PUBLIC LECTURE SERIES

Tiny Stellar Islands in a Big Old Universe

Featuring Guest Speaker:

Trisha Ashley

1
00:00:10,459 --> 00:00:06,320
alright it's 8 o'clock and we have a

2
00:00:11,900 --> 00:00:10,469
nicely busy house so we'll start as I

3
00:00:15,440 --> 00:00:11,910
said my name is Alex Lockwood I'm

4
00:00:18,130 --> 00:00:15,450
replacing Frank summers this evening not

5
00:00:23,090 --> 00:00:18,140
replacing trying to emulate his

6
00:00:24,620 --> 00:00:23,100
magnificence and I'm just here to host

7
00:00:28,040 --> 00:00:24,630
your evening the real star of the show

8
00:00:30,859 --> 00:00:28,050
is dr. Ashley just a couple of

9
00:00:33,260 --> 00:00:30,869
announcements as I mentioned if you're

10
00:00:35,060 --> 00:00:33,270
interested in going to across the street

11
00:00:37,400 --> 00:00:35,070
to the johns hopkins observatory and

12
00:00:38,780 --> 00:00:37,410
looking through their telescope please

13
00:00:42,440 --> 00:00:38,790

meet after the talk

14
00:00:45,080 --> 00:00:42,450
up here at the podium we have a couple

15
00:00:47,270 --> 00:00:45,090
of upcoming public lecture series the

16
00:00:49,970 --> 00:00:47,280
public lecture series for September is

17
00:00:53,180 --> 00:00:49,980
on September 3rd the topic is the

18
00:00:55,400 --> 00:00:53,190
astronomers toolkit and the speaker is

19
00:01:01,549 --> 00:00:55,410
another outreach scientist named dr.

20
00:01:04,399 --> 00:01:01,559
Brandon Lawton yeah Brandon and then on

21
00:01:07,250 --> 00:01:04,409
October the October public lecture is on

22
00:01:10,160 --> 00:01:07,260
October 1st and the title is black holes

23
00:01:13,370 --> 00:01:10,170
and gravitational waves which is very

24
00:01:16,070 --> 00:01:13,380
cool and the speaker is from Johns

25
00:01:18,440 --> 00:01:16,080
Hopkins his name is Emanuel Liberty

26
00:01:19,700 --> 00:01:18,450
I may have butchered that but those are

27
00:01:22,370 --> 00:01:19,710
the upcoming talks they're also

28
00:01:27,050 --> 00:01:22,380
available online as is this recording

29
00:01:30,200 --> 00:01:27,060
after after tonight so with that I would

30
00:01:32,210 --> 00:01:30,210
like to introduce tonight's speaker dr.

31
00:01:34,880 --> 00:01:32,220
Tricia Ashley got her bachelor's degree

32
00:01:38,300 --> 00:01:34,890
in physics and astronomy from the Bryn

33
00:01:40,399 --> 00:01:38,310
Mawr College in 2008 in 2014 she

34
00:01:43,010 --> 00:01:40,409
received her PhD in physics from Florida

35
00:01:45,170 --> 00:01:43,020
International University for her PhD

36
00:01:48,440 --> 00:01:45,180
dissertation she studied star formation

37
00:01:52,160 --> 00:01:48,450
in blue compact dwarf galaxies as part

38
00:01:53,630 --> 00:01:52,170

of the research team little things she

39
00:01:55,789 --> 00:01:53,640
has since worked on understanding the

40
00:01:58,550 --> 00:01:55,799
gas content in isolated early type

41
00:02:00,499 --> 00:01:58,560
galaxies as a postdoc at NASA Ames and

42
00:02:01,870 --> 00:02:00,509
she's currently working as a postdoc at

43
00:02:06,139 --> 00:02:01,880
the Space Telescope Science Institute

44
00:02:07,999 --> 00:02:06,149
with Andy Fox here at Space Telescope's

45
00:02:10,700 --> 00:02:08,009
she studies the Fermi bubbles and gas

46
00:02:13,370 --> 00:02:10,710
flows into and from

47
00:02:15,920 --> 00:02:13,380
the Milky Way she also spends time as an

48
00:02:17,390 --> 00:02:15,930
organiser of astronomy on tap Baltimore

49
00:02:19,700 --> 00:02:17,400
which I'm sure she'd be happy to answer

50
00:02:21,860 --> 00:02:19,710
questions about an outreach program that

51
00:02:23,870 --> 00:02:21,870
brings scientists to bars in Baltimore

52
00:02:26,600 --> 00:02:23,880
to give fun and exciting talks about

53
00:02:36,740 --> 00:02:26,610
space so please join me in a round of

54
00:02:39,680 --> 00:02:36,750
applause welcome dr. Ashley okay can you

55
00:02:42,320 --> 00:02:39,690
hear me good okay that was a great

56
00:02:44,210 --> 00:02:42,330
introduction to my talk because it

57
00:02:47,180 --> 00:02:44,220
actually now I can stick a few lines my

58
00:02:50,810 --> 00:02:47,190
talk so today I'm going to talk to you

59
00:02:53,240 --> 00:02:50,820
about dwarf galaxies but first as

60
00:02:55,340 --> 00:02:53,250
mentioned earlier I actually wanted to

61
00:02:57,050 --> 00:02:55,350
tell you where I got my passion for

62
00:03:00,170 --> 00:02:57,060
dwarf galaxies and that was during my

63
00:03:03,160 --> 00:03:00,180

dissertation because as mentioned I did

64
00:03:05,750 --> 00:03:03,170
my dissertation work on dwarf galaxies

65
00:03:08,300 --> 00:03:05,760
so this is a picture of me getting my

66
00:03:12,530 --> 00:03:08,310
PhD this is one of my official photos

67
00:03:14,240 --> 00:03:12,540
yes very nice and so I got my PhD

68
00:03:16,130 --> 00:03:14,250
because I did that work on dwarf

69
00:03:18,410 --> 00:03:16,140
galaxies but I want to take a minute to

70
00:03:26,600 --> 00:03:18,420
analyze this photo because I'm a

71
00:03:29,840 --> 00:03:26,610
scientist no but very close so this

72
00:03:33,680 --> 00:03:29,850
picture I really believe is a graduation

73
00:03:36,770 --> 00:03:33,690
photo level expert and the reason I

74
00:03:41,449 --> 00:03:36,780
believe that is because one you got your

75
00:03:42,800 --> 00:03:41,459
monocle - you have your pipe three most

76
00:03:44,840 --> 00:03:42,810
of you may have missed it but you have

77
00:03:48,260 --> 00:03:44,850
your flask strapped to your leg filled

78
00:03:49,940 --> 00:03:48,270
with coffee of course and then finally

79
00:03:53,840 --> 00:03:49,950
you have your family degree because of

80
00:03:55,729 --> 00:03:53,850
real things in the mail so as mentioned

81
00:03:57,440 --> 00:03:55,739
I got my PhD on this work and I've been

82
00:03:59,990 --> 00:03:57,450
interested in it ever since and I

83
00:04:02,720 --> 00:04:00,000
continue to work on it on the side but

84
00:04:04,550 --> 00:04:02,730
before I introduced to George Gallup see

85
00:04:07,520 --> 00:04:04,560
I want to first introduce to you your

86
00:04:10,370 --> 00:04:07,530
own galaxy that you live in and that is

87
00:04:14,150 --> 00:04:10,380
the Milky Way so this is a beautiful

88
00:04:17,960 --> 00:04:14,160

picture taken of the night sky and if

89
00:04:20,150 --> 00:04:17,970
you go out into a very dark place where

90
00:04:22,790 --> 00:04:20,160
the nearest city is tens of miles away

91
00:04:24,020 --> 00:04:22,800
and look up at the sky you might see

92
00:04:26,210 --> 00:04:24,030
something like this

93
00:04:28,820 --> 00:04:26,220
now it won't be this beautiful in color

94
00:04:31,460 --> 00:04:28,830
it'll be mostly gray and white but it's

95
00:04:34,010 --> 00:04:31,470
the same idea we're going down the

96
00:04:37,100 --> 00:04:34,020
middle of this image you have the Milky

97
00:04:39,560 --> 00:04:37,110
Way disk so this is a galaxy that you

98
00:04:41,540 --> 00:04:39,570
all live in and you can see it

99
00:04:45,320 --> 00:04:41,550
yourselves if you do go out to these

100
00:04:47,210 --> 00:04:45,330
very dark sky places now if you take a

101
00:04:48,020 --> 00:04:47,220
bunch of images of the Milky Way from

102
00:04:49,760 --> 00:04:48,030
Earth

103
00:04:52,910 --> 00:04:49,770
and put them together you can get an

104
00:04:57,350 --> 00:04:52,920
image like this where most of the light

105
00:04:59,570 --> 00:04:57,360
is in this thin disc here and that's the

106
00:05:03,080 --> 00:04:59,580
disc the main disk of our galaxy the

107
00:05:06,409 --> 00:05:03,090
Milky Way so it's very thin and most of

108
00:05:10,340 --> 00:05:06,419
that light is coming from stars in our

109
00:05:13,940 --> 00:05:10,350
galaxy and so our galaxy is made up of

110
00:05:16,040 --> 00:05:13,950
stars dust gas and dark matter all of

111
00:05:19,430 --> 00:05:16,050
those things put together and it's this

112
00:05:21,710 --> 00:05:19,440
little island of all of those things so

113
00:05:27,650 --> 00:05:21,720

that's why I called dwarf galaxies

114
00:05:32,030 --> 00:05:27,660
islands of stars now it looks very thin

115
00:05:34,700 --> 00:05:32,040
in this picture oops blah we'll go back

116
00:05:38,810 --> 00:05:34,710
well then there it is it looks very thin

117
00:05:41,750 --> 00:05:38,820
in this picture that's because the main

118
00:05:44,659 --> 00:05:41,760
disk of our galaxy is quite thin but

119
00:05:46,550 --> 00:05:44,669
that's only our view from the earth what

120
00:05:50,210 --> 00:05:46,560
does it look like when we leave the

121
00:05:52,370 --> 00:05:50,220
earth and leave the galaxy and look back

122
00:05:53,840 --> 00:05:52,380
at it well we can't actually do that

123
00:05:57,170 --> 00:05:53,850
because we don't have the technology to

124
00:05:59,900 --> 00:05:57,180
go that fast but with the data that

125
00:06:01,490 --> 00:05:59,910
we've collected from the Milky Way we

126
00:06:03,890 --> 00:06:01,500
can actually have an artist put together

127
00:06:07,520 --> 00:06:03,900
a picture of what we think it looks like

128
00:06:11,000 --> 00:06:07,530
if we were to leave the galaxy and go

129
00:06:13,550 --> 00:06:11,010
look at it from above so this is what we

130
00:06:16,580 --> 00:06:13,560
think it might look like where you're

131
00:06:18,170 --> 00:06:16,590
here half about halfway between the

132
00:06:20,960 --> 00:06:18,180
center of the galaxy in the outer edge

133
00:06:22,430 --> 00:06:20,970
and we do want to be there we don't want

134
00:06:24,020 --> 00:06:22,440
to be too close to the center because

135
00:06:26,590 --> 00:06:24,030
too much is going on there it would be

136
00:06:31,070 --> 00:06:26,600
very disastrous for us as a population

137
00:06:32,600 --> 00:06:31,080
but you have a couple of features here

138
00:06:35,510 --> 00:06:32,610

that I'd like to point out one it's not

139
00:06:37,010 --> 00:06:35,520
thin anymore if we look down at it it's

140
00:06:39,920 --> 00:06:37,020
this big round dish

141
00:06:42,380 --> 00:06:39,930
so you can think of our galaxy as like a

142
00:06:44,090 --> 00:06:42,390
thin plate it's not exactly shaped

143
00:06:46,790 --> 00:06:44,100
exactly like a plate but it's pretty

144
00:06:49,280 --> 00:06:46,800
much like one and then on top of that

145
00:06:52,340 --> 00:06:49,290
you have these big beautiful spiraling

146
00:06:54,680 --> 00:06:52,350
arms so astronomers look at galaxies

147
00:06:56,360 --> 00:06:54,690
like this and they say oh it has

148
00:06:58,220 --> 00:06:56,370
spiraling arms so we'll call that a

149
00:07:01,340 --> 00:06:58,230
spiral galaxy because we're really good

150
00:07:04,970 --> 00:07:01,350
at naming things so we live in a spiral

151
00:07:08,210 --> 00:07:04,980
galaxy which is great and we have a

152
00:07:10,280 --> 00:07:08,220
pretty good understanding of our no own

153
00:07:11,990 --> 00:07:10,290
Milky Way for having lived in it we're

154
00:07:13,550 --> 00:07:12,000
not we don't understand everything but

155
00:07:16,220 --> 00:07:13,560
we're still studying a lot about it but

156
00:07:18,620 --> 00:07:16,230
one thing we do know is that we are not

157
00:07:21,620 --> 00:07:18,630
the only galaxies out there there are

158
00:07:24,170 --> 00:07:21,630
lots of other galaxies and to prove this

159
00:07:26,300 --> 00:07:24,180
point I have this beautiful image here

160
00:07:27,980 --> 00:07:26,310
which is the Hubble Deep Field so this

161
00:07:30,860 --> 00:07:27,990
is a very famous image and I'm gonna

162
00:07:32,810 --> 00:07:30,870
explain why what they did was a bunch of

163
00:07:36,440 --> 00:07:32,820

astronomers in the 1990s got together

164
00:07:38,330 --> 00:07:36,450
and they said hey what would happen if

165
00:07:40,490 --> 00:07:38,340
we take the Hubble Space Telescope our

166
00:07:43,250 --> 00:07:40,500
most powerful optical telescope and

167
00:07:46,400 --> 00:07:43,260
point it at a black part of this guy

168
00:07:48,380 --> 00:07:46,410
like we don't see anything there nothing

169
00:07:51,020 --> 00:07:48,390
what would happen if we just point it

170
00:07:52,550 --> 00:07:51,030
there for a really long time and so a

171
00:07:54,830 --> 00:07:52,560
bunch of other astronomers who had to

172
00:07:57,830 --> 00:07:54,840
approve this plan said yeah why not go

173
00:08:00,380 --> 00:07:57,840
for it so they spent 10 days in over a

174
00:08:02,560 --> 00:08:00,390
hundred hours staring at this part of

175
00:08:05,960 --> 00:08:02,570
the sky that was supposed to be empty

176
00:08:09,710 --> 00:08:05,970
very small part of this guy yes correct

177
00:08:11,840 --> 00:08:09,720
and they got this and this is a

178
00:08:13,850 --> 00:08:11,850
beautiful image because aside from a few

179
00:08:16,700 --> 00:08:13,860
stars which you can tell have these

180
00:08:18,620 --> 00:08:16,710
pointy features here so those are stars

181
00:08:20,150 --> 00:08:18,630
in our own galaxy the Milky Way we can't

182
00:08:22,000 --> 00:08:20,160
go out there and tell them to move so we

183
00:08:26,080 --> 00:08:22,010
just have to leave them in the image

184
00:08:29,420 --> 00:08:26,090
everything in this image is a galaxy

185
00:08:32,380 --> 00:08:29,430
there are almost 3000 galaxies in this

186
00:08:34,640 --> 00:08:32,390
image and as you can tell from it

187
00:08:37,130 --> 00:08:34,650
they're all different colors and

188
00:08:39,740 --> 00:08:37,140

different shapes so there are lots of

189
00:08:41,690 --> 00:08:39,750
types of galaxies out there and we are

190
00:08:44,150 --> 00:08:41,700
definitely not the only galaxies so lots

191
00:08:48,530 --> 00:08:44,160
of little islands of stars dust gas and

192
00:08:50,060 --> 00:08:48,540
dark matter so I haven't talked much

193
00:08:50,480 --> 00:08:50,070
about dwarf galaxies yet

194
00:08:52,639 --> 00:08:50,490
let's do

195
00:08:54,740 --> 00:08:52,649
that so this again is the artist

196
00:08:56,660 --> 00:08:54,750
depiction of our own Milky Way and what

197
00:08:58,610 --> 00:08:56,670
we think it looks like what happens if

198
00:09:02,690 --> 00:08:58,620
we put outdoors galaxies next to it

199
00:09:04,420 --> 00:09:02,700
Oh looks approximately like that tiny

200
00:09:08,750 --> 00:09:04,430
little square up there in the top left

201
00:09:13,670 --> 00:09:08,760
so it's quite small dwarf galaxies are

202
00:09:15,680 --> 00:09:13,680
about 1/10 - down to about 125th the

203
00:09:18,920 --> 00:09:15,690
size of a big spiral galaxy like our

204
00:09:21,320 --> 00:09:18,930
Milky Way so they're very small so the

205
00:09:23,630 --> 00:09:21,330
question becomes why do we care about

206
00:09:27,800 --> 00:09:23,640
such tiny galaxies what's the point of

207
00:09:30,639 --> 00:09:27,810
studying them well first off there are a

208
00:09:33,019 --> 00:09:30,649
lot of them nearby us and so this image

209
00:09:34,820 --> 00:09:33,029
even though a little bit hard to read it

210
00:09:37,550 --> 00:09:34,830
proves a-- where we have the Milky Way

211
00:09:39,410 --> 00:09:37,560
in the center labeled in yellow and then

212
00:09:41,120 --> 00:09:39,420
we have these two yellow labels here

213
00:09:44,329 --> 00:09:41,130

which are the Andromeda galaxy in the

214
00:09:48,500 --> 00:09:44,339
Triangulum galaxy so those galaxies in

215
00:09:51,139 --> 00:09:48,510
yellow are nearest massive neighbors so

216
00:09:54,350 --> 00:09:51,149
they're big galaxies everything else

217
00:09:57,920 --> 00:09:54,360
here is labeled in light blue and those

218
00:10:00,860 --> 00:09:57,930
are all dwarf galaxies there are about

219
00:10:03,710 --> 00:10:00,870
last time I checked for tea or fuel

220
00:10:06,019 --> 00:10:03,720
exceeds with a distance to the Milky Way

221
00:10:10,550 --> 00:10:06,029
that is smaller than our distance to

222
00:10:12,980 --> 00:10:10,560
Andromeda so 40 dwarf galaxies fit right

223
00:10:15,380 --> 00:10:12,990
in here that's a lot of dwarf galaxies

224
00:10:17,060 --> 00:10:15,390
so we want to understand where they came

225
00:10:20,870 --> 00:10:17,070
from what they're doing and what we can

226
00:10:23,660 --> 00:10:20,880
learn from them so one thing we can

227
00:10:25,430 --> 00:10:23,670
learn from them is star formation we can

228
00:10:28,160 --> 00:10:25,440
learn about star formation and how it

229
00:10:30,829 --> 00:10:28,170
happened so this is an image not of

230
00:10:32,269 --> 00:10:30,839
dwarf galaxies star formation or milky

231
00:10:36,079 --> 00:10:32,279
way star formation this is for all

232
00:10:38,120 --> 00:10:36,089
galaxies so we start off with some

233
00:10:42,470 --> 00:10:38,130
really dense gas in the center in the

234
00:10:46,310 --> 00:10:42,480
red here and then that dense gas can

235
00:10:47,840 --> 00:10:46,320
collapse and form stars and then those

236
00:10:50,180 --> 00:10:47,850
stars live out their lives is either

237
00:10:53,120 --> 00:10:50,190
less massive stars or more massive stars

238
00:10:56,569 --> 00:10:53,130

eventually die but the main point of

239
00:10:59,269 --> 00:10:56,579
this image is that you need dense gas to

240
00:11:03,140 --> 00:10:59,279
form stars and that's actually really

241
00:11:04,070 --> 00:11:03,150
hard to get in some galaxies we don't

242
00:11:06,020 --> 00:11:04,080
know how

243
00:11:09,740 --> 00:11:06,030
gasps always gets to these dentinal

244
00:11:11,960 --> 00:11:09,750
states and so we kind of understand how

245
00:11:14,210 --> 00:11:11,970
that works in the milky way and I'm

246
00:11:16,460 --> 00:11:14,220
gonna take a piece of a spiral arm to

247
00:11:18,680 --> 00:11:16,470
show you that and I'm gonna blow it up

248
00:11:21,440 --> 00:11:18,690
and we're gonna pretend like it it's a

249
00:11:24,710 --> 00:11:21,450
traffic jam but in traffic jams and

250
00:11:28,490 --> 00:11:24,720
galaxies you don't have cars and trucks

251
00:11:31,220 --> 00:11:28,500
you have gas and stars so what happens

252
00:11:34,490 --> 00:11:31,230
is the spiral arm comes sweeping through

253
00:11:36,560 --> 00:11:34,500
the galaxy and the gas in the galaxy

254
00:11:39,470 --> 00:11:36,570
gets caught up in the spiral arm like a

255
00:11:41,930 --> 00:11:39,480
traffic jam and the gas starts bumping

256
00:11:43,720 --> 00:11:41,940
into each other creating regions of high

257
00:11:46,730 --> 00:11:43,730
density because it gets stirred up and

258
00:11:50,990 --> 00:11:46,740
that high density gas can then collapse

259
00:11:56,830 --> 00:11:51,000
and form stars so that's generally how

260
00:12:00,770 --> 00:11:56,840
you get stars in a spiral galaxy but

261
00:12:02,870 --> 00:12:00,780
dwarf galaxies don't have spiral arms so

262
00:12:04,700 --> 00:12:02,880
they don't have this mechanism to kind

263
00:12:07,850 --> 00:12:04,710

of stir up their gas and make regions of

264
00:12:11,720 --> 00:12:07,860
high density so we want to understand

265
00:12:15,320 --> 00:12:11,730
what causes their gas to get stirred up

266
00:12:17,570 --> 00:12:15,330
enough in order to create stars and if

267
00:12:19,730 --> 00:12:17,580
we do that then we have a more basic

268
00:12:22,670 --> 00:12:19,740
understanding of how star formation can

269
00:12:28,910 --> 00:12:22,680
happen without the aid of these extra

270
00:12:31,130 --> 00:12:28,920
spiral arms so some galaxies some dwarf

271
00:12:34,250 --> 00:12:31,140
galaxies are really good at forming

272
00:12:36,260 --> 00:12:34,260
stars and some are really bad so in

273
00:12:38,660 --> 00:12:36,270
these images I've taken their combined

274
00:12:41,150 --> 00:12:38,670
images where we've taken the Stars the

275
00:12:43,190 --> 00:12:41,160
old stars and the new stars and combined

276
00:12:45,860 --> 00:12:43,200
it with images of the gas so the gas is

277
00:12:47,270 --> 00:12:45,870
in red and the old stars are in green

278
00:12:51,050 --> 00:12:47,280
which you can see a little bit here in

279
00:12:53,660 --> 00:12:51,060
2d do to 16 and then new stars are the

280
00:12:56,140 --> 00:12:53,670
blue stars so those are little pops of

281
00:12:58,910 --> 00:12:56,150
blue you can see Indy do to 16 and

282
00:13:01,130 --> 00:12:58,920
notice to do to 16 doesn't have many

283
00:13:03,230 --> 00:13:01,140
pops of blue so it's not very good at

284
00:13:07,040 --> 00:13:03,240
forming stars right now it doesn't have

285
00:13:10,490 --> 00:13:07,050
many new stars whereas herre 36 on the

286
00:13:12,790 --> 00:13:10,500
right side has this bright white spot

287
00:13:15,920 --> 00:13:12,800
here where it's forming a ton of stars

288
00:13:17,689 --> 00:13:15,930

so it's very good at forming stars and

289
00:13:19,340 --> 00:13:17,699
we want to figure out why

290
00:13:20,960 --> 00:13:19,350
why are these dwarf galaxies so

291
00:13:23,119 --> 00:13:20,970
different what happened to one that

292
00:13:24,559 --> 00:13:23,129
didn't happen to the other to make it

293
00:13:29,569 --> 00:13:24,569
really good at forming stars are really

294
00:13:31,249 --> 00:13:29,579
bad at forming stars so I keep having

295
00:13:33,530 --> 00:13:31,259
this little symbol in the bottom right

296
00:13:35,599 --> 00:13:33,540
and as mentioned earlier little things

297
00:13:38,449 --> 00:13:35,609
as the research group that I belong to

298
00:13:40,579 --> 00:13:38,459
and I worked with for my dissertation so

299
00:13:43,849 --> 00:13:40,589
little things is actually great because

300
00:13:46,340 --> 00:13:43,859
it's an acronym and it's really fun to

301
00:13:48,289 --> 00:13:46,350
say out loud at once when you try to

302
00:13:50,869 --> 00:13:48,299
read out this acronym so where did it

303
00:13:53,900 --> 00:13:50,879
come from well first there was a group

304
00:13:57,169 --> 00:13:53,910
called things things was a group that

305
00:14:01,340 --> 00:13:57,179
studied things nearby us so they studied

306
00:14:04,629 --> 00:14:01,350
the gas and nearby massive galaxies and

307
00:14:08,539 --> 00:14:04,639
that gas is called atomic hydrogen or h1

308
00:14:11,780 --> 00:14:08,549
so their acronym is the h1 nearby

309
00:14:14,659 --> 00:14:11,790
galaxies survey or the gas nearby

310
00:14:17,059 --> 00:14:14,669
galaxies survey so that's simple kind of

311
00:14:19,549 --> 00:14:17,069
easy to remember right but then little

312
00:14:22,039 --> 00:14:19,559
things group came along and they said

313
00:14:24,739 --> 00:14:22,049

hey we want to do the same thing as

314
00:14:27,079 --> 00:14:24,749
things but we want to do it with smaller

315
00:14:29,659 --> 00:14:27,089
galaxies so we want to do it with little

316
00:14:31,999 --> 00:14:29,669
things so then they had to come up with

317
00:14:35,119 --> 00:14:32,009
an acronym that fit this of course like

318
00:14:38,269 --> 00:14:35,129
true astronomers and they got creative

319
00:14:41,059 --> 00:14:38,279
and now you're about to figure out why I

320
00:14:43,939 --> 00:14:41,069
don't ever say the full acronym out loud

321
00:14:46,400 --> 00:14:43,949
to many people it is the local irregular

322
00:14:50,629 --> 00:14:46,410
is that trace luminosity extremes the h1

323
00:14:53,749 --> 00:14:50,639
nearby galaxies surveys so just a little

324
00:14:56,119 --> 00:14:53,759
a great example of acronyms and

325
00:15:00,439 --> 00:14:56,129
astronomy and how far they can be taken

326
00:15:02,179 --> 00:15:00,449
so what did we do to get this data well

327
00:15:05,299 --> 00:15:02,189
we were looking mainly for the gas data

328
00:15:08,900 --> 00:15:05,309
and we took stellar data from other

329
00:15:10,879 --> 00:15:08,910
surveys and we got that gas data from

330
00:15:13,159 --> 00:15:10,889
The Very Large Array telescope and this

331
00:15:14,239 --> 00:15:13,169
is a beautiful picture of only part of

332
00:15:17,779 --> 00:15:14,249
that telescope

333
00:15:20,509 --> 00:15:17,789
there are actually 27 of these dishes

334
00:15:23,479 --> 00:15:20,519
that belong to this telescope and they

335
00:15:25,369 --> 00:15:23,489
together make one big telescope which is

336
00:15:26,899 --> 00:15:25,379
great because then you can move them

337
00:15:28,669 --> 00:15:26,909
closer together to make a small

338
00:15:31,060 --> 00:15:28,679

telescope or you can move them further

339
00:15:34,550 --> 00:15:31,070
apart to make a bigger telescope

340
00:15:37,730 --> 00:15:34,560
so this is a beautiful telescope which

341
00:15:39,320 --> 00:15:37,740
I've visited and we get the gas data

342
00:15:40,900 --> 00:15:39,330
from there here's me sitting on top of

343
00:15:44,210 --> 00:15:40,910
one of the dishes at the edge very

344
00:15:46,400 --> 00:15:44,220
perilous situation and then just to

345
00:15:48,410 --> 00:15:46,410
explain how big they are here's me way

346
00:15:50,660 --> 00:15:48,420
down at the bottom of one on the right

347
00:15:55,130 --> 00:15:50,670
side so these are giant dishes they're

348
00:15:56,660 --> 00:15:55,140
about 25 meters in diameter so that's

349
00:16:01,340 --> 00:15:56,670
how we got our data we got it from this

350
00:16:04,460 --> 00:16:01,350
telescope the gaseous data and we tried

351
00:16:06,590 --> 00:16:04,470
to understand what can help form stars

352
00:16:08,450 --> 00:16:06,600
in most of these galaxies and some other

353
00:16:11,390 --> 00:16:08,460
things but what I was mainly focused on

354
00:16:16,040 --> 00:16:11,400
is regulating star formation and dwarf

355
00:16:19,280 --> 00:16:16,050
galaxies so this is a list of just some

356
00:16:21,080 --> 00:16:19,290
of the ways you might be able to

357
00:16:22,550 --> 00:16:21,090
regulate star formation it's a long list

358
00:16:24,950 --> 00:16:22,560
you don't need to read it all go through

359
00:16:26,840 --> 00:16:24,960
some of them but in general it just

360
00:16:29,840 --> 00:16:26,850
gives you an idea of how many different

361
00:16:31,880 --> 00:16:29,850
ideas there are out there for forming

362
00:16:35,270 --> 00:16:31,890
stars and galaxies and we're trying to

363
00:16:38,480 --> 00:16:35,280

understand which galaxies might be doing

364
00:16:41,840 --> 00:16:38,490
these things so we're gonna focus on

365
00:16:43,850 --> 00:16:41,850
these for tonight and I did mention

366
00:16:45,260 --> 00:16:43,860
regulating star formation was my

367
00:16:48,140 --> 00:16:45,270
interest but really I was more

368
00:16:51,080 --> 00:16:48,150
interested in how galaxies can form more

369
00:16:52,640 --> 00:16:51,090
stars for tonight's talk so how do we

370
00:16:55,940 --> 00:16:52,650
get more of them now how do we get less

371
00:17:00,370 --> 00:16:55,950
of them so let's start off with our

372
00:17:05,320 --> 00:17:00,380
first way so you can have old stars

373
00:17:10,610 --> 00:17:08,180
well if we start off with a bunch of

374
00:17:13,880 --> 00:17:10,620
stars that have just formed okay these

375
00:17:16,970 --> 00:17:13,890
are the stars in the center in gas so

376
00:17:19,610 --> 00:17:16,980
the gas is the orange here so if these

377
00:17:22,550 --> 00:17:19,620
stars just formed they're giving off a

378
00:17:25,430 --> 00:17:22,560
lot of radiation if there are enough of

379
00:17:27,650 --> 00:17:25,440
them and when they give off all of this

380
00:17:30,020 --> 00:17:27,660
radiation we like to call them stellar

381
00:17:32,810 --> 00:17:30,030
winds that radiation is called a wind

382
00:17:35,840 --> 00:17:32,820
and what that wind or that radiation

383
00:17:40,790 --> 00:17:35,850
does is it keeps up the surrounding gas

384
00:17:42,650 --> 00:17:40,800
it also starts to push gas away from the

385
00:17:43,990 --> 00:17:42,660
stars because it's just radiation

386
00:17:48,250 --> 00:17:44,000
pushing away the gas

387
00:17:52,450 --> 00:17:48,260
rounds it and as it does it it creates a

388
00:17:55,360 --> 00:17:52,460

snowplow effect in the gas and remember

389
00:17:57,370 --> 00:17:55,370
we need dense gas to form stars so

390
00:18:00,430 --> 00:17:57,380
eventually these stars in the center

391
00:18:02,590 --> 00:18:00,440
will start to die off the really big

392
00:18:05,110 --> 00:18:02,600
ones and that radiation will calm down

393
00:18:07,750 --> 00:18:05,120
and so this dense gas which is kind of

394
00:18:11,620 --> 00:18:07,760
like a bubble around these stars now can

395
00:18:15,550 --> 00:18:11,630
start to cool and collapse and form new

396
00:18:17,830 --> 00:18:15,560
stars so that's how you can get new

397
00:18:22,620 --> 00:18:17,840
stars created by a bunch of old stars

398
00:18:25,630 --> 00:18:22,630
this snowplow effect in the gas so that

399
00:18:27,280 --> 00:18:25,640
does happen in some dwarf galaxies we

400
00:18:30,430 --> 00:18:27,290
think we see that and this is an image

401
00:18:34,780 --> 00:18:30,440
again some little things with galaxy IC

402
00:18:37,540 --> 00:18:34,790
1613 we're in red you have this

403
00:18:39,100 --> 00:18:37,550
beautiful gas and in the center you

404
00:18:42,520 --> 00:18:39,110
notice a bunch of green and those are

405
00:18:44,890 --> 00:18:42,530
our older stars and those older stars

406
00:18:46,900 --> 00:18:44,900
may have pushed out this gas because you

407
00:18:50,170 --> 00:18:46,910
don't see much red on top of the green

408
00:18:52,240 --> 00:18:50,180
here and given it that snowplow effect

409
00:18:55,690 --> 00:18:52,250
where now you see a bunch of blue or

410
00:18:58,630 --> 00:18:55,700
younger stars are forming in it so this

411
00:19:00,820 --> 00:18:58,640
is a beautiful nearby example of a

412
00:19:02,830 --> 00:19:00,830
galaxy that might be having the snowplow

413
00:19:05,560 --> 00:19:02,840

effect where older stars are forming new

414
00:19:08,950 --> 00:19:05,570
stars so what's our second way we're

415
00:19:12,010 --> 00:19:08,960
going to talk about so let's pump it up

416
00:19:15,040 --> 00:19:12,020
a notch let's go to gas consumption so

417
00:19:17,050 --> 00:19:15,050
galaxies eating gas this is a way you

418
00:19:21,310 --> 00:19:17,060
can get a lot of star formation all at

419
00:19:23,440 --> 00:19:21,320
once so this is an artist's image of

420
00:19:25,150 --> 00:19:23,450
that going on for a more massive galaxy

421
00:19:27,550 --> 00:19:25,160
but it still works for Dwarfs galaxies

422
00:19:30,310 --> 00:19:27,560
and with a lot of gas but we'll talk

423
00:19:33,040 --> 00:19:30,320
about little chunks of gas so the idea

424
00:19:36,790 --> 00:19:33,050
is you have a dwarf galaxy just sitting

425
00:19:39,970 --> 00:19:36,800
out there and some gas is nearby if that

426
00:19:42,220 --> 00:19:39,980
gas gets caught in the gravity of your

427
00:19:44,080 --> 00:19:42,230
galaxy it's gonna ram into the galaxy

428
00:19:45,910 --> 00:19:44,090
right because it wants to go towards the

429
00:19:49,510 --> 00:19:45,920
galaxy when it's gravitationally

430
00:19:52,419 --> 00:19:49,520
attracted and so as it comes ramming

431
00:19:55,419 --> 00:19:52,429
into the galaxy it's going to stir up

432
00:19:57,100 --> 00:19:55,429
all the gas already inside of the galaxy

433
00:20:00,039 --> 00:19:57,110
and on top of that

434
00:20:04,299 --> 00:20:00,049
it's providing fuel for future star

435
00:20:06,370 --> 00:20:04,309
formation because stars form from gas so

436
00:20:07,960 --> 00:20:06,380
you can get a burst of star formation

437
00:20:11,500 --> 00:20:07,970
and then you're on top of that giving it

438
00:20:14,980 --> 00:20:11,510

fuel for later star formation and we

439
00:20:17,440 --> 00:20:14,990
think we see that in sevens wiki 403 so

440
00:20:19,600 --> 00:20:17,450
on the left side here this is our galaxy

441
00:20:21,190 --> 00:20:19,610
sevens wiki 403 where I've combined the

442
00:20:23,410 --> 00:20:21,200
images of the stars and the gas again

443
00:20:25,830 --> 00:20:23,420
and you notice the bursts of star

444
00:20:28,240 --> 00:20:25,840
formation in the center of this one and

445
00:20:32,860 --> 00:20:28,250
then on the right side I've separated

446
00:20:35,950 --> 00:20:32,870
out just the gas in this galaxy so on

447
00:20:38,650 --> 00:20:35,960
the right side I have in gray contours

448
00:20:41,919 --> 00:20:38,660
here that's the gas that we think

449
00:20:45,669 --> 00:20:41,929
belongs to sevens with G 403 for the

450
00:20:49,870 --> 00:20:45,679
most part but we found this chunk of gas

451
00:20:52,650 --> 00:20:49,880
an orange that is moving differently

452
00:20:55,720 --> 00:20:52,660
than the rest of the gas in the galaxy

453
00:20:57,490 --> 00:20:55,730
so since it's moving so very differently

454
00:20:59,680 --> 00:20:57,500
from the rest of the gas we think this

455
00:21:03,340 --> 00:20:59,690
is a gas cloud that's coming crashing

456
00:21:05,230 --> 00:21:03,350
into the galaxy so this is an example of

457
00:21:07,720 --> 00:21:05,240
where they may be happening where this

458
00:21:10,630 --> 00:21:07,730
gas cloud is crashing into the galaxies

459
00:21:13,710 --> 00:21:10,640
stirring up the gas and then being maybe

460
00:21:16,090 --> 00:21:13,720
providing fuel for future star formation

461
00:21:20,380 --> 00:21:16,100
so that's a really cool example of where

462
00:21:22,180 --> 00:21:20,390
we think we see that now I keep

463
00:21:26,980 --> 00:21:22,190

mentioning all these names of galaxies

464
00:21:30,490 --> 00:21:26,990
IC 1613 D do 216 sevens wiki 403 what

465
00:21:32,140 --> 00:21:30,500
does that all mean well they're actually

466
00:21:35,530 --> 00:21:32,150
not that interesting of an answer their

467
00:21:40,539 --> 00:21:35,540
catalog names so for example seven

468
00:21:44,500 --> 00:21:40,549
Sookie 403 it's fritz zwicky's seventh

469
00:21:46,120 --> 00:21:44,510
catalog object zero four zero three not

470
00:21:47,710 --> 00:21:46,130
that interesting right well the reason I

471
00:21:50,320 --> 00:21:47,720
bring that up is because Fritz Zwicky

472
00:21:53,380 --> 00:21:50,330
is one of my pictorial heroes and what

473
00:21:56,110 --> 00:21:53,390
do I mean by that well he's really good

474
00:21:57,900 --> 00:21:56,120
at taking professional photos so I

475
00:22:01,000 --> 00:21:57,910
really believe that he has reached

476
00:22:02,380 --> 00:22:01,010
professional photo level experts so I'm

477
00:22:08,480 --> 00:22:02,390
going to be trying to reach this in my

478
00:22:10,310 --> 00:22:08,490
future career so just keep an eye out so

479
00:22:13,030 --> 00:22:10,320
what's our third way that we can do this

480
00:22:16,100 --> 00:22:13,040
well we can talk about interacting and

481
00:22:18,140 --> 00:22:16,110
merging dwarf galaxies we're here on the

482
00:22:19,940 --> 00:22:18,150
left we have some Zords that are

483
00:22:21,680 --> 00:22:19,950
momentarily interacting and then they

484
00:22:24,500 --> 00:22:21,690
let go and go off on their own ways and

485
00:22:27,049 --> 00:22:24,510
on the right we have some Zords that are

486
00:22:29,860 --> 00:22:27,059
merging to become a Megazord okay but

487
00:22:32,690 --> 00:22:29,870
what does that look like with galaxies

488
00:22:34,430 --> 00:22:32,700

well it looks something like this where

489
00:22:36,770 --> 00:22:34,440
this video I'm playing actually depicts

490
00:22:39,590 --> 00:22:36,780
maps of galaxies but that's okay

491
00:22:41,419 --> 00:22:39,600
works for dwarfs again and the Pops of

492
00:22:44,540 --> 00:22:41,429
blue that you can kind of see here our

493
00:22:46,820 --> 00:22:44,550
stars forming so as they pass by each

494
00:22:49,190 --> 00:22:46,830
other they're interacting and you see

495
00:22:50,840 --> 00:22:49,200
lots of pops of blue so lots of new

496
00:22:53,450 --> 00:22:50,850
stars forming so they're stirring up

497
00:22:54,620 --> 00:22:53,460
each other's gas gravitationally but

498
00:22:56,990 --> 00:22:54,630
they're caught in each other with

499
00:23:00,560 --> 00:22:57,000
gravity so they're eventually going to

500
00:23:03,650 --> 00:23:00,570
merge and as they merge you're going to

501
00:23:05,210 --> 00:23:03,660
see lots more pops of blue so as they're

502
00:23:07,730 --> 00:23:05,220
merging they're stirring up each other's

503
00:23:13,180 --> 00:23:07,740
gas a lot creating regions of high gas

504
00:23:17,090 --> 00:23:13,190
density which can then form stars but

505
00:23:19,310 --> 00:23:17,100
there is as we replay it I'm going to

506
00:23:23,660 --> 00:23:19,320
show you some signatures that

507
00:23:25,250 --> 00:23:23,670
astronomers look for when they are

508
00:23:28,280 --> 00:23:25,260
looking for these merging and

509
00:23:30,020 --> 00:23:28,290
interacting galaxies so as they interact

510
00:23:32,210 --> 00:23:30,030
they come close to each other and the

511
00:23:35,299 --> 00:23:32,220
galaxies on the right you're gonna see

512
00:23:38,690 --> 00:23:35,309
it change shape and when it changes

513
00:23:43,100 --> 00:23:38,700

shape it actually leaves these curved

514
00:23:46,549 --> 00:23:43,110
features behind and that's because the

515
00:23:49,790 --> 00:23:46,559
other galaxies it's gravity has ripped

516
00:23:53,060 --> 00:23:49,800
the stars off the outer edge and created

517
00:23:55,790 --> 00:23:53,070
these curved features so these are what

518
00:23:57,740 --> 00:23:55,800
we call tidal tails so that's something

519
00:24:02,390 --> 00:23:57,750
that astronomers look for when they're

520
00:24:05,120 --> 00:24:02,400
looking for interacting galaxies then if

521
00:24:08,180 --> 00:24:05,130
we want to look for merging galaxies

522
00:24:11,360 --> 00:24:08,190
like these to one thing we can look for

523
00:24:14,419 --> 00:24:11,370
is their centers so these two have very

524
00:24:19,040 --> 00:24:14,429
bright centers very bright cores we call

525
00:24:20,930 --> 00:24:19,050
them and as they merge you notice that

526
00:24:22,269 --> 00:24:20,940
they're bright cores don't merge

527
00:24:25,089 --> 00:24:22,279
immediately there's still

528
00:24:27,099 --> 00:24:25,099
visible for a while so if you see these

529
00:24:30,269 --> 00:24:27,109
two separate cords with a bunch of these

530
00:24:32,469 --> 00:24:30,279
titles tails or these pulled out stars

531
00:24:37,989 --> 00:24:32,479
then you know you have a merging

532
00:24:39,609 --> 00:24:37,999
galaxies situation so in Harrow 36 this

533
00:24:41,979 --> 00:24:39,619
galaxy I showed you earlier that's

534
00:24:44,950 --> 00:24:41,989
forming a ton of stars we think we see

535
00:24:46,690 --> 00:24:44,960
that so here on the left as the image I

536
00:24:49,899 --> 00:24:46,700
showed you before of the stars and the

537
00:24:52,119 --> 00:24:49,909
gas and red and the stars here in this

538
00:24:54,519 --> 00:24:52,129

bright white part are forming a lot of

539
00:24:57,820 --> 00:24:54,529
them and then on the right side have

540
00:25:00,519 --> 00:24:57,830
just pulled out the gas image so this is

541
00:25:02,739 --> 00:25:00,529
just the gas in the orange here and you

542
00:25:05,440 --> 00:25:02,749
can see going straight up there's this

543
00:25:09,070 --> 00:25:05,450
really thin feature and we think that's

544
00:25:12,999 --> 00:25:09,080
the title tail and then on top of that

545
00:25:15,940 --> 00:25:13,009
it's possible that this galaxy still has

546
00:25:17,649 --> 00:25:15,950
those two cores and it's gas visible so

547
00:25:20,680 --> 00:25:17,659
it's still settling down it's still

548
00:25:25,359 --> 00:25:20,690
mixing together so this is a possible

549
00:25:27,099 --> 00:25:25,369
example of a merged galaxy so what's our

550
00:25:29,430 --> 00:25:27,109
fourth way that we can get lots more

551
00:25:31,599 --> 00:25:29,440
stars and galaxies

552
00:25:38,279 --> 00:25:31,609
well that's through Ram pressure

553
00:25:44,950 --> 00:25:40,930
you have something very dramatic

554
00:25:48,639 --> 00:25:44,960
happening to your galaxy so the space

555
00:25:51,279 --> 00:25:48,649
between galaxies is not actually empty

556
00:25:53,259 --> 00:25:51,289
it's full of stuff stuff that galaxies

557
00:25:55,719 --> 00:25:53,269
expelled stuff that galaxies haven't

558
00:25:59,409 --> 00:25:55,729
eaten yet it's just a bunch of stuff out

559
00:26:01,719 --> 00:25:59,419
there and so if you get a galaxy like

560
00:26:05,379 --> 00:26:01,729
the one in the top left corner of this

561
00:26:09,219 --> 00:26:05,389
image here moving really fast through

562
00:26:11,649 --> 00:26:09,229
that stuff its gas is going to be ripped

563
00:26:13,749 --> 00:26:11,659

off it's just gonna be ripped straight

564
00:26:20,469 --> 00:26:13,759
off and that's the stripping part of

565
00:26:22,119 --> 00:26:20,479
this word or this phrase so as its when

566
00:26:24,609 --> 00:26:22,129
astronomers talk about Ram pressure

567
00:26:26,680 --> 00:26:24,619
stripping they don't typically talk

568
00:26:28,299 --> 00:26:26,690
about forming stars they talk about the

569
00:26:30,399 --> 00:26:28,309
death of the galaxies in terms of

570
00:26:33,269 --> 00:26:30,409
forming stars because you're ripping off

571
00:26:35,940 --> 00:26:33,279
all that fuel for star formation right

572
00:26:38,850 --> 00:26:35,950
but there

573
00:26:42,269 --> 00:26:38,860
a brief moment when this is happening to

574
00:26:45,539 --> 00:26:42,279
a galaxy where there's still gas left

575
00:26:48,539 --> 00:26:45,549
inside the galaxy and that gas is being

576
00:26:50,039 --> 00:26:48,549
stirred up a lot and so that gas that's

577
00:26:52,649 --> 00:26:50,049
being stirred up will start to form a

578
00:26:56,370 --> 00:26:52,659
lot of stars and so that's its kind of

579
00:27:00,870 --> 00:26:56,380
last burst of star formation before it

580
00:27:03,779 --> 00:27:00,880
dies well not really dies but you get

581
00:27:06,330 --> 00:27:03,789
the idea so this is a dramatic picture

582
00:27:08,370 --> 00:27:06,340
of that happening here and a very

583
00:27:10,230 --> 00:27:08,380
beautiful one with a massive galaxy

584
00:27:12,750 --> 00:27:10,240
that's moving towards the top left of

585
00:27:14,879 --> 00:27:12,760
this image and trailing behind it in

586
00:27:16,740 --> 00:27:14,889
this bluish purple color is a lot of its

587
00:27:18,350 --> 00:27:16,750
gas that's just being ripped straight

588
00:27:22,259 --> 00:27:18,360

out of it

589
00:27:26,129 --> 00:27:22,269
so with dwarf galaxies we might be

590
00:27:29,940 --> 00:27:26,139
seeing that in Markarian 178 here so

591
00:27:32,399 --> 00:27:29,950
this image on the left again is our gas

592
00:27:35,370 --> 00:27:32,409
in red and our oldest stars and green

593
00:27:37,259 --> 00:27:35,380
with our new stars in blue so there's a

594
00:27:41,820 --> 00:27:37,269
lot of star formation going on in the

595
00:27:43,919 --> 00:27:41,830
center of this galaxy but in this left

596
00:27:47,820 --> 00:27:43,929
image you notice that the red is kind of

597
00:27:50,789 --> 00:27:47,830
trailing off to this tip so that could

598
00:27:53,039 --> 00:27:50,799
be the gas that is being left behind by

599
00:27:55,230 --> 00:27:53,049
Ram pressure stripping if this galaxy is

600
00:27:57,509 --> 00:27:55,240
more moving towards the bottom left of

601
00:28:02,100 --> 00:27:57,519
this image so it's just being pulled

602
00:28:04,740 --> 00:28:02,110
straight off then on the right here I've

603
00:28:06,629 --> 00:28:04,750
taken two parts of this image I've taken

604
00:28:09,659 --> 00:28:06,639
the old stars which are in green here

605
00:28:11,789 --> 00:28:09,669
and I've taken the gas which is an

606
00:28:15,779 --> 00:28:11,799
orange so the old stars are these gray

607
00:28:18,570 --> 00:28:15,789
lines here and you notice that the stars

608
00:28:20,519 --> 00:28:18,580
the old stars don't have any gas

609
00:28:23,279 --> 00:28:20,529
covering them on the bottom left and

610
00:28:25,639 --> 00:28:23,289
that might be because that gas that used

611
00:28:28,710 --> 00:28:25,649
to be there has already been ripped off

612
00:28:31,350 --> 00:28:28,720
so this part which is forming a lot of

613
00:28:34,019 --> 00:28:31,360

stars in the middle is kind of the front

614
00:28:36,080 --> 00:28:34,029
of the galaxy that might be running into

615
00:28:38,669 --> 00:28:36,090
all of this stuff and being stirred up

616
00:28:41,399 --> 00:28:38,679
so this is a moment in this galaxy's

617
00:28:46,680 --> 00:28:41,409
life right before it may stop forming

618
00:28:48,720 --> 00:28:46,690
stars so we've gone through all

619
00:28:51,200 --> 00:28:48,730
these different ways that you can add

620
00:28:53,580 --> 00:28:51,210
more stars to your galaxy dwarf galaxies

621
00:28:55,080 --> 00:28:53,590
but there are plenty more you can feel

622
00:28:56,940 --> 00:28:55,090
free to ask me about them

623
00:28:58,050 --> 00:28:56,950
I've included one extra there but we

624
00:29:01,530 --> 00:28:58,060
definitely don't have time to go through

625
00:29:03,090 --> 00:29:01,540
that so I just want to leave you with a

626
00:29:06,980 --> 00:29:03,100
few thoughts to take home

627
00:29:09,360 --> 00:29:06,990
first of all dwarf galaxies are awesome

628
00:29:11,790 --> 00:29:09,370
second of all there are a lot of them

629
00:29:13,080 --> 00:29:11,800
nearby remember that image I showed you

630
00:29:17,280 --> 00:29:13,090
at the very beginning with all those

631
00:29:19,320 --> 00:29:17,290
blue labels also star formation and

632
00:29:20,670 --> 00:29:19,330
Joris galaxies can be triggered in a lot

633
00:29:22,800 --> 00:29:20,680
of different ways we didn't even go

634
00:29:26,700 --> 00:29:22,810
through probably half of the ideas out

635
00:29:28,470 --> 00:29:26,710
there and then last but not least Jewish

636
00:29:30,990 --> 00:29:28,480
galaxies can better help us better

637
00:29:33,420 --> 00:29:31,000
understand star formation in general

638
00:29:35,640 --> 00:29:33,430

because we don't have those big spiral

639
00:29:38,370 --> 00:29:35,650
arms helping us out so we have to figure

640
00:29:41,820 --> 00:29:38,380
out new and creative ways to get started

641
00:29:44,490 --> 00:29:41,830
to forming your galaxy I also wanted to

642
00:29:47,130 --> 00:29:44,500
just plug astronomy on tap Baltimore

643
00:29:50,130 --> 00:29:47,140
which was mentioned earlier we have

644
00:29:51,750 --> 00:29:50,140
bimonthly events last Wednesday of every

645
00:29:54,140 --> 00:29:51,760
month so if you can't get enough

646
00:29:58,080 --> 00:29:54,150
astronomy join us at declined of all

647
00:30:00,660 --> 00:29:58,090
down in Hamden and probably saying that

648
00:30:04,410 --> 00:30:00,670
name terribly wrong but dkd as most

649
00:30:06,570 --> 00:30:04,420
people know it and we sit in a bar and

650
00:30:08,760 --> 00:30:06,580
we have astronomers like myself get up

651
00:30:10,980 --> 00:30:08,770
and give you talks while you have a nice

652
00:30:14,340 --> 00:30:10,990
drink and relax so it's a really fun

653
00:30:16,260 --> 00:30:14,350
setting I heard they're just adding food

654
00:30:17,820 --> 00:30:16,270
to their menu if you want a snack well

655
00:30:20,220 --> 00:30:17,830
you listen to astronomy talks but our

656
00:30:22,350 --> 00:30:20,230
next phone will be in September 25th and

657
00:30:32,890 --> 00:30:22,360
we have a Facebook group so you can look

658
00:30:38,710 --> 00:30:35,549
[Applause]

659
00:30:42,070 --> 00:30:38,720
and I believe we have plenty of time for

660
00:30:44,500 --> 00:30:42,080
questions so alright we're waiting for

661
00:30:48,070 --> 00:30:44,510
the lovely cube so people online can

662
00:31:08,860 --> 00:30:48,080
hear us one second just Thomas is making

663
00:31:10,659 --> 00:31:08,870

his way down so my question has to do

664
00:31:13,810 --> 00:31:10,669
with black hole formation and dwarf

665
00:31:15,760 --> 00:31:13,820
galaxies I don't even know if any form

666
00:31:17,560 --> 00:31:15,770
or not but if they do can you speak a

667
00:31:19,840 --> 00:31:17,570
little bit about black hole formation

668
00:31:24,340 --> 00:31:19,850
yeah so this used to be a very touchy

669
00:31:28,960 --> 00:31:24,350
subject of mine oh no it's good now the

670
00:31:32,279 --> 00:31:28,970
so the idea that every galaxy has a

671
00:31:35,470 --> 00:31:32,289
supermassive black hole is not correct

672
00:31:38,620 --> 00:31:35,480
however dwarf galaxies can certainly

673
00:31:42,149 --> 00:31:38,630
form black holes there's a lot of recent

674
00:31:45,159 --> 00:31:42,159
research into going going into trying to

675
00:31:48,190 --> 00:31:45,169
see how many of them have what's called

676
00:31:50,980 --> 00:31:48,200
intermediate black mass black holes so a

677
00:31:55,690 --> 00:31:50,990
supermassive black hole I think is about

678
00:31:57,700 --> 00:31:55,700
a million times the mass of our Sun but

679
00:31:59,110 --> 00:31:57,710
an intermediate mass black hole can be

680
00:32:02,340 --> 00:31:59,120
anywhere from a hundred times the mass

681
00:32:05,080 --> 00:32:02,350
of our Sun to about a million and

682
00:32:07,510 --> 00:32:05,090
they're trying to figure that out

683
00:32:09,850 --> 00:32:07,520
because we believe that dwarf galaxies

684
00:32:11,980 --> 00:32:09,860
can merge or used to in the past merge

685
00:32:13,779 --> 00:32:11,990
together to become bigger galaxies

686
00:32:17,140 --> 00:32:13,789
something like direct galaxies used to

687
00:32:20,320 --> 00:32:17,150
do that and so they want to see if they

688
00:32:22,270 --> 00:32:20,330

have themselves these seeds of black

689
00:32:25,450 --> 00:32:22,280
holes to create a bigger supermassive

690
00:32:28,330 --> 00:32:25,460
black hole and there is some evidence

691
00:32:30,190 --> 00:32:28,340
for it but it's very recent research so

692
00:32:36,159 --> 00:32:30,200
I can't speak too much to the details of

693
00:32:38,730 --> 00:32:36,169
it what causes galaxies to move like

694
00:32:40,420 --> 00:32:38,740
propelled or something like that

695
00:32:43,390 --> 00:32:40,430
[Music]

696
00:32:46,000 --> 00:32:43,400
do you mean move in themselves or move

697
00:32:47,680 --> 00:32:46,010
amongst each other just moving like the

698
00:32:50,320 --> 00:32:47,690
crashing at each other and they're

699
00:32:52,720 --> 00:32:50,330
disappearing from one another and that

700
00:32:55,930 --> 00:32:52,730
momentum comes from when they were

701
00:32:58,900 --> 00:32:55,940
forming so it there's lots of reasons

702
00:33:01,390 --> 00:32:58,910
section so for example if there's a big

703
00:33:03,400 --> 00:33:01,400
cluster of galaxies their gravity of

704
00:33:05,070 --> 00:33:03,410
monks each other causes them to move

705
00:33:08,440 --> 00:33:05,080
around each other

706
00:33:10,570 --> 00:33:08,450
and when they were forming maybe that

707
00:33:12,220 --> 00:33:10,580
gas that they formed from in the star

708
00:33:14,860 --> 00:33:12,230
the dark matter that they're formed from

709
00:33:18,160 --> 00:33:14,870
may have been moving also so that all

710
00:33:20,560 --> 00:33:18,170
has to do with where they formed and how

711
00:33:25,300 --> 00:33:20,570
fast their stuff that would they form

712
00:33:30,330 --> 00:33:25,310
from was moving and also the expansion

713
00:33:35,440 --> 00:33:33,370

question about the age of dwarf galaxies

714
00:33:40,360 --> 00:33:35,450
are they generally younger or older than

715
00:33:43,810 --> 00:33:40,370
very very good question so people used

716
00:33:46,060 --> 00:33:43,820
to think that a lot of there is a subset

717
00:33:48,820 --> 00:33:46,070
of dwarf galaxies called blue compact

718
00:33:51,250 --> 00:33:48,830
dwarf galaxies that were very young and

719
00:33:53,260 --> 00:33:51,260
the reason they used to think that was

720
00:33:55,420 --> 00:33:53,270
because all we could see were their

721
00:33:58,390 --> 00:33:55,430
bright young stars because they had so

722
00:34:00,820 --> 00:33:58,400
many of them but eventually we found out

723
00:34:03,430 --> 00:34:00,830
they had this older stellar population

724
00:34:05,710 --> 00:34:03,440
that was just hiding behind these young

725
00:34:10,180 --> 00:34:05,720
stars so we think George galaxies

726
00:34:14,740 --> 00:34:10,190
generally tend to be older about you

727
00:34:17,169 --> 00:34:14,750
know as old as other galaxies but where

728
00:34:19,270 --> 00:34:17,179
there are a few galaxies that are young

729
00:34:21,220 --> 00:34:19,280
in this sense that they're they may be

730
00:34:24,399 --> 00:34:21,230
going through their first bursts of star

731
00:34:25,930 --> 00:34:24,409
formation so in that sense they're kind

732
00:34:29,169 --> 00:34:25,940
of young that they're just going through

733
00:34:31,330 --> 00:34:29,179
this first burst and you see dwarf

734
00:34:33,730 --> 00:34:31,340
galaxies mostly in the vicinity

735
00:34:36,250 --> 00:34:33,740
give me the further out you look do you

736
00:34:38,590 --> 00:34:36,260
still see the same frequency of them so

737
00:34:41,590 --> 00:34:38,600
it's actually hard to see them further

738
00:34:44,770 --> 00:34:41,600

out so we can't see them pretty far out

739
00:34:47,470 --> 00:34:44,780
but if you're talking cosmological

740
00:34:49,690 --> 00:34:47,480
distances which I do have some friends

741
00:34:51,280 --> 00:34:49,700
that work in that and we can't see them

742
00:34:54,109 --> 00:34:51,290
because they become too faint they're

743
00:34:56,960 --> 00:34:54,119
too dim we have a

744
00:35:01,299 --> 00:34:56,970
quick question online which anime is

745
00:35:03,079 --> 00:35:01,309
your animation from this is Cowboy Bebop

746
00:35:07,599 --> 00:35:03,089
Cowboy Bebop

747
00:35:13,279 --> 00:35:07,609
from the mushroom episode yeah I'm

748
00:35:15,170 --> 00:35:13,289
Edward a9 the you didn't mention the

749
00:35:19,630 --> 00:35:15,180
Magellanic Clouds are they considered

750
00:35:22,220 --> 00:35:19,640
Dwarfs I mean they're dwarf like that

751
00:35:25,130 --> 00:35:22,230
they're a little big but they are

752
00:35:27,950 --> 00:35:25,140
dwarfed within the limits of Dwarfs like

753
00:35:32,989 --> 00:35:27,960
sizes yeah so everything you talked

754
00:35:34,880 --> 00:35:32,999
about here would apply yeah yeah the

755
00:35:38,059 --> 00:35:34,890
Magellanic Clouds are a special case

756
00:35:43,120 --> 00:35:38,069
because they actually were in one of my

757
00:35:47,569 --> 00:35:43,130
images which is I said most of the light

758
00:35:49,940 --> 00:35:47,579
so the Magellanic Clouds are these two

759
00:35:51,920 --> 00:35:49,950
dots of light down here they're their

760
00:35:54,109 --> 00:35:51,930
special case because they're interacting

761
00:35:57,650 --> 00:35:54,119
with each other and the Milky Way so

762
00:36:00,380 --> 00:35:57,660
that interaction part of my talk does

763
00:36:02,420 --> 00:36:00,390

still work with them but it is a very

764
00:36:04,279 --> 00:36:02,430
complicated case because you have not

765
00:36:19,270 --> 00:36:04,289
only the milky way's gravity but each

766
00:36:19,280 --> 00:36:28,000
[Music]

767
00:36:33,800 --> 00:36:30,860
so this greenery is the older stars that

768
00:36:36,170 --> 00:36:33,810
I mentioned before so the older stars

769
00:36:37,850 --> 00:36:36,180
are not covered by the red part here

770
00:36:39,920 --> 00:36:37,860
which is the gas which is why you can

771
00:36:43,190 --> 00:36:39,930
see them so well because that gas has

772
00:36:45,970 --> 00:36:43,200
been stripped away from them so the

773
00:36:51,050 --> 00:36:45,980
glass is that is that like hydrogen

774
00:36:52,910 --> 00:36:51,060
hydrogen it's atomic hydrogen yeah it's

775
00:36:55,210 --> 00:36:52,920
the most common element in the universe

776
00:36:57,950 --> 00:36:55,220
so that's why we try to look at it

777
00:37:00,890 --> 00:36:57,960
worked out see some matters countable of

778
00:37:03,110 --> 00:37:00,900
Eduardo Custer's little custody equally

779
00:37:05,690 --> 00:37:03,120
old but they're all uniformly shaped

780
00:37:07,250 --> 00:37:05,700
they're all circles all these galaxies

781
00:37:10,130 --> 00:37:07,260
are irregular shape

782
00:37:13,070 --> 00:37:10,140
well I why are the galaxies irregular

783
00:37:15,740 --> 00:37:13,080
shape yes good um they don't have the

784
00:37:17,180 --> 00:37:15,750
gravity to hold a regular shape do they

785
00:37:19,670 --> 00:37:17,190
have the same mass as a globular cluster

786
00:37:22,280 --> 00:37:19,680
which is regular shape well I'm not

787
00:37:23,750 --> 00:37:22,290
quite sure how globular clusters form

788
00:37:26,690 --> 00:37:23,760

but my understanding is they've been

789
00:37:28,670 --> 00:37:26,700
through quite a lot of gravitational

790
00:37:31,640 --> 00:37:28,680
interaction which tends to form those

791
00:37:35,030 --> 00:37:31,650
more ball-like shapes that you see and

792
00:37:38,180 --> 00:37:35,040
globba their clusters whereas these guys

793
00:37:39,950 --> 00:37:38,190
since they're their own entities if they

794
00:37:42,620 --> 00:37:39,960
were interacting a lot with other

795
00:37:44,870 --> 00:37:42,630
galaxies they might form that same type

796
00:37:47,600 --> 00:37:44,880
of ball or football shape which is

797
00:37:52,970 --> 00:37:47,610
called an elliptical dwarf galaxy it's

798
00:37:56,000 --> 00:37:52,980
another type of galaxy this green and

799
00:37:58,940 --> 00:37:56,010
blue eyes others false colors yes okay

800
00:38:02,450 --> 00:37:58,950
so I - the others

801
00:38:04,400 --> 00:38:02,460
there's been no reason to include it to

802
00:38:07,520 --> 00:38:04,410
introduce any complexity between the

803
00:38:09,350 --> 00:38:07,530
dark matter and the visible matter you

804
00:38:11,120 --> 00:38:09,360
just assumed it always goes along

805
00:38:13,250 --> 00:38:11,130
exactly with so we have collision

806
00:38:16,730 --> 00:38:13,260
I mean ask me have you ever has there

807
00:38:19,280 --> 00:38:16,740
been any work on showing that there is

808
00:38:21,320 --> 00:38:19,290
no complexity they just do you have to

809
00:38:25,020 --> 00:38:21,330
assume no complexity it's for the dark

810
00:38:27,180 --> 00:38:25,030
matter yeah so the dark matter

811
00:38:29,220 --> 00:38:27,190
my work I just assume it's their kind of

812
00:38:31,140 --> 00:38:29,230
doing its thing but we do actually have

813
00:38:33,720 --> 00:38:31,150

little things members that work on the

814
00:38:36,570 --> 00:38:33,730
dark matter specifically and the shape

815
00:38:39,030 --> 00:38:36,580
of the dark matter and where it sits and

816
00:38:40,560 --> 00:38:39,040
that is very model dependent so there's

817
00:38:42,690 --> 00:38:40,570
still some ongoing work with dwarf

818
00:38:44,420 --> 00:38:42,700
galaxies in general trying to understand

819
00:38:47,670 --> 00:38:44,430
what their dark matter looks like and

820
00:38:50,280 --> 00:38:47,680
how the galaxies might sit in that

821
00:38:56,610 --> 00:38:50,290
potential while that gravity of the the

822
00:39:02,750 --> 00:38:56,620
Dark Matter we have another question on

823
00:39:05,180 --> 00:39:02,760
line what is the age of the Milky Way I

824
00:39:11,820 --> 00:39:05,190
don't know

825
00:39:16,350 --> 00:39:11,830
very old can you go back to the Loki way

826
00:39:24,330 --> 00:39:16,360
galaxy earth looking in and then to be

827
00:39:26,760 --> 00:39:24,340
conceptual review I know it's a good

828
00:39:29,100 --> 00:39:26,770
educated guess that the science thinks

829
00:39:31,110 --> 00:39:29,110
that's what our galaxy looks like but

830
00:39:34,170 --> 00:39:31,120
when we look at the previous picture

831
00:39:37,200 --> 00:39:34,180
what data are they working on or

832
00:39:45,120 --> 00:39:37,210
collecting to guess that it looks like a

833
00:39:46,020 --> 00:39:45,130
barred spiral with orange must be some

834
00:39:49,230 --> 00:39:46,030
work is with it

835
00:39:51,300 --> 00:39:49,240
Gaia Survey so they're actually trying

836
00:39:55,620 --> 00:39:51,310
to figure out exactly where stars are

837
00:39:58,740 --> 00:39:55,630
placed in our galaxy by measuring their

838
00:40:00,330 --> 00:39:58,750

distances and that's a lot of work and

839
00:40:02,250 --> 00:40:00,340
it's very ongoing but there are also

840
00:40:04,500 --> 00:40:02,260
other types of measurements to measure

841
00:40:07,680 --> 00:40:04,510
the location of our spiral arms for

842
00:40:11,450 --> 00:40:07,690
example in my undergraduate I did some

843
00:40:16,650 --> 00:40:11,460
research with a professor who took

844
00:40:19,260 --> 00:40:16,660
background objects so pulsars in our

845
00:40:21,480 --> 00:40:19,270
caves and we measured how their light

846
00:40:23,580 --> 00:40:21,490
rotated and this is a very complicated

847
00:40:27,230 --> 00:40:23,590
concept which I could do an entire talk

848
00:40:30,090 --> 00:40:27,240
on by itself but essentially you measure

849
00:40:32,570 --> 00:40:30,100
the polarization so you know how your

850
00:40:34,770 --> 00:40:32,580
sunglasses are polarized if you take two

851
00:40:36,390 --> 00:40:34,780
sunglasses and you that are polarized

852
00:40:38,609 --> 00:40:36,400
and you put them next to each other

853
00:40:42,079 --> 00:40:38,619
they'll block out all the light so

854
00:40:47,809 --> 00:40:42,089
that's a linear polarization up and down

855
00:40:50,430 --> 00:40:47,819
so if you try and measure how that

856
00:40:52,680 --> 00:40:50,440
polarization changes you can figure out

857
00:40:56,459 --> 00:40:52,690
how much stuff is between you and that

858
00:40:58,589 --> 00:40:56,469
light and sorry this is like not the

859
00:41:04,829 --> 00:40:58,599
most satisfactory explanation I'm sure

860
00:41:06,390 --> 00:41:04,839
but it it's called it's the rotation of

861
00:41:07,890 --> 00:41:06,400
the polarization and what it does is

862
00:41:10,380 --> 00:41:07,900
tells you how much stuff as I see you

863
00:41:13,799 --> 00:41:10,390

can measure exactly where you think the

864
00:41:18,890 --> 00:41:13,809
spiral arms are in your galaxy and it's

865
00:41:28,499 --> 00:41:22,739
you know they were able to from where

866
00:41:29,930 --> 00:41:28,509
that thing is they were able so they

867
00:41:32,579 --> 00:41:29,940
were able to figure out what's between

868
00:41:35,969 --> 00:41:32,589
that thing that we're looking at the

869
00:41:38,009 --> 00:41:35,979
background source and us so they're able

870
00:41:43,859 --> 00:41:38,019
to figure out what's how much stuff is

871
00:41:46,920 --> 00:41:43,869
in between there yeah in looking at the

872
00:41:50,120 --> 00:41:46,930
dwarf galaxies how does the tip of one

873
00:41:52,920 --> 00:41:50,130
compare in size to the Milky Way galaxy

874
00:41:54,809 --> 00:41:52,930
how does the which one the dwarf

875
00:41:57,109 --> 00:41:54,819
galaxies how does the have it how much

876
00:42:00,749 --> 00:41:57,119
smaller would they be in the Milky Way

877
00:42:04,799 --> 00:42:00,759
yeah so I put up one next to each other

878
00:42:07,109 --> 00:42:04,809
here so they're typically this dwarf

879
00:42:10,109 --> 00:42:07,119
galaxy here's one that I showed later on

880
00:42:11,700 --> 00:42:10,119
in my talk it's Markarian 178 the one

881
00:42:12,450 --> 00:42:11,710
that's possibly being Ram pressure

882
00:42:15,589 --> 00:42:12,460
stripping

883
00:42:18,719 --> 00:42:15,599
they're typically considered to be about

884
00:42:22,549 --> 00:42:18,729
125th the size of our Milky Way all the

885
00:42:28,890 --> 00:42:22,559
way up to 1/10 the size of our Milky Way

886
00:42:31,109 --> 00:42:28,900
thank you mm-hmm we have a question on

887
00:42:35,690 --> 00:42:31,119
line can you recommend some literature

888
00:42:40,019 --> 00:42:35,700

about Ram pressure stripping Alexei's Oh

889
00:42:43,140 --> 00:42:40,029
some literature so I must say I mostly

890
00:42:46,860 --> 00:42:43,150
read journal articles and that is not

891
00:42:50,640 --> 00:42:46,870
literature that most people want to read

892
00:42:52,710 --> 00:42:50,650
I I will say actually that recently just

893
00:42:55,620 --> 00:42:52,720
a few months ago we put out an article

894
00:42:57,780 --> 00:42:55,630
on Webb telescope gorg talking about how

895
00:43:01,650 --> 00:42:57,790
the James Webb Space Telescope will look

896
00:43:03,180 --> 00:43:01,660
at these exact systems so for the person

897
00:43:04,980 --> 00:43:03,190
online if you want to go to Webb

898
00:43:08,220 --> 00:43:04,990
telescope org search Ram pressure

899
00:43:10,200 --> 00:43:08,230
stripping Alexei's that will lead you

900
00:43:18,300 --> 00:43:10,210
into a whole cornucopia of literature I

901
00:43:19,260 --> 00:43:18,310
believe I also need to read those you

902
00:43:26,070 --> 00:43:19,270
can feel free to ask me questions

903
00:43:28,410 --> 00:43:26,080
afterwards too so I remember from

904
00:43:31,200 --> 00:43:28,420
decades ago that the somebody thought

905
00:43:33,720 --> 00:43:31,210
that the Sun was between arms and this

906
00:43:37,020 --> 00:43:33,730
and you now know from this picture I can

907
00:43:39,480 --> 00:43:37,030
see that we're on the unarmed alright I

908
00:43:42,780 --> 00:43:39,490
think we're close to an arm the Orion

909
00:43:54,090 --> 00:43:42,790
spur I don't know if our faculty on I

910
00:43:55,590 --> 00:43:54,100
would have to look up that article we

911
00:43:57,870 --> 00:43:55,600
hear regularly about how hard it is to

912
00:43:59,280 --> 00:43:57,880
get time and Hubble in time how hard was

913
00:44:00,720 --> 00:43:59,290

the Very Large Array which I know is

914
00:44:02,250 --> 00:44:00,730
looking for other things for you to get

915
00:44:04,620 --> 00:44:02,260
time on when you were there oh

916
00:44:10,440 --> 00:44:04,630
definitely not as hard as Hubble like

917
00:44:13,800 --> 00:44:10,450
that so the VLA it's it's not easy to

918
00:44:15,570 --> 00:44:13,810
get time on the VLA this is a beautiful

919
00:44:18,950 --> 00:44:15,580
picture of it that I showed earlier

920
00:44:21,960 --> 00:44:18,960
around but this is actually the VLA so

921
00:44:24,330 --> 00:44:21,970
it is still difficult to get time on it

922
00:44:26,550 --> 00:44:24,340
and the reason being especially because

923
00:44:29,880 --> 00:44:26,560
they just upgraded it so they made it a

924
00:44:31,710 --> 00:44:29,890
little bit better and that everyone now

925
00:44:35,700 --> 00:44:31,720
wants to use it because it's this big

926
00:44:37,830 --> 00:44:35,710
better machine but I don't know how

927
00:44:39,930 --> 00:44:37,840
oversubscribed it is I'd have to look up

928
00:44:41,610 --> 00:44:39,940
those numbers for you but I have tried a

929
00:44:49,520 --> 00:44:41,620
Hubble time and I find that's a lot

930
00:45:06,070 --> 00:44:55,130
I think in general could we get an

931
00:45:12,380 --> 00:45:10,340
if you've got that let me know yes happy

932
00:45:13,790 --> 00:45:12,390
to do so that's actually why I'm all

933
00:45:16,130 --> 00:45:13,800
dressed up today is because we had folks

934
00:45:18,200 --> 00:45:16,140
from NASA headquarters come visit us and

935
00:45:21,520 --> 00:45:18,210
we had to brief them on what we're doing

936
00:45:24,890 --> 00:45:21,530
so the latest of the James Webb is that

937
00:45:27,590 --> 00:45:24,900
as I think it was today

938
00:45:28,670 --> 00:45:27,600

there was a successful deployment of the

939
00:45:32,210 --> 00:45:28,680
secondary mirror

940
00:45:33,410 --> 00:45:32,220
so they both the pieces of James Webb

941
00:45:34,550 --> 00:45:33,420
you can look at the model over there

942
00:45:35,930 --> 00:45:34,560
it's kind of turned on its side but

943
00:45:38,270 --> 00:45:35,940
there's the top part which is the

944
00:45:39,830 --> 00:45:38,280
optical element which has all of the

945
00:45:41,390 --> 00:45:39,840
mirrors that gather the light and all of

946
00:45:43,040 --> 00:45:41,400
the instruments that analyze the light

947
00:45:45,200 --> 00:45:43,050
and then you have the bottom part which

948
00:45:47,810 --> 00:45:45,210
is the Sun shield blocking the Sun and

949
00:45:49,700 --> 00:45:47,820
all with its infrared radiation and the

950
00:45:52,100 --> 00:45:49,710
spacecraft and so currently both of

951
00:45:54,850 --> 00:45:52,110
those are two big pieces they're sitting

952
00:45:58,670 --> 00:45:54,860
in California at the Northrop Grumman

953
00:46:00,320 --> 00:45:58,680
facility and they just did a test where

954
00:46:01,700 --> 00:46:00,330
they're not together yet but they're

955
00:46:03,500 --> 00:46:01,710
talking to each other so they just said

956
00:46:06,140 --> 00:46:03,510
a test where they deployed successfully

957
00:46:07,730 --> 00:46:06,150
the secondary mirror and got everything

958
00:46:14,360 --> 00:46:07,740
working and weightless and all that

959
00:46:16,370 --> 00:46:14,370
stuff and to mean you and me in the next

960
00:46:20,060 --> 00:46:16,380
are we still recording maybe I should be

961
00:46:22,250 --> 00:46:20,070
more discreet we are in the process of

962
00:46:25,520 --> 00:46:22,260
integrating the two halves of the

963
00:46:29,180 --> 00:46:25,530

observatory so sometime in the next few

964
00:46:30,740 --> 00:46:29,190
weeks we will be mating the the top half

965
00:46:33,830 --> 00:46:30,750
and the bottom half of the observatory

966
00:46:37,310 --> 00:46:33,840
that is the final integration step for

967
00:46:39,470 --> 00:46:37,320
the observatory then they actually take

968
00:46:41,360 --> 00:46:39,480
several weeks to connect all those wires

969
00:46:45,050 --> 00:46:41,370
and make the big thing and the big thing

970
00:46:47,060 --> 00:46:45,060
work nicely together and that's

971
00:46:48,920 --> 00:46:47,070
happening over the next month or two is

972
00:46:51,110 --> 00:46:48,930
that I think they actually touchdown

973
00:46:52,520 --> 00:46:51,120
sometime in the next week or two and

974
00:46:54,980 --> 00:46:52,530
then they'll be connecting all the wires

975
00:46:56,840 --> 00:46:54,990
everything should be all set and then

976
00:46:59,480 --> 00:46:56,850
later in the fall they put it all

977
00:47:02,360 --> 00:46:59,490
through the whole testing rigmarole a

978
00:47:03,880 --> 00:47:02,370
vacuum chamber and acoustic testing

979
00:47:07,600 --> 00:47:03,890
again

980
00:47:09,570 --> 00:47:07,610
and we are still set for a march 2021

981
00:47:14,080 --> 00:47:09,580
launch date that was my meeting today

982
00:47:15,430 --> 00:47:14,090
from French Guiana and if there's any

983
00:47:17,200 --> 00:47:15,440
other specific questions I'm happy to

984
00:47:20,940 --> 00:47:17,210
answer them but that's that's for James

985
00:47:24,910 --> 00:47:23,500
we only get one shot at this one so

986
00:47:31,150 --> 00:47:24,920
we're making sure that it's right the

987
00:47:33,730 --> 00:47:31,160
first time I have two questions for you

988
00:47:36,520 --> 00:47:33,740

the first one is are there any

989
00:47:39,400 --> 00:47:36,530
particular interactions between galaxies

990
00:47:43,240 --> 00:47:39,410
like our own and these draweth galaxies

991
00:47:46,690 --> 00:47:43,250
like for instance do galaxies like ours

992
00:47:49,300 --> 00:47:46,700
break up into small galaxies or do they

993
00:47:52,630 --> 00:47:49,310
merge and become galaxies like ours or

994
00:47:54,850 --> 00:47:52,640
are they totally independent so there's

995
00:47:57,700 --> 00:47:54,860
many parts to that question of which are

996
00:48:00,190 --> 00:47:57,710
it's a very good question so at the

997
00:48:04,000 --> 00:48:00,200
beginning of the universe when galaxies

998
00:48:07,240 --> 00:48:04,010
were just forming we think that dwarf

999
00:48:11,220 --> 00:48:07,250
like galaxies existed and they combined

1000
00:48:13,930 --> 00:48:11,230
to make larger galaxies like our own now

1001
00:48:16,720 --> 00:48:13,940
there are still a lot of dwarfs left

1002
00:48:20,590 --> 00:48:16,730
over they in all like combine into these

1003
00:48:25,870 --> 00:48:20,600
and they may have formed later etc now

1004
00:48:29,950 --> 00:48:25,880
that the the Milky Way galaxy also has a

1005
00:48:32,980 --> 00:48:29,960
ton of dwarf galaxies around it and so

1006
00:48:34,390 --> 00:48:32,990
eventually it'll eat those galaxies and

1007
00:48:39,640 --> 00:48:34,400
it's currently in the process of eating

1008
00:48:41,710 --> 00:48:39,650
several galaxies one galaxy that I can

1009
00:48:45,070 --> 00:48:41,720
think of as the nearest galaxy to us

1010
00:48:49,480 --> 00:48:45,080
which is 25,000 light-years to earth and

1011
00:48:52,630 --> 00:48:49,490
it is the Canis Major dwarf and that is

1012
00:48:56,260 --> 00:48:52,640
just being torn apart by the Milky Way

1013
00:48:58,240 --> 00:48:56,270

and we it's possible now I'm not quite

1014
00:49:02,610 --> 00:48:58,250
sure where the research is on this but

1015
00:49:05,380 --> 00:49:02,620
that galaxy may have left three rings

1016
00:49:08,140 --> 00:49:05,390
around the Milky Way from going around

1017
00:49:09,910 --> 00:49:08,150
at three times so it's just being torn

1018
00:49:12,070 --> 00:49:09,920
apart by the Milky Way and it eventually

1019
00:49:14,560 --> 00:49:12,080
will merge with it and make the Milky

1020
00:49:15,569 --> 00:49:14,570
Way more massive does that answer your

1021
00:49:18,329 --> 00:49:15,579
question yes

1022
00:49:21,630 --> 00:49:18,339
but the other question I have it is this

1023
00:49:23,789 --> 00:49:21,640
in comparison of the large galaxies and

1024
00:49:26,699 --> 00:49:23,799
small galaxies if you think the

1025
00:49:29,279 --> 00:49:26,709
aggregate of the drop galaxies that are

1026
00:49:31,349 --> 00:49:29,289
within our region you said that you can

1027
00:49:33,359 --> 00:49:31,359
only see but so far away and see dwarf

1028
00:49:35,880 --> 00:49:33,369
galaxies but if you take that region

1029
00:49:38,430 --> 00:49:35,890
that you can see like how many stars

1030
00:49:40,529 --> 00:49:38,440
might be in dropped Alexei's and how

1031
00:49:43,469 --> 00:49:40,539
many would be in large galaxies like our

1032
00:49:45,599 --> 00:49:43,479
own like a 10% of them only in drunk

1033
00:49:48,059 --> 00:49:45,609
galaxies or do they make up more like

1034
00:49:49,469 --> 00:49:48,069
50% of all I don't know I would have to

1035
00:49:51,359 --> 00:49:49,479
look that up that's a really good

1036
00:49:53,339 --> 00:49:51,369
question I have not done that math yet

1037
00:49:55,410 --> 00:49:53,349
because I would have to figure out how

1038
00:49:57,479 --> 00:49:55,420

many galaxies we know of nearby and then

1039
00:49:58,890 --> 00:49:57,489
figure out their approximate masses and

1040
00:49:59,249 --> 00:49:58,900
then add them up I would have to look

1041
00:50:01,410 --> 00:49:59,259
that up

1042
00:50:04,229 --> 00:50:01,420
yeah the feeling for whether they have a

1043
00:50:06,989 --> 00:50:04,239
significant number of stars I mean I I

1044
00:50:14,099 --> 00:50:06,999
don't know yeah I would have I have no

1045
00:50:16,620 --> 00:50:14,109
idea so is anybody studying the

1046
00:50:21,150 --> 00:50:16,630
formation of solar systems within the

1047
00:50:24,029 --> 00:50:21,160
dwarf galaxies we do not have the

1048
00:50:27,630 --> 00:50:24,039
technology as far as I know to go out

1049
00:50:29,910 --> 00:50:27,640
that far because Kepler can only see so

1050
00:50:32,519 --> 00:50:29,920
far out so we're mainly looking in our

1051
00:50:34,469 --> 00:50:32,529
own galaxy for solar systems the Milky

1052
00:50:35,219 --> 00:50:34,479
Way we can barely study them in our own

1053
00:50:38,430 --> 00:50:35,229
galaxy

1054
00:50:46,170 --> 00:50:38,440
um I studied proprietary disks plane of

1055
00:50:56,060 --> 00:50:46,180
formation only in our galaxy yeah and

1056
00:51:01,610 --> 00:50:58,100
is the technology to look at other

1057
00:51:04,520 --> 00:51:01,620
galaxies for capillary like they're just

1058
00:51:07,460 --> 00:51:04,530
this yeah it is anything that's in other

1059
00:51:11,030 --> 00:51:07,470
galaxies well we can see the stars in

1060
00:51:12,650 --> 00:51:11,040
them and we can see the gas but in terms

1061
00:51:15,680 --> 00:51:12,660
of Kepler I would assume we're pretty

1062
00:51:17,900 --> 00:51:15,690
far off by the sounds of it so looking

1063
00:51:28,100 --> 00:51:17,910

at solar systems and other galaxies

1064
00:51:31,520 --> 00:51:28,110
we're quite far off any other questions

1065
00:51:39,880 --> 00:51:31,530
first speaker all right well let's give

1066
00:51:44,299 --> 00:51:42,799
Thank You dr. Ashley and thank you all

1067
00:51:46,099 --> 00:51:44,309
for coming I appreciate your support

1068
00:51:49,249 --> 00:51:46,109
very glad you're so invested in

1069
00:51:51,140 --> 00:51:49,259
astronomy as are we and again if you are

1070
00:51:54,319 --> 00:51:51,150
interested in going on the observatory

1071
00:51:57,259 --> 00:51:54,329
tour in a few minutes just meet up here

1072
00:51:59,900 --> 00:51:57,269
and you will be guided by Eleni from