosphere current sheet becomes

852
00:31:18,149 --> 00:31:16,320
quite large as it already has and the

853
00:31:19,830 --> 00:31:18,159
solar wind is no longer so simply

854
00:31:22,149 --> 00:31:19,840
ordered by latitude

855
00:31:25,350 --> 00:31:22,159
over the next number of years

856
00:31:27,750 --> 00:31:25,360
those particles will travel out and bend

857
00:31:29,510 --> 00:31:27,760
back and head down the heliotail and so

858
00:31:31,830 --> 00:31:29,520
our expectation is

859
00:31:34,070 --> 00:31:31,840
um that we should be able to see the

860
00:31:36,870 --> 00:31:34,080
effect of the changing sun and solar

861
00:31:39,350 --> 00:31:36,880
wind on the helios heliotail structure

862
00:31:41,990 --> 00:31:39,360
over time we hope to do that with ibex

863
00:31:44,549 --> 00:31:42,000

and uh if ibex stays healthy which it

864
00:31:46,710 --> 00:31:44,559
has so far um it was only designed for

865
00:31:49,509 --> 00:31:46,720
two years but you know it's launched in

866
00:31:51,029 --> 00:31:49,519
2008 and we're still going strong um if

867
00:31:53,029 --> 00:31:51,039
ibex continues to be healthy and if

868
00:31:55,350 --> 00:31:53,039
there's funding through the through the

869
00:31:57,029 --> 00:31:55,360
decadal survey process that are talking

870
00:31:59,190 --> 00:31:57,039
about uh we hope to be able to make

871
00:32:01,190 --> 00:31:59,200
those measurements with ibex uh however

872
00:32:04,950 --> 00:32:01,200
we're also incredibly excited about the

873
00:32:07,430 --> 00:32:04,960
possibility of an even better uh

874
00:32:09,110 --> 00:32:07,440
set of measurements from the new imat

875
00:32:10,870 --> 00:32:09,120
mission that he was talking about that

876
00:32:12,789 --> 00:32:10,880
eric was talking about coming out of the

877
00:32:14,710 --> 00:32:12,799
heliophysics decadal survey that would

878
00:32:16,230 --> 00:32:14,720
be just an incredibly exciting mission

879
00:32:18,710 --> 00:32:16,240
with much better sensitivity and

880
00:32:20,870 --> 00:32:18,720
resolution and carry on the work of ibex

881
00:32:22,230 --> 00:32:20,880
uh even better than ibex is able to

882
00:32:24,389 --> 00:32:22,240
itself

883
00:32:26,310 --> 00:32:24,399
just a minor correction the ibex funding

884
00:32:28,470 --> 00:32:26,320
comes through the senior review process

885
00:32:30,630 --> 00:32:28,480
uh not the dedicated survey process

886
00:32:32,470 --> 00:32:30,640
that was a speaker and if i could add

887
00:32:34,230 --> 00:32:32,480
something uh one of the interesting

888
00:32:35,750 --> 00:32:34,240

things about the continuing with the

889
00:32:38,549 --> 00:32:35,760
ibex data

890
00:32:42,149 --> 00:32:38,559
is that as dave said earlier ibex

891
00:32:44,149 --> 00:32:42,159
essentially sees a line of sight it sees

892
00:32:45,750 --> 00:32:44,159
everything in a given direction

893
00:32:48,230 --> 00:32:45,760
and so

894
00:32:51,110 --> 00:32:48,240
as the sun gets more active as the solar

895
00:32:54,470 --> 00:32:51,120
wind structure changes we can see those

896
00:32:56,230 --> 00:32:54,480
changes in the ibex map and the timing

897
00:32:58,230 --> 00:32:56,240
of that because these particles take

898
00:33:00,470 --> 00:32:58,240
years to get out there the timing of it

899
00:33:02,389 --> 00:33:00,480
is actually a good way to tell exactly

900
00:33:04,070 --> 00:33:02,399
where these energetic neutral atoms are

901
00:33:06,070 --> 00:33:04,080
being formed and give us a lot more

902
00:33:08,870 --> 00:33:06,080
information about the ibex data and

903
00:33:10,789 --> 00:33:08,880
what's going on in the heliosphere

904
00:33:12,789 --> 00:33:10,799
another question about ibex this has to

905
00:33:15,590 --> 00:33:12,799
do with how it does its detecting of

906
00:33:18,149 --> 00:33:15,600
this kind of feature does ibex pick up

907
00:33:22,149 --> 00:33:18,159
the charged particles of cosmic rays or

908
00:33:22,830 --> 00:33:22,159
is it limited to solar particles

909
00:33:25,830 --> 00:33:22,840
well

910
00:33:27,669 --> 00:33:25,840
ibex ibex doesn't directly measure

911
00:33:30,630 --> 00:33:27,679
charged particles it measures neutral

912
00:33:33,750 --> 00:33:30,640
atoms produced through charge exchange

913
00:33:36,549 --> 00:33:33,760

um primarily those neutral particles

914
00:33:39,350 --> 00:33:36,559
were originally from the solar wind but

915
00:33:42,070 --> 00:33:39,360
not all of them some of the interstellar

916
00:33:44,389 --> 00:33:42,080
material which is originally neutral

917
00:33:46,389 --> 00:33:44,399
comes floating into the heliosphere and

918
00:33:49,590 --> 00:33:46,399
gets picked up by the solar and gets

919
00:33:51,190 --> 00:33:49,600
ionized and charged uh starts gyrating

920
00:33:53,350 --> 00:33:51,200
around the magnetic field in the solar

921
00:33:54,950 --> 00:33:53,360
wind is carried out uh and can be

922
00:33:57,029 --> 00:33:54,960
neutralized again through charge

923
00:33:58,230 --> 00:33:57,039
exchange producing energetic neutral

924
00:34:00,389 --> 00:33:58,240
atoms and so

925
00:34:03,029 --> 00:34:00,399
ibex doesn't differentiate between those

926
00:34:04,789 --> 00:34:03,039
two it observes all energetic neutral

927
00:34:07,110 --> 00:34:04,799
atoms that had happened to be heading

928
00:34:10,149 --> 00:34:07,120
back in towards the earth and towards

929
00:34:12,389 --> 00:34:10,159
the spacecraft that said they have

930
00:34:14,389 --> 00:34:12,399
different sorts of energy distributions

931
00:34:16,470 --> 00:34:14,399
and because ibex isn't simply taking a

932
00:34:19,030 --> 00:34:16,480
picture of energetic neutral atoms at

933
00:34:21,109 --> 00:34:19,040
one energy but actually differentiates

934
00:34:23,349 --> 00:34:21,119
energies all the way from about 10

935
00:34:25,750 --> 00:34:23,359
electron volts all the way up to 6000

936
00:34:27,589 --> 00:34:25,760
electron volts we actually make these

937
00:34:29,909 --> 00:34:27,599
measurements as a function of energy and

938
00:34:32,149 --> 00:34:29,919

we're pretty well able to separate uh

939
00:34:34,069 --> 00:34:32,159
the source of different enas whether

940
00:34:36,069 --> 00:34:34,079
they came from the sun and solar wind

941
00:34:37,909 --> 00:34:36,079
originally or from pickup ions or

942
00:34:39,990 --> 00:34:37,919
something else

943
00:34:41,430 --> 00:34:40,000
okay thank you uh and i'd like to add

944
00:34:43,510 --> 00:34:41,440
something quickly

945
00:34:45,349 --> 00:34:43,520
so ibex also

946
00:34:47,270 --> 00:34:45,359
measures the

947
00:34:50,310 --> 00:34:47,280
neutral atoms that are coming directly

948
00:34:52,710 --> 00:34:50,320
at us from the interstellar medium the

949
00:34:54,790 --> 00:34:52,720
the most of the interstellar medium is

950
00:34:57,270 --> 00:34:54,800
ionized and that gets pushed out by the

951
00:34:58,710 --> 00:34:57,280
magnetic field and flows around our

952
00:35:01,270 --> 00:34:58,720
solar system

953
00:35:03,270 --> 00:35:01,280
but some of the gas that's outside of

954
00:35:05,750 --> 00:35:03,280
our solar system in the galaxy is

955
00:35:08,230 --> 00:35:05,760
neutral and that flows straight in to

956
00:35:10,710 --> 00:35:08,240
the inner solar system and ibex has made

957
00:35:13,270 --> 00:35:10,720
some really interesting

958
00:35:15,349 --> 00:35:13,280
results from that interstellar neutrals

959
00:35:17,109 --> 00:35:15,359
to come in

960
00:35:19,030 --> 00:35:17,119
okay thank you uh brenda this is a

961
00:35:21,270 --> 00:35:19,040
question for you about uh galactic

962
00:35:23,910 --> 00:35:21,280
cosmic rays you had talked about

963
00:35:26,150 --> 00:35:23,920

uh the focusing that might uh be

964
00:35:27,910 --> 00:35:26,160
happening in the direction of the tale

965
00:35:29,510 --> 00:35:27,920
uh can you talk a little bit more and

966
00:35:33,030 --> 00:35:29,520
tell our viewers a little bit more about

967
00:35:34,550 --> 00:35:33,040
how galactic cosmic rays get into the

968
00:35:37,190 --> 00:35:34,560
solar system

969
00:35:41,349 --> 00:35:37,200
from different directions

970
00:35:42,950 --> 00:35:41,359
sure so the galactic cosmic rays um

971
00:35:45,430 --> 00:35:42,960
they are influenced by the magnetic

972
00:35:46,870 --> 00:35:45,440
field uh outside our solar system which

973
00:35:49,190 --> 00:35:46,880
is one thing that ibex is telling us

974
00:35:51,030 --> 00:35:49,200
what the the magnetic field is like just

975
00:35:53,349 --> 00:35:51,040
outside our solar system but then

976
00:35:55,750 --> 00:35:53,359
they're also in this magnetic turbulence

977
00:35:59,750 --> 00:35:55,760
that's created by this bubble

978
00:36:02,550 --> 00:35:59,760
um will will deflect the particles um

979
00:36:04,630 --> 00:36:02,560
just kind of like we see on the earth we

980
00:36:06,550 --> 00:36:04,640
see particles coming in these cosmic ray

981
00:36:08,710 --> 00:36:06,560
particles and they're affected by the

982
00:36:11,750 --> 00:36:08,720
earth's magnetic field and you can see

983
00:36:12,870 --> 00:36:11,760
the aurora at high galactic latitudes

984
00:36:15,190 --> 00:36:12,880
but at the

985
00:36:17,829 --> 00:36:15,200
at the equator you don't so

986
00:36:20,870 --> 00:36:17,839
basically a particle cannot cross

987
00:36:23,589 --> 00:36:20,880
um a magnetic field line very easily

988
00:36:26,870 --> 00:36:23,599

but the more energy the particle has the

989
00:36:29,030 --> 00:36:26,880
less that magnetic field matters so

990
00:36:30,310 --> 00:36:29,040
the higher the energy of the particles

991
00:36:32,630 --> 00:36:30,320
the more

992
00:36:34,630 --> 00:36:32,640
they just blast right on through

993
00:36:37,430 --> 00:36:34,640
and the

994
00:36:39,349 --> 00:36:37,440
the cosmic rays at really high energies

995
00:36:42,230 --> 00:36:39,359
are isotropic

996
00:36:44,790 --> 00:36:42,240
they come from almost all

997
00:36:47,109 --> 00:36:44,800
directions equally but as you go to

998
00:36:49,990 --> 00:36:47,119
slightly lower energies we're starting

999
00:36:51,829 --> 00:36:50,000
to see this this non-isotropic

1000
00:36:54,069 --> 00:36:51,839
distribution meaning that they're coming

1001
00:36:56,230 --> 00:36:54,079
from some directions preferentially and

1002
00:36:57,430 --> 00:36:56,240
if you may be coming in from the heli

1003
00:36:59,589 --> 00:36:57,440
look like they're coming in from the

1004
00:37:01,750 --> 00:36:59,599
direction of the heliotail and that

1005
00:37:02,870 --> 00:37:01,760
would be where the sun's influence is

1006
00:37:05,589 --> 00:37:02,880
the least

1007
00:37:07,829 --> 00:37:05,599
because it's the farthest away from from

1008
00:37:09,910 --> 00:37:07,839
us and so maybe that's why we're

1009
00:37:11,670 --> 00:37:09,920
actually seeing an excess of cosmic rays

1010
00:37:14,790 --> 00:37:11,680
but we don't know

1011
00:37:16,230 --> 00:37:14,800
exactly what the situation is

1012
00:37:18,069 --> 00:37:16,240
and it's actually

1013
00:37:20,710 --> 00:37:18,079

pretty hard to influence such high

1014
00:37:22,710 --> 00:37:20,720
energy cosmic rays with the solar field

1015
00:37:23,990 --> 00:37:22,720
so it's a

1016
00:37:26,150 --> 00:37:24,000
question that's going to require some

1017
00:37:28,710 --> 00:37:26,160
theoretical work to take the ibex

1018
00:37:31,030 --> 00:37:28,720
results and the cosmic ray results and

1019
00:37:31,910 --> 00:37:31,040
put them together and try and see if it

1020
00:37:33,349 --> 00:37:31,920
holds

1021
00:37:34,790 --> 00:37:33,359
if it makes sense

1022
00:37:36,790 --> 00:37:34,800
and that work hasn't been done yet this

1023
00:37:39,109 --> 00:37:36,800
is a very new result

1024
00:37:41,510 --> 00:37:39,119
okay thanks brenda a reminder for those

1025
00:37:44,069 --> 00:37:41,520
watching online you can ask a question

1026
00:37:48,470 --> 00:37:44,079
we still have several more to go here

1027
00:37:50,470 --> 00:37:48,480
by using the hashtag asknasa on twitter

1028
00:37:53,270 --> 00:37:50,480
and if you're uh media on the phone

1029
00:37:55,349 --> 00:37:53,280
lines just press star one to ask your

1030
00:37:58,310 --> 00:37:55,359
question and we'll get you in the queue

1031
00:37:59,910 --> 00:37:58,320
uh here's a general question um

1032
00:38:01,750 --> 00:37:59,920
throw it open to the group is the

1033
00:38:03,750 --> 00:38:01,760
heliosphere like the earth's

1034
00:38:07,190 --> 00:38:03,760
magnetosphere how do they different how

1035
00:38:10,550 --> 00:38:09,589
like the earth's magnetosphere

1036
00:38:16,310 --> 00:38:10,560
um

1037
00:38:18,230 --> 00:38:16,320
in the case of the heliosphere it's the

1038
00:38:19,349 --> 00:38:18,240

sun's magnetic field and the sun's

1039
00:38:22,390 --> 00:38:19,359
plasma

1040
00:38:24,069 --> 00:38:22,400
that and inflates the heliosphere

1041
00:38:25,910 --> 00:38:24,079
um in the case of the earth's

1042
00:38:26,790 --> 00:38:25,920
magnetosphere it's the earth's magnetic

1043
00:38:29,109 --> 00:38:26,800
field

1044
00:38:30,950 --> 00:38:29,119
um and a mixture of the earth's plasma

1045
00:38:32,950 --> 00:38:30,960
and plasma from the solar wind which

1046
00:38:34,470 --> 00:38:32,960
fill the the magnetosphere

1047
00:38:37,109 --> 00:38:34,480
in both cases

1048
00:38:39,750 --> 00:38:37,119
uh they basically exclude most of the

1049
00:38:41,750 --> 00:38:39,760
material coming in from the outside

1050
00:38:43,030 --> 00:38:41,760
uh in both cases there's a relative

1051
00:38:44,390 --> 00:38:43,040
motion

1052
00:38:46,790 --> 00:38:44,400
between

1053
00:38:48,870 --> 00:38:46,800
uh for the magnetosphere the the solar

1054
00:38:51,829 --> 00:38:48,880
wind blows towards the earth in the case

1055
00:38:54,150 --> 00:38:51,839
of the heliosphere um we move through

1056
00:38:55,829 --> 00:38:54,160
the local interstellar medium uh but in

1057
00:38:57,829 --> 00:38:55,839
both cases you end up with structures

1058
00:39:00,390 --> 00:38:57,839
that have this sort of blunt shape on

1059
00:39:03,190 --> 00:39:00,400
the nose and now we know an extended

1060
00:39:05,270 --> 00:39:03,200
heliotail to go with the magneto tail on

1061
00:39:06,790 --> 00:39:05,280
the on the downwind side

1062
00:39:07,829 --> 00:39:06,800
but there are also some significant

1063
00:39:09,670 --> 00:39:07,839

differences

1064
00:39:11,510 --> 00:39:09,680
certainly in the size and scale of these

1065
00:39:13,270 --> 00:39:11,520
structures

1066
00:39:16,870 --> 00:39:13,280
heliosphere being

1067
00:39:18,310 --> 00:39:16,880
immensely larger than the magnetosphere

1068
00:39:19,990 --> 00:39:18,320
did somebody else want to comment on

1069
00:39:25,589 --> 00:39:20,000
that

1070
00:39:28,630 --> 00:39:25,599
the the whole sort of shape of the

1071
00:39:30,550 --> 00:39:28,640
magnetic field inside the heliosphere is

1072
00:39:33,270 --> 00:39:30,560
different than the shape of the magnetic

1073
00:39:35,829 --> 00:39:33,280
field inside the magnetosphere mostly

1074
00:39:38,069 --> 00:39:35,839
because of the solar wind the solar wind

1075
00:39:40,630 --> 00:39:38,079
as it travels out from the sun drags the

1076
00:39:42,710 --> 00:39:40,640
magnetic field out with it and actually

1077
00:39:45,190 --> 00:39:42,720
because the sun is rotating causes the

1078
00:39:47,270 --> 00:39:45,200
magnetic field to have a spiral pattern

1079
00:39:49,589 --> 00:39:47,280
uh what we call the parker spiral

1080
00:39:53,109 --> 00:39:49,599
whereas the earth's magnetic field field

1081
00:39:55,990 --> 00:39:53,119
is much more like a dipole like you get

1082
00:39:58,069 --> 00:39:56,000
from a standard bar magnet with a tail

1083
00:39:59,190 --> 00:39:58,079
the earth has a magnetic tail that drags

1084
00:40:01,349 --> 00:39:59,200
behind it

1085
00:40:03,589 --> 00:40:01,359
so

1086
00:40:06,550 --> 00:40:03,599
okay thank you uh the question referring

1087
00:40:09,109 --> 00:40:06,560
to those astrosphere images from

1088
00:40:10,550 --> 00:40:09,119

around other stars that we were shown

1089
00:40:12,630 --> 00:40:10,560
earlier

1090
00:40:15,829 --> 00:40:12,640
in a simple language how would you

1091
00:40:19,270 --> 00:40:15,839
describe the shape of earth's heliotail

1092
00:40:21,109 --> 00:40:19,280
i i'm sorry of the entire heliosphere

1093
00:40:23,750 --> 00:40:21,119
we see some there that look like broad

1094
00:40:25,990 --> 00:40:23,760
fans some are long elongated tubes how

1095
00:40:28,870 --> 00:40:26,000
would you describe the shape of our

1096
00:40:31,990 --> 00:40:30,150
well i think what we've learned from

1097
00:40:33,670 --> 00:40:32,000
ibex

1098
00:40:34,790 --> 00:40:33,680
is that it

1099
00:40:37,510 --> 00:40:34,800
it

1100
00:40:38,790 --> 00:40:37,520
is bullet shaped

1101
00:40:41,430 --> 00:40:38,800
bullet shaped and this is not just

1102
00:40:43,589 --> 00:40:41,440
reminders from ibex plus a lot of theory

1103
00:40:45,589 --> 00:40:43,599
and simulation and including the voyager

1104
00:40:47,829 --> 00:40:45,599
results so pulling all that together i

1105
00:40:50,550 --> 00:40:47,839
think we see the the earth's uh the uh

1106
00:40:51,430 --> 00:40:50,560
the heliosphere as bullet-shaped on the

1107
00:40:53,670 --> 00:40:51,440
front

1108
00:40:55,910 --> 00:40:53,680
and now we understand that it's got this

1109
00:40:58,150 --> 00:40:55,920
helio tail that extends back probably

1110
00:41:01,109 --> 00:40:58,160
something like 10 times further than it

1111
00:41:02,470 --> 00:41:01,119
is towards the nose or direction so

1112
00:41:04,710 --> 00:41:02,480
um

1113
00:41:06,710 --> 00:41:04,720

quite long fairly long kind of bullet

1114
00:41:09,829 --> 00:41:06,720
shaped um but that that bullet isn't

1115
00:41:12,069 --> 00:41:09,839
symmetric it's actually misshapen by the

1116
00:41:13,990 --> 00:41:12,079
external magnetic field

1117
00:41:15,030 --> 00:41:14,000
there's probably additional fine

1118
00:41:15,829 --> 00:41:15,040
structure

1119
00:41:17,750 --> 00:41:15,839
um

1120
00:41:19,910 --> 00:41:17,760
waves on the surface and on the

1121
00:41:22,150 --> 00:41:19,920
boundaries uh we don't have the

1122
00:41:24,309 --> 00:41:22,160
resolution and sensitivity with ibex to

1123
00:41:27,030 --> 00:41:24,319
pick those sorts of fine structures up

1124
00:41:30,150 --> 00:41:27,040
although a follow-on mission like imap

1125
00:41:31,190 --> 00:41:30,160
should be able to do that um but it it

1126
00:41:33,109 --> 00:41:31,200
probably

1127
00:41:35,349 --> 00:41:33,119
doesn't look very much like any of the

1128
00:41:37,270 --> 00:41:35,359
three images that that you can see in

1129
00:41:40,630 --> 00:41:37,280
this uh in the astrosphere's graphic if

1130
00:41:42,309 --> 00:41:40,640
you put that if you put that back up um

1131
00:41:44,950 --> 00:41:42,319
probably doesn't look very much like any

1132
00:41:48,950 --> 00:41:44,960
of those maybe the most like the right

1133
00:41:50,069 --> 00:41:48,960
hand portion of of the bottom one uh

1134
00:41:52,470 --> 00:41:50,079
mira

1135
00:41:54,550 --> 00:41:52,480
with sort of a kind of a longer tube

1136
00:41:57,430 --> 00:41:54,560
going back uh from a sort of

1137
00:41:59,270 --> 00:41:57,440
bullet-shaped front

1138
00:42:01,750 --> 00:41:59,280

and a related question how will these

1139
00:42:06,950 --> 00:42:01,760
ibex observations help us learn more

1140
00:42:10,150 --> 00:42:08,069
well i

1141
00:42:12,710 --> 00:42:10,160
think there's a huge opportunity for

1142
00:42:14,630 --> 00:42:12,720
sort of comparative

1143
00:42:17,349 --> 00:42:14,640
heliospheric and astrospheric

1144
00:42:19,109 --> 00:42:17,359
observations i mean we really have

1145
00:42:20,710 --> 00:42:19,119
a lot of detailed information now with

1146
00:42:22,710 --> 00:42:20,720
ibex and the voyagers about our

1147
00:42:24,390 --> 00:42:22,720
heliosphere on the other hand we get

1148
00:42:28,150 --> 00:42:24,400
these beautiful pictures from the

1149
00:42:30,309 --> 00:42:28,160
outside of of the astrophysical objects

1150
00:42:32,710 --> 00:42:30,319
and so it's always been one of my dreams

1151
00:42:34,630 --> 00:42:32,720
with the ibex mission um that we would

1152
00:42:36,790 --> 00:42:34,640
be able to get the astrophysics

1153
00:42:39,750 --> 00:42:36,800
community more engaged with the ibex

1154
00:42:41,910 --> 00:42:39,760
results uh and and see if we can work

1155
00:42:43,430 --> 00:42:41,920
together on understanding how the

1156
00:42:45,750 --> 00:42:43,440
detailed information that we get from

1157
00:42:48,870 --> 00:42:45,760
our own heliosphere helps inform and

1158
00:42:51,030 --> 00:42:48,880
understand uh this menagerie of of

1159
00:42:53,030 --> 00:42:51,040
different sort of astrosphere type

1160
00:42:55,190 --> 00:42:53,040
structures that we observe

1161
00:42:59,109 --> 00:42:55,200
around other stars

1162
00:42:59,910 --> 00:42:59,119
did anybody else want to comment on that

1163
00:43:03,190 --> 00:42:59,920

okay

1164
00:43:05,270 --> 00:43:03,200
um another question from online what

1165
00:43:08,630 --> 00:43:05,280
institutions are involved with the ibex

1166
00:43:12,950 --> 00:43:10,470
uh yeah

1167
00:43:15,030 --> 00:43:12,960
if it's a huge list we can uh review

1168
00:43:16,870 --> 00:43:15,040
it online it's it's a it's a long list

1169
00:43:18,790 --> 00:43:16,880
and we certainly should put it online i

1170
00:43:20,309 --> 00:43:18,800
you know and i'm afraid i'm afraid to

1171
00:43:22,630 --> 00:43:20,319
start giving a list and leave somebody

1172
00:43:24,950 --> 00:43:22,640
important out off the top um the idex

1173
00:43:28,069 --> 00:43:24,960
mission is led uh by the southwest

1174
00:43:30,630 --> 00:43:28,079
research institute in san antonio texas

1175
00:43:32,710 --> 00:43:30,640
with strong partnerships from a bunch of

1176
00:43:34,309 --> 00:43:32,720
other institutions los alamos national

1177
00:43:36,230 --> 00:43:34,319
laboratory

1178
00:43:37,670 --> 00:43:36,240
university of new hampshire

1179
00:43:38,790 --> 00:43:37,680
um

1180
00:43:41,910 --> 00:43:38,800
we even have international

1181
00:43:44,390 --> 00:43:41,920
collaborations the university of bern uh

1182
00:43:46,550 --> 00:43:44,400
switzerland uh contributed hardware and

1183
00:43:47,750 --> 00:43:46,560
a number of many many other places there

1184
00:43:49,990 --> 00:43:47,760
are a lot of institutions with

1185
00:43:51,910 --> 00:43:50,000
scientists who are involved from across

1186
00:43:54,390 --> 00:43:51,920
the country and around the world and so

1187
00:43:55,829 --> 00:43:54,400
it's quite a long list um and i

1188
00:43:56,630 --> 00:43:55,839

i'd like us to post that so that we

1189
00:43:58,230 --> 00:43:56,640
don't

1190
00:43:59,430 --> 00:43:58,240
we're sure everybody gets that gets the

1191
00:44:00,870 --> 00:43:59,440
credit they're due

1192
00:44:03,349 --> 00:44:00,880
right and we can refer people to the

1193
00:44:05,990 --> 00:44:03,359
website in a minute i think this is our

1194
00:44:08,390 --> 00:44:06,000
last question dave this is for you uh

1195
00:44:10,790 --> 00:44:08,400
what ibex discovery of the many that has

1196
00:44:14,309 --> 00:44:10,800
made uh so far has surprised you the

1197
00:44:19,270 --> 00:44:16,630
that's a really interesting question um

1198
00:44:22,390 --> 00:44:19,280
there have been so many great surprises

1199
00:44:24,230 --> 00:44:22,400
with with ibex and

1200
00:44:27,670 --> 00:44:24,240
it's amazing when you

1201
00:44:29,510 --> 00:44:27,680
i feel i feel like we've

1202
00:44:30,870 --> 00:44:29,520
we've had the first telescope to look

1203
00:44:32,630 --> 00:44:30,880
out into the skies with i mean it's

1204
00:44:35,109 --> 00:44:32,640
almost you almost feel like you know

1205
00:44:38,390 --> 00:44:35,119
your galileo galileo and living in that

1206
00:44:40,870 --> 00:44:38,400
era we have the the first really

1207
00:44:44,309 --> 00:44:40,880
good high sensitivity energetic neutral

1208
00:44:46,230 --> 00:44:44,319
atom imaging telescopes to look out with

1209
00:44:47,510 --> 00:44:46,240
and we've made so many discoveries with

1210
00:44:50,309 --> 00:44:47,520
those that they're really hard to

1211
00:44:52,710 --> 00:44:50,319
compare i mean the ribbon was completely

1212
00:44:55,190 --> 00:44:52,720
unexpected uh by any of the theories or

1213
00:44:57,430 --> 00:44:55,200

models before the ibex results the fact

1214
00:44:59,270 --> 00:44:57,440
that there's no bow shock uh the fact

1215
00:45:01,750 --> 00:44:59,280
that there's this complicated uh

1216
00:45:03,750 --> 00:45:01,760
heliotail behind us the measurements the

1217
00:45:05,510 --> 00:45:03,760
direct measurements of the interstellar

1218
00:45:07,430 --> 00:45:05,520
material where we're able to actually

1219
00:45:09,510 --> 00:45:07,440
get the composition of it and show you

1220
00:45:10,309 --> 00:45:09,520
that it's not exactly solar-like in some

1221
00:45:12,069 --> 00:45:10,319
ways

1222
00:45:13,910 --> 00:45:12,079
there's there's just such a long list of

1223
00:45:16,150 --> 00:45:13,920
those that it's you know it's hard it's

1224
00:45:19,510 --> 00:45:16,160
hard to pick a favorite it's like

1225
00:45:21,750 --> 00:45:19,520
all all my children are wonderful

1226
00:45:23,270 --> 00:45:21,760
understood understood

1227
00:45:25,030 --> 00:45:23,280
okay well that's the last question we

1228
00:45:26,870 --> 00:45:25,040
have so uh thank you to all our

1229
00:45:29,270 --> 00:45:26,880
panelists and i wanted to let everyone

1230
00:45:31,589 --> 00:45:29,280
online know that they can continue to

1231
00:45:34,230 --> 00:45:31,599
follow the ibex mission find out about

1232
00:45:38,150 --> 00:45:34,240
some of its previous discoveries online

1233
00:45:41,589 --> 00:45:39,349
ibex

1234
00:45:44,630 --> 00:45:41,599
and please continue to follow nasa

1235
00:45:46,870 --> 00:45:44,640
science nasa heliophysics on the variety

1236
00:45:48,470 --> 00:45:46,880
of social media channels that nasa has

1237
00:45:50,790 --> 00:45:48,480
available

1238
00:45:51,750 --> 00:45:50,800

they're all listed here

1239
00:45:53,910 --> 00:45:51,760
and

1240
00:45:55,670 --> 00:45:53,920
thank again thank you all for watching