

1
00:00:03,950 --> 00:00:10,469
alright it's 8 o'clock and we have a

2
00:00:06,330 --> 00:00:11,910
nicely busy house so we'll start as I

3
00:00:10,468 --> 00:00:15,449
said my name is Alex Lockwood I'm

4
00:00:11,910 --> 00:00:18,140
replacing Frank summers this evening not

5
00:00:15,449 --> 00:00:23,100
replacing trying to emulate his

6
00:00:18,140 --> 00:00:24,630
magnificence and I'm just here to host

7
00:00:23,100 --> 00:00:28,050
your evening the real star of the show

8
00:00:24,629 --> 00:00:30,868
is dr. Ashley just a couple of

9
00:00:28,050 --> 00:00:33,270
announcements as I mentioned if you're

10
00:00:30,868 --> 00:00:35,070
interested in going to across the street

11
00:00:33,270 --> 00:00:37,410
to the Johns Hopkins observatory and

12
00:00:35,070 --> 00:00:38,789
looking through their telescope please

13
00:00:37,409 --> 00:00:42,449
meet after the talk

14
00:00:38,789 --> 00:00:45,089
up here at the podium we have a couple

15
00:00:42,450 --> 00:00:47,280
of upcoming public lecture series the

16
00:00:45,090 --> 00:00:49,980
public lecture series for September is

17
00:00:47,280 --> 00:00:53,189
on September 3rd the topic is the

18
00:00:49,979 --> 00:00:55,409
astronomers toolkit and the speaker is

19
00:00:53,189 --> 00:01:01,558
another outreach scientist named dr.

20
00:00:55,409 --> 00:01:04,408
Brandon Lawton yeah Brandon and then on

21
00:01:01,558 --> 00:01:07,259
October the October public lecture is on

22
00:01:04,409 --> 00:01:10,170
October 1st and the title is black holes

23
00:01:07,260 --> 00:01:13,380
and gravitational waves which is very

24
00:01:10,170 --> 00:01:16,079
cool and the speaker is from Johns

25
00:01:13,379 --> 00:01:18,449
Hopkins his name is Emanuel Liberty

26
00:01:16,079 --> 00:01:19,709
I may have butchered that but those are

27
00:01:18,450 --> 00:01:22,380
the upcoming talks they're also

28
00:01:19,709 --> 00:01:27,059
available online as is this recording

29

00:01:22,379 --> 00:01:30,209
after after tonight so with that I would

30
00:01:27,060 --> 00:01:32,219
like to introduce tonight's speaker dr.

31
00:01:30,209 --> 00:01:34,889
Tricia Ashley got her bachelor's degree

32
00:01:32,219 --> 00:01:38,310
in physics and astronomy from the Bryn

33
00:01:34,890 --> 00:01:40,409
Mawr College in 2008 in 2014 she

34
00:01:38,310 --> 00:01:43,019
received her PhD in physics from Florida

35
00:01:40,409 --> 00:01:45,180
International University for her PhD

36
00:01:43,019 --> 00:01:48,449
dissertation she studied star formation

37
00:01:45,180 --> 00:01:52,170
in blue compact dwarf galaxies as part

38
00:01:48,450 --> 00:01:53,640
of the research team little things she

39
00:01:52,170 --> 00:01:55,799
has since worked on understanding the

40
00:01:53,640 --> 00:01:58,560
gas content in isolated early type

41
00:01:55,799 --> 00:02:00,509
galaxies as a postdoc at NASA Ames and

42
00:01:58,560 --> 00:02:01,879
she's currently working as a postdoc at

43
00:02:00,509 --> 00:02:06,149

the Space Telescope Science Institute

44

00:02:01,879 --> 00:02:08,008

with Andy Fox here at Space Telescope's

45

00:02:06,149 --> 00:02:10,710

she studies the Fermi bubbles and gas

46

00:02:08,008 --> 00:02:13,379

flows into and from

47

00:02:10,710 --> 00:02:15,930

the Milky Way she also spends time as an

48

00:02:13,379 --> 00:02:17,400

organiser of astronomy on tap Baltimore

49

00:02:15,930 --> 00:02:19,710

which I'm sure she'd be happy to answer

50

00:02:17,400 --> 00:02:21,870

questions about an outreach program that

51

00:02:19,710 --> 00:02:23,879

brings scientists to bars in Baltimore

52

00:02:21,870 --> 00:02:26,610

to give fun and exciting talks about

53

00:02:23,879 --> 00:02:36,750

space so please join me in a round of

54

00:02:26,610 --> 00:02:39,690

applause welcome dr. Ashley okay can you

55

00:02:36,750 --> 00:02:42,330

hear me good okay that was a great

56

00:02:39,689 --> 00:02:44,219

introduction to my talk because it

57

00:02:42,330 --> 00:02:47,190

actually now I can stick a few lines my

58
00:02:44,219 --> 00:02:50,819
talk so today I'm going to talk to you

59
00:02:47,189 --> 00:02:53,250
about dwarf galaxies but first as

60
00:02:50,819 --> 00:02:55,349
mentioned earlier I actually wanted to

61
00:02:53,250 --> 00:02:57,060
tell you where I got my passion for

62
00:02:55,349 --> 00:03:00,180
dwarf galaxies and that was during my

63
00:02:57,060 --> 00:03:03,170
dissertation because as mentioned I did

64
00:03:00,180 --> 00:03:05,760
my dissertation work on dwarf galaxies

65
00:03:03,169 --> 00:03:08,309
so this is a picture of me getting my

66
00:03:05,759 --> 00:03:12,539
PhD this is one of my official photos

67
00:03:08,310 --> 00:03:14,250
yes very nice and so I got my PhD

68
00:03:12,539 --> 00:03:16,139
because I did that work on dwarf

69
00:03:14,250 --> 00:03:18,419
galaxies but I want to take a minute to

70
00:03:16,139 --> 00:03:26,609
analyze this photo because I'm a

71
00:03:18,419 --> 00:03:29,849
scientist no but very close so this

72
00:03:26,610 --> 00:03:33,690
picture I really believe is a graduation

73
00:03:29,849 --> 00:03:36,780
photo level expert and the reason I

74
00:03:33,689 --> 00:03:41,459
believe that is because one you got your

75
00:03:36,780 --> 00:03:42,810
monocle - you have your pipe three most

76
00:03:41,459 --> 00:03:44,849
of you may have missed it but you have

77
00:03:42,810 --> 00:03:48,270
your flask strapped to your leg filled

78
00:03:44,849 --> 00:03:49,949
with coffee of course and then finally

79
00:03:48,270 --> 00:03:53,850
you have your family degree because of

80
00:03:49,949 --> 00:03:55,738
real things in the mail so as mentioned

81
00:03:53,849 --> 00:03:57,449
I got my PhD on this work and I've been

82
00:03:55,739 --> 00:04:00,000
interested in it ever since and I

83
00:03:57,449 --> 00:04:02,729
continue to work on it on the side but

84
00:04:00,000 --> 00:04:04,560
before I introduced to George Gallup see

85
00:04:02,729 --> 00:04:07,530
I want to first introduce to you your

86

00:04:04,560 --> 00:04:10,379
own galaxy that you live in and that is

87
00:04:07,530 --> 00:04:14,159
the Milky Way so this is a beautiful

88
00:04:10,379 --> 00:04:17,969
picture taken of the night sky and if

89
00:04:14,159 --> 00:04:20,159
you go out into a very dark place where

90
00:04:17,970 --> 00:04:22,800
the nearest city is tens of miles away

91
00:04:20,160 --> 00:04:24,030
and look up at the sky you might see

92
00:04:22,800 --> 00:04:26,220
something like this

93
00:04:24,029 --> 00:04:28,829
now it won't be this beautiful in color

94
00:04:26,220 --> 00:04:31,470
it'll be mostly gray and white but it's

95
00:04:28,829 --> 00:04:34,019
the same idea we're going down the

96
00:04:31,470 --> 00:04:37,110
middle of this image you have the Milky

97
00:04:34,019 --> 00:04:39,569
Way disk so this is a galaxy that you

98
00:04:37,110 --> 00:04:41,550
all live in and you can see it

99
00:04:39,569 --> 00:04:45,329
yourselves if you do go out to these

100
00:04:41,550 --> 00:04:47,220

very dark sky places now if you take a

101

00:04:45,329 --> 00:04:48,029

bunch of images of the Milky Way from

102

00:04:47,220 --> 00:04:49,770

Earth

103

00:04:48,029 --> 00:04:52,919

and put them together you can get an

104

00:04:49,769 --> 00:04:57,359

image like this where most of the light

105

00:04:52,920 --> 00:04:59,580

is in this thin disc here and that's the

106

00:04:57,360 --> 00:05:03,090

disc the main disk of our galaxy the

107

00:04:59,579 --> 00:05:06,418

Milky Way so it's very thin and most of

108

00:05:03,089 --> 00:05:10,349

that light is coming from stars in our

109

00:05:06,418 --> 00:05:13,949

galaxy and so our galaxy is made up of

110

00:05:10,350 --> 00:05:16,050

stars dust gas and dark matter all of

111

00:05:13,949 --> 00:05:19,439

those things put together and it's this

112

00:05:16,050 --> 00:05:21,720

little island of all of those things so

113

00:05:19,439 --> 00:05:27,660

that's why I called dwarf galaxies

114

00:05:21,720 --> 00:05:32,040

islands of stars now it looks very thin

115
00:05:27,660 --> 00:05:34,710
in this picture oops blah we'll go back

116
00:05:32,040 --> 00:05:38,819
well then there it is it looks very thin

117
00:05:34,709 --> 00:05:41,759
in this picture that's because the main

118
00:05:38,819 --> 00:05:44,668
disk of our galaxy is quite thin but

119
00:05:41,759 --> 00:05:46,560
that's only our view from the earth what

120
00:05:44,668 --> 00:05:50,219
does it look like when we leave the

121
00:05:46,560 --> 00:05:52,379
earth and leave the galaxy and look back

122
00:05:50,220 --> 00:05:53,850
at it well we can't actually do that

123
00:05:52,379 --> 00:05:57,180
because we don't have the technology to

124
00:05:53,850 --> 00:05:59,910
go that fast but with the data that

125
00:05:57,180 --> 00:06:01,500
we've collected from the Milky Way we

126
00:05:59,910 --> 00:06:03,900
can actually have an artist put together

127
00:06:01,500 --> 00:06:07,529
a picture of what we think it looks like

128
00:06:03,899 --> 00:06:11,009
if we were to leave the galaxy and go

129
00:06:07,529 --> 00:06:13,559
look at it from above so this is what we

130
00:06:11,009 --> 00:06:16,589
think it might look like where you're

131
00:06:13,560 --> 00:06:18,180
here half about halfway between the

132
00:06:16,589 --> 00:06:20,969
center of the galaxy in the outer edge

133
00:06:18,180 --> 00:06:22,439
and we do want to be there we don't want

134
00:06:20,970 --> 00:06:24,030
to be too close to the center because

135
00:06:22,439 --> 00:06:26,600
too much is going on there it would be

136
00:06:24,029 --> 00:06:31,079
very disastrous for us as a population

137
00:06:26,600 --> 00:06:32,610
but you have a couple of features here

138
00:06:31,079 --> 00:06:35,519
that I'd like to point out one it's not

139
00:06:32,610 --> 00:06:37,020
thin anymore if we look down at it it's

140
00:06:35,519 --> 00:06:39,930
this big round dish

141
00:06:37,019 --> 00:06:42,389
so you can think of our galaxy as like a

142
00:06:39,930 --> 00:06:44,100
thin plate it's not exactly shaped

143

00:06:42,389 --> 00:06:46,800
exactly like a plate but it's pretty

144
00:06:44,100 --> 00:06:49,290
much like one and then on top of that

145
00:06:46,800 --> 00:06:52,350
you have these big beautiful spiraling

146
00:06:49,290 --> 00:06:54,689
arms so astronomers look at galaxies

147
00:06:52,350 --> 00:06:56,370
like this and they say oh it has

148
00:06:54,689 --> 00:06:58,230
spiraling arms so we'll call that a

149
00:06:56,370 --> 00:07:01,350
spiral galaxy because we're really good

150
00:06:58,230 --> 00:07:04,980
at naming things so we live in a spiral

151
00:07:01,350 --> 00:07:08,220
galaxy which is great and we have a

152
00:07:04,980 --> 00:07:10,290
pretty good understanding of our no own

153
00:07:08,220 --> 00:07:12,000
Milky Way for having lived in it we're

154
00:07:10,290 --> 00:07:13,560
not we don't understand everything but

155
00:07:12,000 --> 00:07:16,230
we're still studying a lot about it but

156
00:07:13,560 --> 00:07:18,629
one thing we do know is that we are not

157
00:07:16,230 --> 00:07:21,629

the only galaxies out there there are

158

00:07:18,629 --> 00:07:24,180

lots of other galaxies and to prove this

159

00:07:21,629 --> 00:07:26,310

point I have this beautiful image here

160

00:07:24,180 --> 00:07:27,990

which is the Hubble Deep Field so this

161

00:07:26,310 --> 00:07:30,870

is a very famous image and I'm gonna

162

00:07:27,990 --> 00:07:32,819

explain why what they did was a bunch of

163

00:07:30,870 --> 00:07:36,449

astronomers in the 1990s got together

164

00:07:32,819 --> 00:07:38,339

and they said hey what would happen if

165

00:07:36,449 --> 00:07:40,500

we take the Hubble Space Telescope our

166

00:07:38,339 --> 00:07:43,259

most powerful optical telescope and

167

00:07:40,500 --> 00:07:46,410

point it at a black part of this guy

168

00:07:43,259 --> 00:07:48,389

like we don't see anything there nothing

169

00:07:46,410 --> 00:07:51,030

what would happen if we just point it

170

00:07:48,389 --> 00:07:52,560

there for a really long time and so a

171

00:07:51,029 --> 00:07:54,839

bunch of other astronomers who had to

172
00:07:52,560 --> 00:07:57,839
approve this plan said yeah why not go

173
00:07:54,839 --> 00:08:00,389
for it so they spent 10 days in over a

174
00:07:57,839 --> 00:08:02,569
hundred hours staring at this part of

175
00:08:00,389 --> 00:08:05,969
the sky that was supposed to be empty

176
00:08:02,569 --> 00:08:09,719
very small part of this guy yes correct

177
00:08:05,970 --> 00:08:11,850
and they got this and this is a

178
00:08:09,720 --> 00:08:13,860
beautiful image because aside from a few

179
00:08:11,850 --> 00:08:16,710
stars which you can tell have these

180
00:08:13,860 --> 00:08:18,629
pointy features here so those are stars

181
00:08:16,709 --> 00:08:20,159
in our own galaxy the Milky Way we can't

182
00:08:18,629 --> 00:08:22,009
go out there and tell them to move so we

183
00:08:20,160 --> 00:08:26,090
just have to leave them in the image

184
00:08:22,009 --> 00:08:29,430
everything in this image is a galaxy

185
00:08:26,089 --> 00:08:32,389
there are almost 3000 galaxies in this

186
00:08:29,430 --> 00:08:34,649
image and as you can tell from it

187
00:08:32,389 --> 00:08:37,139
they're all different colors and

188
00:08:34,649 --> 00:08:39,750
different shapes so there are lots of

189
00:08:37,139 --> 00:08:41,699
types of galaxies out there and we are

190
00:08:39,750 --> 00:08:44,159
definitely not the only galaxies so lots

191
00:08:41,700 --> 00:08:48,540
of little islands of stars dust gas and

192
00:08:44,159 --> 00:08:50,069
dark matter so I haven't talked much

193
00:08:48,539 --> 00:08:50,490
about dwarf galaxies yet

194
00:08:50,070 --> 00:08:52,649
let's do

195
00:08:50,490 --> 00:08:54,750
that so this again is the artist

196
00:08:52,649 --> 00:08:56,669
depiction of our own Milky Way and what

197
00:08:54,750 --> 00:08:58,620
we think it looks like what happens if

198
00:08:56,669 --> 00:09:02,699
we put outdoors galaxies next to it

199
00:08:58,620 --> 00:09:04,429
Oh looks approximately like that tiny

200

00:09:02,700 --> 00:09:08,759
little square up there in the top left

201
00:09:04,429 --> 00:09:13,679
so it's quite small dwarf galaxies are

202
00:09:08,759 --> 00:09:15,689
about 1/10 - down to about 125th the

203
00:09:13,679 --> 00:09:18,929
size of a big spiral galaxy like our

204
00:09:15,690 --> 00:09:21,330
Milky Way so they're very small so the

205
00:09:18,929 --> 00:09:23,639
question becomes why do we care about

206
00:09:21,330 --> 00:09:27,810
such tiny galaxies what's the point of

207
00:09:23,639 --> 00:09:30,649
studying them well first off there are a

208
00:09:27,809 --> 00:09:33,028
lot of them nearby us and so this image

209
00:09:30,649 --> 00:09:34,830
even though a little bit hard to read it

210
00:09:33,028 --> 00:09:37,559
proves a-- where we have the Milky Way

211
00:09:34,830 --> 00:09:39,420
in the center labeled in yellow and then

212
00:09:37,559 --> 00:09:41,129
we have these two yellow labels here

213
00:09:39,419 --> 00:09:44,338
which are the Andromeda galaxy in the

214
00:09:41,129 --> 00:09:48,509

Triangulum galaxy so those galaxies in

215

00:09:44,339 --> 00:09:51,149

yellow are nearest massive neighbors so

216

00:09:48,509 --> 00:09:54,360

they're big galaxies everything else

217

00:09:51,149 --> 00:09:57,929

here is labeled in light blue and those

218

00:09:54,360 --> 00:10:00,870

are all dwarf galaxies there are about

219

00:09:57,929 --> 00:10:03,719

last time I checked for tea or fuel

220

00:10:00,870 --> 00:10:06,028

exceeds with a distance to the Milky Way

221

00:10:03,720 --> 00:10:10,560

that is smaller than our distance to

222

00:10:06,028 --> 00:10:12,990

Andromeda so 40 dwarf galaxies fit right

223

00:10:10,559 --> 00:10:15,389

in here that's a lot of dwarf galaxies

224

00:10:12,990 --> 00:10:17,070

so we want to understand where they came

225

00:10:15,389 --> 00:10:20,879

from what they're doing and what we can

226

00:10:17,070 --> 00:10:23,670

learn from them so one thing we can

227

00:10:20,879 --> 00:10:25,439

learn from them is star formation we can

228

00:10:23,669 --> 00:10:28,169

learn about star formation and how it

229
00:10:25,440 --> 00:10:30,839
happened so this is an image not of

230
00:10:28,169 --> 00:10:32,278
dwarf galaxies star formation or milky

231
00:10:30,839 --> 00:10:36,089
way star formation this is for all

232
00:10:32,278 --> 00:10:38,129
galaxies so we start off with some

233
00:10:36,089 --> 00:10:42,480
really dense gas in the center in the

234
00:10:38,129 --> 00:10:46,320
red here and then that dense gas can

235
00:10:42,480 --> 00:10:47,850
collapse and form stars and then those

236
00:10:46,320 --> 00:10:50,190
stars live out their lives is either

237
00:10:47,850 --> 00:10:53,129
less massive stars or more massive stars

238
00:10:50,190 --> 00:10:56,579
eventually die but the main point of

239
00:10:53,129 --> 00:10:59,278
this image is that you need dense gas to

240
00:10:56,578 --> 00:11:03,149
form stars and that's actually really

241
00:10:59,278 --> 00:11:04,080
hard to get in some galaxies we don't

242
00:11:03,149 --> 00:11:06,029
know how

243
00:11:04,080 --> 00:11:09,750
gasps always gets to these dentinal

244
00:11:06,029 --> 00:11:11,970
states and so we kind of understand how

245
00:11:09,750 --> 00:11:14,220
that works in the milky way and I'm

246
00:11:11,970 --> 00:11:16,470
gonna take a piece of a spiral arm to

247
00:11:14,220 --> 00:11:18,690
show you that and I'm gonna blow it up

248
00:11:16,470 --> 00:11:21,450
and we're gonna pretend like it it's a

249
00:11:18,690 --> 00:11:24,720
traffic jam but in traffic jams and

250
00:11:21,450 --> 00:11:28,500
galaxies you don't have cars and trucks

251
00:11:24,720 --> 00:11:31,230
you have gas and stars so what happens

252
00:11:28,500 --> 00:11:34,500
is the spiral arm comes sweeping through

253
00:11:31,230 --> 00:11:36,570
the galaxy and the gas in the galaxy

254
00:11:34,500 --> 00:11:39,480
gets caught up in the spiral arm like a

255
00:11:36,570 --> 00:11:41,940
traffic jam and the gas starts bumping

256
00:11:39,480 --> 00:11:43,730
into each other creating regions of high

257

00:11:41,940 --> 00:11:46,740
density because it gets stirred up and

258
00:11:43,730 --> 00:11:51,000
that high density gas can then collapse

259
00:11:46,740 --> 00:11:56,840
and form stars so that's generally how

260
00:11:51,000 --> 00:12:00,779
you get stars in a spiral galaxy but

261
00:11:56,840 --> 00:12:02,879
dwarf galaxies don't have spiral arms so

262
00:12:00,779 --> 00:12:04,709
they don't have this mechanism to kind

263
00:12:02,879 --> 00:12:07,860
of stir up their gas and make regions of

264
00:12:04,710 --> 00:12:11,730
high density so we want to understand

265
00:12:07,860 --> 00:12:15,330
what causes their gas to get stirred up

266
00:12:11,730 --> 00:12:17,580
enough in order to create stars and if

267
00:12:15,330 --> 00:12:19,740
we do that then we have a more basic

268
00:12:17,580 --> 00:12:22,680
understanding of how star formation can

269
00:12:19,740 --> 00:12:28,919
happen without the aid of these extra

270
00:12:22,679 --> 00:12:31,139
spiral arms so some galaxies some dwarf

271
00:12:28,919 --> 00:12:34,259

galaxies are really good at forming

272

00:12:31,139 --> 00:12:36,269

stars and some are really bad so in

273

00:12:34,259 --> 00:12:38,669

these images I've taken their combined

274

00:12:36,269 --> 00:12:41,159

images where we've taken the Stars the

275

00:12:38,669 --> 00:12:43,199

old stars and the new stars and combined

276

00:12:41,159 --> 00:12:45,870

it with images of the gas so the gas is

277

00:12:43,200 --> 00:12:47,280

in red and the old stars are in green

278

00:12:45,870 --> 00:12:51,060

which you can see a little bit here in

279

00:12:47,279 --> 00:12:53,669

2d do to 16 and then new stars are the

280

00:12:51,059 --> 00:12:56,149

blue stars so those are little pops of

281

00:12:53,669 --> 00:12:58,919

blue you can see Indy do to 16 and

282

00:12:56,149 --> 00:13:01,139

notice to do to 16 doesn't have many

283

00:12:58,919 --> 00:13:03,240

pops of blue so it's not very good at

284

00:13:01,139 --> 00:13:07,049

forming stars right now it doesn't have

285

00:13:03,240 --> 00:13:10,500

many new stars whereas herre 36 on the

286
00:13:07,049 --> 00:13:12,799
right side has this bright white spot

287
00:13:10,500 --> 00:13:15,929
here where it's forming a ton of stars

288
00:13:12,799 --> 00:13:17,698
so it's very good at forming stars and

289
00:13:15,929 --> 00:13:19,349
we want to figure out why

290
00:13:17,698 --> 00:13:20,969
why are these dwarf galaxies so

291
00:13:19,350 --> 00:13:23,129
different what happened to one that

292
00:13:20,970 --> 00:13:24,569
didn't happen to the other to make it

293
00:13:23,129 --> 00:13:29,579
really good at forming stars are really

294
00:13:24,568 --> 00:13:31,259
bad at forming stars so I keep having

295
00:13:29,578 --> 00:13:33,539
this little symbol in the bottom right

296
00:13:31,259 --> 00:13:35,609
and as mentioned earlier little things

297
00:13:33,539 --> 00:13:38,458
as the research group that I belong to

298
00:13:35,609 --> 00:13:40,589
and I worked with for my dissertation so

299
00:13:38,458 --> 00:13:43,858
little things is actually great because

300
00:13:40,589 --> 00:13:46,350
it's an acronym and it's really fun to

301
00:13:43,859 --> 00:13:48,299
say out loud at once when you try to

302
00:13:46,350 --> 00:13:50,879
read out this acronym so where did it

303
00:13:48,298 --> 00:13:53,909
come from well first there was a group

304
00:13:50,879 --> 00:13:57,178
called things things was a group that

305
00:13:53,909 --> 00:14:01,350
studied things nearby us so they studied

306
00:13:57,178 --> 00:14:04,639
the gas and nearby massive galaxies and

307
00:14:01,350 --> 00:14:08,548
that gas is called atomic hydrogen or h1

308
00:14:04,639 --> 00:14:11,789
so their acronym is the h1 nearby

309
00:14:08,548 --> 00:14:14,668
galaxies survey or the gas nearby

310
00:14:11,789 --> 00:14:17,068
galaxies survey so that's simple kind of

311
00:14:14,668 --> 00:14:19,558
easy to remember right but then little

312
00:14:17,068 --> 00:14:22,048
things group came along and they said

313
00:14:19,558 --> 00:14:24,749
hey we want to do the same thing as

314

00:14:22,048 --> 00:14:27,088
things but we want to do it with smaller

315
00:14:24,749 --> 00:14:29,668
galaxies so we want to do it with little

316
00:14:27,089 --> 00:14:32,009
things so then they had to come up with

317
00:14:29,668 --> 00:14:35,129
an acronym that fit this of course like

318
00:14:32,009 --> 00:14:38,278
true astronomers and they got creative

319
00:14:35,129 --> 00:14:41,069
and now you're about to figure out why I

320
00:14:38,278 --> 00:14:43,948
don't ever say the full acronym out loud

321
00:14:41,068 --> 00:14:46,409
to many people it is the local irregular

322
00:14:43,948 --> 00:14:50,639
is that trace luminosity extremes the h1

323
00:14:46,409 --> 00:14:53,759
nearby galaxies surveys so just a little

324
00:14:50,639 --> 00:14:56,129
a great example of acronyms and

325
00:14:53,759 --> 00:15:00,449
astronomy and how far they can be taken

326
00:14:56,129 --> 00:15:02,188
so what did we do to get this data well

327
00:15:00,448 --> 00:15:05,308
we were looking mainly for the gas data

328
00:15:02,188 --> 00:15:08,909

and we took stellar data from other

329

00:15:05,308 --> 00:15:10,889

surveys and we got that gas data from

330

00:15:08,909 --> 00:15:13,168

The Very Large Array telescope and this

331

00:15:10,889 --> 00:15:14,249

is a beautiful picture of only part of

332

00:15:13,168 --> 00:15:17,788

that telescope

333

00:15:14,249 --> 00:15:20,519

there are actually 27 of these dishes

334

00:15:17,788 --> 00:15:23,489

that belong to this telescope and they

335

00:15:20,519 --> 00:15:25,379

together make one big telescope which is

336

00:15:23,489 --> 00:15:26,908

great because then you can move them

337

00:15:25,379 --> 00:15:28,678

closer together to make a small

338

00:15:26,908 --> 00:15:31,069

telescope or you can move them further

339

00:15:28,678 --> 00:15:34,559

apart to make a bigger telescope

340

00:15:31,070 --> 00:15:37,740

so this is a beautiful telescope which

341

00:15:34,559 --> 00:15:39,329

I've visited and we get the gas data

342

00:15:37,740 --> 00:15:40,909

from there here's me sitting on top of

343
00:15:39,330 --> 00:15:44,220
one of the dishes at the edge very

344
00:15:40,909 --> 00:15:46,409
perilous situation and then just to

345
00:15:44,220 --> 00:15:48,420
explain how big they are here's me way

346
00:15:46,409 --> 00:15:50,669
down at the bottom of one on the right

347
00:15:48,419 --> 00:15:55,139
side so these are giant dishes they're

348
00:15:50,669 --> 00:15:56,669
about 25 meters in diameter so that's

349
00:15:55,139 --> 00:16:01,350
how we got our data we got it from this

350
00:15:56,669 --> 00:16:04,469
telescope the gaseous data and we tried

351
00:16:01,350 --> 00:16:06,600
to understand what can help form stars

352
00:16:04,470 --> 00:16:08,460
in most of these galaxies and some other

353
00:16:06,600 --> 00:16:11,399
things but what I was mainly focused on

354
00:16:08,460 --> 00:16:16,050
is regulating star formation and dwarf

355
00:16:11,399 --> 00:16:19,289
galaxies so this is a list of just some

356
00:16:16,049 --> 00:16:21,089
of the ways you might be able to

357
00:16:19,289 --> 00:16:22,559
regulate star formation it's a long list

358
00:16:21,090 --> 00:16:24,960
you don't need to read it all go through

359
00:16:22,559 --> 00:16:26,849
some of them but in general it just

360
00:16:24,960 --> 00:16:29,850
gives you an idea of how many different

361
00:16:26,850 --> 00:16:31,889
ideas there are out there for forming

362
00:16:29,850 --> 00:16:35,279
stars and galaxies and we're trying to

363
00:16:31,889 --> 00:16:38,490
understand which galaxies might be doing

364
00:16:35,279 --> 00:16:41,850
these things so we're gonna focus on

365
00:16:38,490 --> 00:16:43,860
these for tonight and I did mention

366
00:16:41,850 --> 00:16:45,269
regulating star formation was my

367
00:16:43,860 --> 00:16:48,149
interest but really I was more

368
00:16:45,269 --> 00:16:51,090
interested in how galaxies can form more

369
00:16:48,149 --> 00:16:52,649
stars for tonight's talk so how do we

370
00:16:51,090 --> 00:16:55,950
get more of them now how do we get less

371

00:16:52,649 --> 00:17:00,379
of them so let's start off with our

372
00:16:55,950 --> 00:17:05,269
first way so you can have old stars

373
00:17:00,379 --> 00:17:05,269
forming new stars so how does that work

374
00:17:05,329 --> 00:17:10,619
well if we start off with a bunch of

375
00:17:08,190 --> 00:17:13,890
stars that have just formed okay these

376
00:17:10,619 --> 00:17:16,979
are the stars in the center in gas so

377
00:17:13,890 --> 00:17:19,620
the gas is the orange here so if these

378
00:17:16,980 --> 00:17:22,559
stars just formed they're giving off a

379
00:17:19,619 --> 00:17:25,439
lot of radiation if there are enough of

380
00:17:22,559 --> 00:17:27,659
them and when they give off all of this

381
00:17:25,440 --> 00:17:30,029
radiation we like to call them stellar

382
00:17:27,660 --> 00:17:32,820
winds that radiation is called a wind

383
00:17:30,029 --> 00:17:35,849
and what that wind or that radiation

384
00:17:32,819 --> 00:17:40,799
does is it keeps up the surrounding gas

385
00:17:35,849 --> 00:17:42,659

it also starts to push gas away from the

386

00:17:40,799 --> 00:17:44,000

stars because it's just radiation

387

00:17:42,660 --> 00:17:48,259

pushing away the gas

388

00:17:44,000 --> 00:17:52,460

rounds it and as it does it it creates a

389

00:17:48,259 --> 00:17:55,369

snowplow effect in the gas and remember

390

00:17:52,460 --> 00:17:57,380

we need dense gas to form stars so

391

00:17:55,369 --> 00:18:00,439

eventually these stars in the center

392

00:17:57,380 --> 00:18:02,600

will start to die off the really big

393

00:18:00,440 --> 00:18:05,120

ones and that radiation will calm down

394

00:18:02,599 --> 00:18:07,759

and so this dense gas which is kind of

395

00:18:05,119 --> 00:18:11,629

like a bubble around these stars now can

396

00:18:07,759 --> 00:18:15,559

start to cool and collapse and form new

397

00:18:11,630 --> 00:18:17,840

stars so that's how you can get new

398

00:18:15,559 --> 00:18:22,629

stars created by a bunch of old stars

399

00:18:17,839 --> 00:18:25,639

this snowplow effect in the gas so that

400
00:18:22,630 --> 00:18:27,290
does happen in some dwarf galaxies we

401
00:18:25,640 --> 00:18:30,440
think we see that and this is an image

402
00:18:27,289 --> 00:18:34,789
again some little things with galaxy IC

403
00:18:30,440 --> 00:18:37,549
1613 we're in red you have this

404
00:18:34,789 --> 00:18:39,109
beautiful gas and in the center you

405
00:18:37,549 --> 00:18:42,529
notice a bunch of green and those are

406
00:18:39,109 --> 00:18:44,899
our older stars and those older stars

407
00:18:42,529 --> 00:18:46,910
may have pushed out this gas because you

408
00:18:44,900 --> 00:18:50,180
don't see much red on top of the green

409
00:18:46,910 --> 00:18:52,250
here and given it that snowplow effect

410
00:18:50,180 --> 00:18:55,700
where now you see a bunch of blue or

411
00:18:52,250 --> 00:18:58,640
younger stars are forming in it so this

412
00:18:55,700 --> 00:19:00,830
is a beautiful nearby example of a

413
00:18:58,640 --> 00:19:02,840
galaxy that might be having the snowplow

414
00:19:00,829 --> 00:19:05,569
effect where older stars are forming new

415
00:19:02,839 --> 00:19:08,959
stars so what's our second way we're

416
00:19:05,569 --> 00:19:12,019
going to talk about so let's pump it up

417
00:19:08,960 --> 00:19:15,049
a notch let's go to gas consumption so

418
00:19:12,019 --> 00:19:17,059
galaxies eating gas this is a way you

419
00:19:15,049 --> 00:19:21,319
can get a lot of star formation all at

420
00:19:17,059 --> 00:19:23,450
once so this is an artist's image of

421
00:19:21,319 --> 00:19:25,159
that going on for a more massive galaxy

422
00:19:23,450 --> 00:19:27,559
but it still works for Dwarfs galaxies

423
00:19:25,160 --> 00:19:30,320
and with a lot of gas but we'll talk

424
00:19:27,559 --> 00:19:33,049
about little chunks of gas so the idea

425
00:19:30,319 --> 00:19:36,799
is you have a dwarf galaxy just sitting

426
00:19:33,049 --> 00:19:39,980
out there and some gas is nearby if that

427
00:19:36,799 --> 00:19:42,230
gas gets caught in the gravity of your

428

00:19:39,980 --> 00:19:44,089
galaxy it's gonna ram into the galaxy

429
00:19:42,230 --> 00:19:45,920
right because it wants to go towards the

430
00:19:44,089 --> 00:19:49,519
galaxy when it's gravitationally

431
00:19:45,920 --> 00:19:52,429
attracted and so as it comes ramming

432
00:19:49,519 --> 00:19:55,429
into the galaxy it's going to stir up

433
00:19:52,429 --> 00:19:57,110
all the gas already inside of the galaxy

434
00:19:55,429 --> 00:20:00,048
and on top of that

435
00:19:57,109 --> 00:20:04,308
it's providing fuel for future star

436
00:20:00,048 --> 00:20:06,379
formation because stars form from gas so

437
00:20:04,308 --> 00:20:07,970
you can get a burst of star formation

438
00:20:06,380 --> 00:20:11,510
and then you're on top of that giving it

439
00:20:07,970 --> 00:20:14,990
fuel for later star formation and we

440
00:20:11,509 --> 00:20:17,450
think we see that in sevens wiki 403 so

441
00:20:14,990 --> 00:20:19,609
on the left side here this is our galaxy

442
00:20:17,450 --> 00:20:21,200

sevens wiki 403 where I've combined the

443

00:20:19,609 --> 00:20:23,419
images of the stars and the gas again

444

00:20:21,200 --> 00:20:25,840
and you notice the bursts of star

445

00:20:23,420 --> 00:20:28,250
formation in the center of this one and

446

00:20:25,839 --> 00:20:32,869
then on the right side I've separated

447

00:20:28,250 --> 00:20:35,960
out just the gas in this galaxy so on

448

00:20:32,869 --> 00:20:38,659
the right side I have in gray contours

449

00:20:35,960 --> 00:20:41,929
here that's the gas that we think

450

00:20:38,660 --> 00:20:45,679
belongs to sevens with G 403 for the

451

00:20:41,929 --> 00:20:49,880
most part but we found this chunk of gas

452

00:20:45,679 --> 00:20:52,660
an orange that is moving differently

453

00:20:49,880 --> 00:20:55,730
than the rest of the gas in the galaxy

454

00:20:52,660 --> 00:20:57,500
so since it's moving so very differently

455

00:20:55,730 --> 00:20:59,690
from the rest of the gas we think this

456

00:20:57,500 --> 00:21:03,349
is a gas cloud that's coming crashing

457
00:20:59,690 --> 00:21:05,240
into the galaxy so this is an example of

458
00:21:03,349 --> 00:21:07,730
where they may be happening where this

459
00:21:05,240 --> 00:21:10,640
gas cloud is crashing into the galaxies

460
00:21:07,730 --> 00:21:13,720
stirring up the gas and then being maybe

461
00:21:10,640 --> 00:21:16,100
providing fuel for future star formation

462
00:21:13,720 --> 00:21:20,390
so that's a really cool example of where

463
00:21:16,099 --> 00:21:22,189
we think we see that now I keep

464
00:21:20,390 --> 00:21:26,990
mentioning all these names of galaxies

465
00:21:22,190 --> 00:21:30,500
IC 1613 D do 216 sevens wiki 403 what

466
00:21:26,990 --> 00:21:32,150
does that all mean well they're actually

467
00:21:30,500 --> 00:21:35,539
not that interesting of an answer their

468
00:21:32,150 --> 00:21:40,548
catalog names so for example seven

469
00:21:35,539 --> 00:21:44,509
Sookie 403 it's fritz zwicky's seventh

470
00:21:40,548 --> 00:21:46,129
catalog object zero four zero three not

471
00:21:44,509 --> 00:21:47,720
that interesting right well the reason I

472
00:21:46,130 --> 00:21:50,330
bring that up is because Fritz Zwicky

473
00:21:47,720 --> 00:21:53,390
is one of my pictorial heroes and what

474
00:21:50,329 --> 00:21:56,119
do I mean by that well he's really good

475
00:21:53,390 --> 00:21:57,910
at taking professional photos so I

476
00:21:56,119 --> 00:22:01,009
really believe that he has reached

477
00:21:57,910 --> 00:22:02,390
professional photo level experts so I'm

478
00:22:01,009 --> 00:22:08,490
going to be trying to reach this in my

479
00:22:02,390 --> 00:22:10,320
future career so just keep an eye out so

480
00:22:08,490 --> 00:22:13,039
what's our third way that we can do this

481
00:22:10,319 --> 00:22:16,109
well we can talk about interacting and

482
00:22:13,039 --> 00:22:18,149
merging dwarf galaxies we're here on the

483
00:22:16,109 --> 00:22:19,949
left we have some Zords that are

484
00:22:18,150 --> 00:22:21,690
momentarily interacting and then they

485

00:22:19,950 --> 00:22:24,509
let go and go off on their own ways and

486
00:22:21,690 --> 00:22:27,058
on the right we have some Zords that are

487
00:22:24,509 --> 00:22:29,869
merging to become a Megazord okay but

488
00:22:27,058 --> 00:22:32,700
what does that look like with galaxies

489
00:22:29,869 --> 00:22:34,439
well it looks something like this where

490
00:22:32,700 --> 00:22:36,779
this video I'm playing actually depicts

491
00:22:34,440 --> 00:22:39,600
maps of galaxies but that's okay

492
00:22:36,779 --> 00:22:41,428
works for dwarfs again and the Pops of

493
00:22:39,599 --> 00:22:44,549
blue that you can kind of see here our

494
00:22:41,429 --> 00:22:46,830
stars forming so as they pass by each

495
00:22:44,549 --> 00:22:49,200
other they're interacting and you see

496
00:22:46,829 --> 00:22:50,849
lots of pops of blue so lots of new

497
00:22:49,200 --> 00:22:53,460
stars forming so they're stirring up

498
00:22:50,849 --> 00:22:54,629
each other's gas gravitationally but

499
00:22:53,460 --> 00:22:57,000

they're caught in each other with

500

00:22:54,630 --> 00:23:00,570

gravity so they're eventually going to

501

00:22:57,000 --> 00:23:03,660

merge and as they merge you're going to

502

00:23:00,569 --> 00:23:05,220

see lots more pops of blue so as they're

503

00:23:03,660 --> 00:23:07,740

merging they're stirring up each other's

504

00:23:05,220 --> 00:23:13,190

gas a lot creating regions of high gas

505

00:23:07,740 --> 00:23:17,099

density which can then form stars but

506

00:23:13,190 --> 00:23:19,320

there is as we replay it I'm going to

507

00:23:17,099 --> 00:23:23,669

show you some signatures that

508

00:23:19,319 --> 00:23:25,259

astronomers look for when they are

509

00:23:23,670 --> 00:23:28,289

looking for these merging and

510

00:23:25,259 --> 00:23:30,029

interacting galaxies so as they interact

511

00:23:28,289 --> 00:23:32,220

they come close to each other and the

512

00:23:30,029 --> 00:23:35,308

galaxies on the right you're gonna see

513

00:23:32,220 --> 00:23:38,700

it change shape and when it changes

514
00:23:35,308 --> 00:23:43,109
shape it actually leaves these curved

515
00:23:38,700 --> 00:23:46,558
features behind and that's because the

516
00:23:43,109 --> 00:23:49,799
other galaxies it's gravity has ripped

517
00:23:46,558 --> 00:23:53,069
the stars off the outer edge and created

518
00:23:49,799 --> 00:23:55,799
these curved features so these are what

519
00:23:53,069 --> 00:23:57,750
we call tidal tails so that's something

520
00:23:55,799 --> 00:24:02,399
that astronomers look for when they're

521
00:23:57,750 --> 00:24:05,130
looking for interacting galaxies then if

522
00:24:02,400 --> 00:24:08,190
we want to look for merging galaxies

523
00:24:05,130 --> 00:24:11,370
like these to one thing we can look for

524
00:24:08,190 --> 00:24:14,429
is their centers so these two have very

525
00:24:11,369 --> 00:24:19,049
bright centers very bright cores we call

526
00:24:14,429 --> 00:24:20,940
them and as they merge you notice that

527
00:24:19,049 --> 00:24:22,278
they're bright cores don't merge

528
00:24:20,940 --> 00:24:25,099
immediately there's still

529
00:24:22,278 --> 00:24:27,108
visible for a while so if you see these

530
00:24:25,098 --> 00:24:30,278
two separate cords with a bunch of these

531
00:24:27,108 --> 00:24:32,478
titles tails or these pulled out stars

532
00:24:30,278 --> 00:24:37,999
then you know you have a merging

533
00:24:32,479 --> 00:24:39,619
galaxies situation so in Harrow 36 this

534
00:24:37,999 --> 00:24:41,989
galaxy I showed you earlier that's

535
00:24:39,618 --> 00:24:44,959
forming a ton of stars we think we see

536
00:24:41,989 --> 00:24:46,700
that so here on the left as the image I

537
00:24:44,960 --> 00:24:49,909
showed you before of the stars and the

538
00:24:46,700 --> 00:24:52,129
gas and red and the stars here in this

539
00:24:49,909 --> 00:24:54,528
bright white part are forming a lot of

540
00:24:52,128 --> 00:24:57,829
them and then on the right side have

541
00:24:54,528 --> 00:25:00,528
just pulled out the gas image so this is

542

00:24:57,829 --> 00:25:02,749
just the gas in the orange here and you

543
00:25:00,528 --> 00:25:05,450
can see going straight up there's this

544
00:25:02,749 --> 00:25:09,079
really thin feature and we think that's

545
00:25:05,450 --> 00:25:13,009
the title tail and then on top of that

546
00:25:09,079 --> 00:25:15,949
it's possible that this galaxy still has

547
00:25:13,009 --> 00:25:17,659
those two cores and it's gas visible so

548
00:25:15,950 --> 00:25:20,690
it's still settling down it's still

549
00:25:17,659 --> 00:25:25,369
mixing together so this is a possible

550
00:25:20,690 --> 00:25:27,109
example of a merged galaxy so what's our

551
00:25:25,368 --> 00:25:29,439
fourth way that we can get lots more

552
00:25:27,108 --> 00:25:31,608
stars and galaxies

553
00:25:29,440 --> 00:25:38,109
well that's through Ram pressure

554
00:25:31,608 --> 00:25:38,108
stripping so with Ram pressure stripping

555
00:25:38,288 --> 00:25:44,960
you have something very dramatic

556
00:25:40,940 --> 00:25:48,649

happening to your galaxy so the space

557

00:25:44,960 --> 00:25:51,288

between galaxies is not actually empty

558

00:25:48,648 --> 00:25:53,268

it's full of stuff stuff that galaxies

559

00:25:51,288 --> 00:25:55,729

expelled stuff that galaxies haven't

560

00:25:53,269 --> 00:25:59,419

eaten yet it's just a bunch of stuff out

561

00:25:55,729 --> 00:26:01,729

there and so if you get a galaxy like

562

00:25:59,419 --> 00:26:05,389

the one in the top left corner of this

563

00:26:01,729 --> 00:26:09,229

image here moving really fast through

564

00:26:05,388 --> 00:26:11,658

that stuff its gas is going to be ripped

565

00:26:09,229 --> 00:26:13,759

off it's just gonna be ripped straight

566

00:26:11,659 --> 00:26:20,479

off and that's the stripping part of

567

00:26:13,759 --> 00:26:22,128

this word or this phrase so as its when

568

00:26:20,479 --> 00:26:24,619

astronomers talk about Ram pressure

569

00:26:22,128 --> 00:26:26,689

stripping they don't typically talk

570

00:26:24,618 --> 00:26:28,308

about forming stars they talk about the

571
00:26:26,690 --> 00:26:30,409
death of the galaxies in terms of

572
00:26:28,308 --> 00:26:33,278
forming stars because you're ripping off

573
00:26:30,409 --> 00:26:35,950
all that fuel for star formation right

574
00:26:33,278 --> 00:26:38,859
but there

575
00:26:35,950 --> 00:26:42,278
a brief moment when this is happening to

576
00:26:38,859 --> 00:26:45,548
a galaxy where there's still gas left

577
00:26:42,278 --> 00:26:48,548
inside the galaxy and that gas is being

578
00:26:45,548 --> 00:26:50,048
stirred up a lot and so that gas that's

579
00:26:48,548 --> 00:26:52,658
being stirred up will start to form a

580
00:26:50,048 --> 00:26:56,379
lot of stars and so that's its kind of

581
00:26:52,659 --> 00:27:00,880
last burst of star formation before it

582
00:26:56,380 --> 00:27:03,789
dies well not really dies but you get

583
00:27:00,880 --> 00:27:06,340
the idea so this is a dramatic picture

584
00:27:03,788 --> 00:27:08,379
of that happening here and a very

585
00:27:06,339 --> 00:27:10,240
beautiful one with a massive galaxy

586
00:27:08,380 --> 00:27:12,760
that's moving towards the top left of

587
00:27:10,240 --> 00:27:14,888
this image and trailing behind it in

588
00:27:12,759 --> 00:27:16,750
this bluish purple color is a lot of its

589
00:27:14,888 --> 00:27:18,359
gas that's just being ripped straight

590
00:27:16,750 --> 00:27:22,269
out of it

591
00:27:18,359 --> 00:27:26,138
so with dwarf galaxies we might be

592
00:27:22,269 --> 00:27:29,950
seeing that in Markarian 178 here so

593
00:27:26,138 --> 00:27:32,408
this image on the left again is our gas

594
00:27:29,950 --> 00:27:35,380
in red and our oldest stars and green

595
00:27:32,409 --> 00:27:37,269
with our new stars in blue so there's a

596
00:27:35,380 --> 00:27:41,830
lot of star formation going on in the

597
00:27:37,269 --> 00:27:43,929
center of this galaxy but in this left

598
00:27:41,829 --> 00:27:47,829
image you notice that the red is kind of

599

00:27:43,929 --> 00:27:50,798
trailing off to this tip so that could

600
00:27:47,829 --> 00:27:53,048
be the gas that is being left behind by

601
00:27:50,798 --> 00:27:55,240
Ram pressure stripping if this galaxy is

602
00:27:53,048 --> 00:27:57,519
more moving towards the bottom left of

603
00:27:55,240 --> 00:28:02,109
this image so it's just being pulled

604
00:27:57,519 --> 00:28:04,750
straight off then on the right here I've

605
00:28:02,109 --> 00:28:06,638
taken two parts of this image I've taken

606
00:28:04,750 --> 00:28:09,669
the old stars which are in green here

607
00:28:06,638 --> 00:28:11,798
and I've taken the gas which is an

608
00:28:09,669 --> 00:28:15,788
orange so the old stars are these gray

609
00:28:11,798 --> 00:28:18,579
lines here and you notice that the stars

610
00:28:15,788 --> 00:28:20,528
the old stars don't have any gas

611
00:28:18,579 --> 00:28:23,288
covering them on the bottom left and

612
00:28:20,528 --> 00:28:25,648
that might be because that gas that used

613
00:28:23,288 --> 00:28:28,720

to be there has already been ripped off

614

00:28:25,648 --> 00:28:31,359

so this part which is forming a lot of

615

00:28:28,720 --> 00:28:34,028

stars in the middle is kind of the front

616

00:28:31,359 --> 00:28:36,089

of the galaxy that might be running into

617

00:28:34,028 --> 00:28:38,679

all of this stuff and being stirred up

618

00:28:36,089 --> 00:28:41,408

so this is a moment in this galaxy's

619

00:28:38,679 --> 00:28:46,690

life right before it may stop forming

620

00:28:41,409 --> 00:28:48,730

stars so we've gone through all

621

00:28:46,690 --> 00:28:51,210

these different ways that you can add

622

00:28:48,730 --> 00:28:53,589

more stars to your galaxy dwarf galaxies

623

00:28:51,210 --> 00:28:55,090

but there are plenty more you can feel

624

00:28:53,589 --> 00:28:56,949

free to ask me about them

625

00:28:55,089 --> 00:28:58,059

I've included one extra there but we

626

00:28:56,950 --> 00:29:01,539

definitely don't have time to go through

627

00:28:58,059 --> 00:29:03,099

that so I just want to leave you with a

628

00:29:01,539 --> 00:29:06,990

few thoughts to take home

629

00:29:03,099 --> 00:29:09,369

first of all dwarf galaxies are awesome

630

00:29:06,990 --> 00:29:11,799

second of all there are a lot of them

631

00:29:09,369 --> 00:29:13,089

nearby remember that image I showed you

632

00:29:11,799 --> 00:29:17,289

at the very beginning with all those

633

00:29:13,089 --> 00:29:19,329

blue labels also star formation and

634

00:29:17,289 --> 00:29:20,680

Joris galaxies can be triggered in a lot

635

00:29:19,329 --> 00:29:22,809

of different ways we didn't even go

636

00:29:20,680 --> 00:29:26,710

through probably half of the ideas out

637

00:29:22,809 --> 00:29:28,480

there and then last but not least Jewish

638

00:29:26,710 --> 00:29:31,000

galaxies can better help us better

639

00:29:28,480 --> 00:29:33,430

understand star formation in general

640

00:29:31,000 --> 00:29:35,650

because we don't have those big spiral

641

00:29:33,430 --> 00:29:38,380

arms helping us out so we have to figure

642
00:29:35,650 --> 00:29:41,830
out new and creative ways to get started

643
00:29:38,380 --> 00:29:44,500
to forming your galaxy I also wanted to

644
00:29:41,829 --> 00:29:47,139
just plug astronomy on tap Baltimore

645
00:29:44,500 --> 00:29:50,140
which was mentioned earlier we have

646
00:29:47,140 --> 00:29:51,759
bimonthly events last Wednesday of every

647
00:29:50,140 --> 00:29:54,150
month so if you can't get enough

648
00:29:51,759 --> 00:29:58,089
astronomy join us at declined of all

649
00:29:54,150 --> 00:30:00,670
down in Hamden and probably saying that

650
00:29:58,089 --> 00:30:04,419
name terribly wrong but dkd as most

651
00:30:00,670 --> 00:30:06,580
people know it and we sit in a bar and

652
00:30:04,420 --> 00:30:08,769
we have astronomers like myself get up

653
00:30:06,579 --> 00:30:10,990
and give you talks while you have a nice

654
00:30:08,769 --> 00:30:14,349
drink and relax so it's a really fun

655
00:30:10,990 --> 00:30:16,269
setting I heard they're just adding food

656

00:30:14,349 --> 00:30:17,829
to their menu if you want a snack well

657
00:30:16,269 --> 00:30:20,230
you listen to astronomy talks but our

658
00:30:17,829 --> 00:30:22,359
next phone will be in September 25th and

659
00:30:20,230 --> 00:30:24,660
we have a Facebook group so you can look

660
00:30:22,359 --> 00:30:24,659
us up

661
00:30:32,900 --> 00:30:38,720
[Applause]

662
00:30:35,558 --> 00:30:42,079
and I believe we have plenty of time for

663
00:30:38,720 --> 00:30:44,509
questions so alright we're waiting for

664
00:30:42,079 --> 00:30:48,079
the lovely cube so people online can

665
00:30:44,509 --> 00:31:08,869
hear us one second just Thomas is making

666
00:30:48,079 --> 00:31:10,668
his way down so my question has to do

667
00:31:08,869 --> 00:31:13,819
with black hole formation and dwarf

668
00:31:10,669 --> 00:31:15,770
galaxies I don't even know if any form

669
00:31:13,819 --> 00:31:17,569
or not but if they do can you speak a

670
00:31:15,769 --> 00:31:19,849

little bit about black hole formation

671

00:31:17,569 --> 00:31:24,349

yeah so this used to be a very touchy

672

00:31:19,849 --> 00:31:28,969

subject of mine oh no it's good now the

673

00:31:24,349 --> 00:31:32,288

so the idea that every galaxy has a

674

00:31:28,970 --> 00:31:35,480

supermassive black hole is not correct

675

00:31:32,288 --> 00:31:38,629

however dwarf galaxies can certainly

676

00:31:35,480 --> 00:31:42,159

form black holes there's a lot of recent

677

00:31:38,630 --> 00:31:45,169

research into going going into trying to

678

00:31:42,159 --> 00:31:48,200

see how many of them have what's called

679

00:31:45,169 --> 00:31:50,990

intermediate black mass black holes so a

680

00:31:48,200 --> 00:31:55,700

supermassive black hole I think is about

681

00:31:50,990 --> 00:31:57,710

a million times the mass of our Sun but

682

00:31:55,700 --> 00:31:59,120

an intermediate mass black hole can be

683

00:31:57,710 --> 00:32:02,350

anywhere from a hundred times the mass

684

00:31:59,119 --> 00:32:05,089

of our Sun to about a million and

685
00:32:02,349 --> 00:32:07,519
they're trying to figure that out

686
00:32:05,089 --> 00:32:09,859
because we believe that dwarf galaxies

687
00:32:07,519 --> 00:32:11,990
can merge or used to in the past merge

688
00:32:09,859 --> 00:32:13,788
together to become bigger galaxies

689
00:32:11,990 --> 00:32:17,150
something like direct galaxies used to

690
00:32:13,788 --> 00:32:20,329
do that and so they want to see if they

691
00:32:17,150 --> 00:32:22,280
have themselves these seeds of black

692
00:32:20,329 --> 00:32:25,460
holes to create a bigger supermassive

693
00:32:22,279 --> 00:32:28,339
black hole and there is some evidence

694
00:32:25,460 --> 00:32:30,200
for it but it's very recent research so

695
00:32:28,339 --> 00:32:36,168
I can't speak too much to the details of

696
00:32:30,200 --> 00:32:38,740
it what causes galaxies to move like

697
00:32:36,169 --> 00:32:40,430
propelled or something like that

698
00:32:38,740 --> 00:32:43,400
[Music]

699
00:32:40,430 --> 00:32:46,009
do you mean move in themselves or move

700
00:32:43,400 --> 00:32:47,690
amongst each other just moving like the

701
00:32:46,009 --> 00:32:50,329
crashing at each other and they're

702
00:32:47,690 --> 00:32:52,730
disappearing from one another and that

703
00:32:50,329 --> 00:32:55,939
momentum comes from when they were

704
00:32:52,730 --> 00:32:58,910
forming so it there's lots of reasons

705
00:32:55,940 --> 00:33:01,400
section so for example if there's a big

706
00:32:58,910 --> 00:33:03,410
cluster of galaxies their gravity of

707
00:33:01,400 --> 00:33:05,080
monks each other causes them to move

708
00:33:03,410 --> 00:33:08,450
around each other

709
00:33:05,079 --> 00:33:10,579
and when they were forming maybe that

710
00:33:08,450 --> 00:33:12,230
gas that they formed from in the star

711
00:33:10,579 --> 00:33:14,869
the dark matter that they're formed from

712
00:33:12,230 --> 00:33:18,170
may have been moving also so that all

713

00:33:14,869 --> 00:33:20,569
has to do with where they formed and how

714
00:33:18,170 --> 00:33:25,310
fast their stuff that would they form

715
00:33:20,569 --> 00:33:29,169
from was moving and also the expansion

716
00:33:25,309 --> 00:33:29,169
of the universe but that's an extra step

717
00:33:30,339 --> 00:33:35,449
question about the age of dwarf galaxies

718
00:33:33,380 --> 00:33:40,370
are they generally younger or older than

719
00:33:35,450 --> 00:33:43,819
very very good question so people used

720
00:33:40,369 --> 00:33:46,069
to think that a lot of there is a subset

721
00:33:43,819 --> 00:33:48,829
of dwarf galaxies called blue compact

722
00:33:46,069 --> 00:33:51,259
dwarf galaxies that were very young and

723
00:33:48,829 --> 00:33:53,269
the reason they used to think that was

724
00:33:51,259 --> 00:33:55,430
because all we could see were their

725
00:33:53,269 --> 00:33:58,400
bright young stars because they had so

726
00:33:55,430 --> 00:34:00,830
many of them but eventually we found out

727
00:33:58,400 --> 00:34:03,440

they had this older stellar population

728

00:34:00,829 --> 00:34:05,720

that was just hiding behind these young

729

00:34:03,440 --> 00:34:10,190

stars so we think George galaxies

730

00:34:05,720 --> 00:34:14,750

generally tend to be older about you

731

00:34:10,190 --> 00:34:17,179

know as old as other galaxies but where

732

00:34:14,750 --> 00:34:19,280

there are a few galaxies that are young

733

00:34:17,179 --> 00:34:21,230

in this sense that they're they may be

734

00:34:19,280 --> 00:34:24,409

going through their first bursts of star

735

00:34:21,230 --> 00:34:25,940

formation so in that sense they're kind

736

00:34:24,409 --> 00:34:29,179

of young that they're just going through

737

00:34:25,940 --> 00:34:31,340

this first burst and you see dwarf

738

00:34:29,179 --> 00:34:33,740

galaxies mostly in the vicinity

739

00:34:31,340 --> 00:34:36,260

give me the further out you look do you

740

00:34:33,739 --> 00:34:38,599

still see the same frequency of them so

741

00:34:36,260 --> 00:34:41,600

it's actually hard to see them further

742
00:34:38,599 --> 00:34:44,779
out so we can't see them pretty far out

743
00:34:41,599 --> 00:34:47,480
but if you're talking cosmological

744
00:34:44,780 --> 00:34:49,700
distances which I do have some friends

745
00:34:47,480 --> 00:34:51,289
that work in that and we can't see them

746
00:34:49,699 --> 00:34:54,118
because they become too faint they're

747
00:34:51,289 --> 00:34:56,969
too dim we have a

748
00:34:54,119 --> 00:35:01,309
quick question online which anime is

749
00:34:56,969 --> 00:35:03,088
your animation from this is Cowboy Bebop

750
00:35:01,309 --> 00:35:07,609
Cowboy Bebop

751
00:35:03,088 --> 00:35:13,288
from the mushroom episode yeah I'm

752
00:35:07,608 --> 00:35:15,179
Edward a9 the you didn't mention the

753
00:35:13,289 --> 00:35:19,640
Magellanic Clouds are they considered

754
00:35:15,179 --> 00:35:22,230
Dwarfs I mean they're dwarf like that

755
00:35:19,639 --> 00:35:25,139
they're a little big but they are

756
00:35:22,230 --> 00:35:27,960
dwarfed within the limits of Dwarfs like

757
00:35:25,139 --> 00:35:32,998
sizes yeah so everything you talked

758
00:35:27,960 --> 00:35:34,889
about here would apply yeah yeah the

759
00:35:32,998 --> 00:35:38,068
Magellanic Clouds are a special case

760
00:35:34,889 --> 00:35:43,129
because they actually were in one of my

761
00:35:38,068 --> 00:35:47,579
images which is I said most of the light

762
00:35:43,130 --> 00:35:49,950
so the Magellanic Clouds are these two

763
00:35:47,579 --> 00:35:51,930
dots of light down here they're their

764
00:35:49,949 --> 00:35:54,118
special case because they're interacting

765
00:35:51,929 --> 00:35:57,659
with each other and the Milky Way so

766
00:35:54,119 --> 00:36:00,390
that interaction part of my talk does

767
00:35:57,659 --> 00:36:02,429
still work with them but it is a very

768
00:36:00,389 --> 00:36:04,288
complicated case because you have not

769
00:36:02,429 --> 00:36:07,940
only the milky way's gravity but each

770

00:36:04,289 --> 00:36:07,940
other's gravity pulling on them

771
00:36:19,280 --> 00:36:26,500
[Music]

772
00:36:28,010 --> 00:36:33,810
so this greenery is the older stars that

773
00:36:30,869 --> 00:36:36,179
I mentioned before so the older stars

774
00:36:33,809 --> 00:36:37,860
are not covered by the red part here

775
00:36:36,179 --> 00:36:39,929
which is the gas which is why you can

776
00:36:37,860 --> 00:36:43,200
see them so well because that gas has

777
00:36:39,929 --> 00:36:45,980
been stripped away from them so the

778
00:36:43,199 --> 00:36:51,059
glass is that is that like hydrogen

779
00:36:45,980 --> 00:36:52,920
hydrogen it's atomic hydrogen yeah it's

780
00:36:51,059 --> 00:36:55,219
the most common element in the universe

781
00:36:52,920 --> 00:36:57,960
so that's why we try to look at it

782
00:36:55,219 --> 00:37:00,899
worked out see some matters countable of

783
00:36:57,960 --> 00:37:03,119
Eduardo Custer's little custody equally

784
00:37:00,900 --> 00:37:05,700

old but they're all uniformly shaped

785

00:37:03,119 --> 00:37:07,259

they're all circles all these galaxies

786

00:37:05,699 --> 00:37:10,139

are irregular shape

787

00:37:07,260 --> 00:37:13,080

well I why are the galaxies irregular

788

00:37:10,139 --> 00:37:15,750

shape yes good um they don't have the

789

00:37:13,079 --> 00:37:17,190

gravity to hold a regular shape do they

790

00:37:15,750 --> 00:37:19,679

have the same mass as a globular cluster

791

00:37:17,190 --> 00:37:22,289

which is regular shape well I'm not

792

00:37:19,679 --> 00:37:23,759

quite sure how globular clusters form

793

00:37:22,289 --> 00:37:26,699

but my understanding is they've been

794

00:37:23,760 --> 00:37:28,680

through quite a lot of gravitational

795

00:37:26,699 --> 00:37:31,649

interaction which tends to form those

796

00:37:28,679 --> 00:37:35,039

more ball-like shapes that you see and

797

00:37:31,650 --> 00:37:38,190

globba their clusters whereas these guys

798

00:37:35,039 --> 00:37:39,960

since they're their own entities if they

799

00:37:38,190 --> 00:37:42,630
were interacting a lot with other

800

00:37:39,960 --> 00:37:44,880
galaxies they might form that same type

801

00:37:42,630 --> 00:37:47,610
of ball or football shape which is

802

00:37:44,880 --> 00:37:52,980
called an elliptical dwarf galaxy it's

803

00:37:47,610 --> 00:37:56,010
another type of galaxy this green and

804

00:37:52,980 --> 00:37:58,949
blue eyes others false colors yes okay

805

00:37:56,010 --> 00:38:02,460
so I - the others

806

00:37:58,949 --> 00:38:04,409
there's been no reason to include it to

807

00:38:02,460 --> 00:38:07,530
introduce any complexity between the

808

00:38:04,409 --> 00:38:09,359
dark matter and the visible matter you

809

00:38:07,530 --> 00:38:11,130
just assumed it always goes along

810

00:38:09,360 --> 00:38:13,260
exactly with so we have collision

811

00:38:11,130 --> 00:38:16,740
I mean ask me have you ever has there

812

00:38:13,260 --> 00:38:19,290
been any work on showing that there is

813
00:38:16,739 --> 00:38:21,329
no complexity they just do you have to

814
00:38:19,289 --> 00:38:25,029
assume no complexity it's for the dark

815
00:38:21,329 --> 00:38:27,190
matter yeah so the dark matter

816
00:38:25,030 --> 00:38:29,230
my work I just assume it's their kind of

817
00:38:27,190 --> 00:38:31,150
doing its thing but we do actually have

818
00:38:29,230 --> 00:38:33,730
little things members that work on the

819
00:38:31,150 --> 00:38:36,579
dark matter specifically and the shape

820
00:38:33,730 --> 00:38:39,039
of the dark matter and where it sits and

821
00:38:36,579 --> 00:38:40,569
that is very model dependent so there's

822
00:38:39,039 --> 00:38:42,699
still some ongoing work with dwarf

823
00:38:40,570 --> 00:38:44,430
galaxies in general trying to understand

824
00:38:42,699 --> 00:38:47,679
what their dark matter looks like and

825
00:38:44,429 --> 00:38:50,289
how the galaxies might sit in that

826
00:38:47,679 --> 00:38:56,619
potential while that gravity of the the

827

00:38:50,289 --> 00:39:02,759
Dark Matter we have another question on

828
00:38:56,619 --> 00:39:05,190
line what is the age of the Milky Way I

829
00:39:02,760 --> 00:39:11,830
don't know

830
00:39:05,190 --> 00:39:16,360
very old can you go back to the Loki way

831
00:39:11,829 --> 00:39:24,340
galaxy earth looking in and then to be

832
00:39:16,360 --> 00:39:26,769
conceptual review I know it's a good

833
00:39:24,340 --> 00:39:29,110
educated guess that the science thinks

834
00:39:26,769 --> 00:39:31,119
that's what our galaxy looks like but

835
00:39:29,110 --> 00:39:34,180
when we look at the previous picture

836
00:39:31,119 --> 00:39:37,210
what data are they working on or

837
00:39:34,179 --> 00:39:45,129
collecting to guess that it looks like a

838
00:39:37,210 --> 00:39:46,030
barred spiral with orange must be some

839
00:39:45,130 --> 00:39:49,240
work is with it

840
00:39:46,030 --> 00:39:51,310
Gaia Survey so they're actually trying

841
00:39:49,239 --> 00:39:55,629

to figure out exactly where stars are

842

00:39:51,309 --> 00:39:58,750

placed in our galaxy by measuring their

843

00:39:55,630 --> 00:40:00,340

distances and that's a lot of work and

844

00:39:58,750 --> 00:40:02,260

it's very ongoing but there are also

845

00:40:00,340 --> 00:40:04,510

other types of measurements to measure

846

00:40:02,260 --> 00:40:07,690

the location of our spiral arms for

847

00:40:04,510 --> 00:40:11,460

example in my undergraduate I did some

848

00:40:07,690 --> 00:40:16,659

research with a professor who took

849

00:40:11,460 --> 00:40:19,269

background objects so pulsars in our

850

00:40:16,659 --> 00:40:21,489

caves and we measured how their light

851

00:40:19,269 --> 00:40:23,590

rotated and this is a very complicated

852

00:40:21,489 --> 00:40:27,239

concept which I could do an entire talk

853

00:40:23,590 --> 00:40:30,100

on by itself but essentially you measure

854

00:40:27,239 --> 00:40:32,579

the polarization so you know how your

855

00:40:30,099 --> 00:40:34,779

sunglasses are polarized if you take two

856
00:40:32,579 --> 00:40:36,400
sunglasses and you that are polarized

857
00:40:34,780 --> 00:40:38,619
and you put them next to each other

858
00:40:36,400 --> 00:40:42,088
they'll block out all the light so

859
00:40:38,619 --> 00:40:47,818
that's a linear polarization up and down

860
00:40:42,088 --> 00:40:50,440
so if you try and measure how that

861
00:40:47,818 --> 00:40:52,690
polarization changes you can figure out

862
00:40:50,440 --> 00:40:56,469
how much stuff is between you and that

863
00:40:52,690 --> 00:40:58,599
light and sorry this is like not the

864
00:40:56,469 --> 00:41:04,838
most satisfactory explanation I'm sure

865
00:40:58,599 --> 00:41:06,400
but it it's called it's the rotation of

866
00:41:04,838 --> 00:41:07,900
the polarization and what it does is

867
00:41:06,400 --> 00:41:10,389
tells you how much stuff as I see you

868
00:41:07,900 --> 00:41:13,809
can measure exactly where you think the

869
00:41:10,389 --> 00:41:16,858
spiral arms are in your galaxy and it's

870
00:41:13,809 --> 00:41:16,859
a very complicated process

871
00:41:18,900 --> 00:41:28,509
you know they were able to from where

872
00:41:22,748 --> 00:41:29,939
that thing is they were able so they

873
00:41:28,509 --> 00:41:32,588
were able to figure out what's between

874
00:41:29,940 --> 00:41:35,979
that thing that we're looking at the

875
00:41:32,588 --> 00:41:38,018
background source and us so they're able

876
00:41:35,978 --> 00:41:43,868
to figure out what's how much stuff is

877
00:41:38,018 --> 00:41:46,929
in between there yeah in looking at the

878
00:41:43,869 --> 00:41:50,130
dwarf galaxies how does the tip of one

879
00:41:46,929 --> 00:41:52,929
compare in size to the Milky Way galaxy

880
00:41:50,130 --> 00:41:54,818
how does the which one the dwarf

881
00:41:52,929 --> 00:41:57,118
galaxies how does the have it how much

882
00:41:54,818 --> 00:42:00,759
smaller would they be in the Milky Way

883
00:41:57,119 --> 00:42:04,809
yeah so I put up one next to each other

884

00:42:00,759 --> 00:42:07,119
here so they're typically this dwarf

885
00:42:04,809 --> 00:42:10,119
galaxy here's one that I showed later on

886
00:42:07,119 --> 00:42:11,710
in my talk it's Markarian 178 the one

887
00:42:10,119 --> 00:42:12,460
that's possibly being Ram pressure

888
00:42:11,710 --> 00:42:15,599
stripping

889
00:42:12,460 --> 00:42:18,728
they're typically considered to be about

890
00:42:15,599 --> 00:42:22,559
125th the size of our Milky Way all the

891
00:42:18,728 --> 00:42:28,899
way up to 1/10 the size of our Milky Way

892
00:42:22,559 --> 00:42:31,119
thank you mm-hmm we have a question on

893
00:42:28,900 --> 00:42:35,700
line can you recommend some literature

894
00:42:31,119 --> 00:42:40,028
about Ram pressure stripping Alexei's Oh

895
00:42:35,699 --> 00:42:43,149
some literature so I must say I mostly

896
00:42:40,028 --> 00:42:46,869
read journal articles and that is not

897
00:42:43,150 --> 00:42:50,650
literature that most people want to read

898
00:42:46,869 --> 00:42:52,719

I I will say actually that recently just

899

00:42:50,650 --> 00:42:55,630

a few months ago we put out an article

900

00:42:52,719 --> 00:42:57,789

on Webb telescope gorg talking about how

901

00:42:55,630 --> 00:43:01,660

the James Webb Space Telescope will look

902

00:42:57,789 --> 00:43:03,190

at these exact systems so for the person

903

00:43:01,659 --> 00:43:04,989

online if you want to go to Webb

904

00:43:03,190 --> 00:43:08,230

telescope org search Ram pressure

905

00:43:04,989 --> 00:43:10,209

stripping Alexei's that will lead you

906

00:43:08,230 --> 00:43:18,309

into a whole cornucopia of literature I

907

00:43:10,210 --> 00:43:19,269

believe I also need to read those you

908

00:43:18,309 --> 00:43:26,079

can feel free to ask me questions

909

00:43:19,269 --> 00:43:28,420

afterwards too so I remember from

910

00:43:26,079 --> 00:43:31,210

decades ago that the somebody thought

911

00:43:28,420 --> 00:43:33,730

that the Sun was between arms and this

912

00:43:31,210 --> 00:43:37,030

and you now know from this picture I can

913
00:43:33,730 --> 00:43:39,490
see that we're on the unarmed alright I

914
00:43:37,030 --> 00:43:42,790
think we're close to an arm the Orion

915
00:43:39,489 --> 00:43:54,099
spur I don't know if our faculty on I

916
00:43:42,789 --> 00:43:55,599
would have to look up that article we

917
00:43:54,099 --> 00:43:57,880
hear regularly about how hard it is to

918
00:43:55,599 --> 00:43:59,289
get time and Hubble in time how hard was

919
00:43:57,880 --> 00:44:00,730
the Very Large Array which I know is

920
00:43:59,289 --> 00:44:02,259
looking for other things for you to get

921
00:44:00,730 --> 00:44:04,630
time on when you were there oh

922
00:44:02,260 --> 00:44:10,450
definitely not as hard as Hubble like

923
00:44:04,630 --> 00:44:13,809
that so the VLA it's it's not easy to

924
00:44:10,449 --> 00:44:15,579
get time on the VLA this is a beautiful

925
00:44:13,809 --> 00:44:18,960
picture of it that I showed earlier

926
00:44:15,579 --> 00:44:21,969
around but this is actually the VLA so

927
00:44:18,960 --> 00:44:24,340
it is still difficult to get time on it

928
00:44:21,969 --> 00:44:26,559
and the reason being especially because

929
00:44:24,340 --> 00:44:29,890
they just upgraded it so they made it a

930
00:44:26,559 --> 00:44:31,719
little bit better and that everyone now

931
00:44:29,889 --> 00:44:35,710
wants to use it because it's this big

932
00:44:31,719 --> 00:44:37,839
better machine but I don't know how

933
00:44:35,710 --> 00:44:39,940
oversubscribed it is I'd have to look up

934
00:44:37,840 --> 00:44:41,620
those numbers for you but I have tried a

935
00:44:39,940 --> 00:44:44,909
Hubble time and I find that's a lot

936
00:44:41,619 --> 00:44:44,909
harder to get yeah

937
00:44:49,530 --> 00:45:05,269
I think in general could we get an

938
00:44:55,139 --> 00:45:05,269
update on James Webb Space Telescope yes

939
00:45:06,079 --> 00:45:12,389
if you've got that let me know yes happy

940
00:45:10,349 --> 00:45:13,799
to do so that's actually why I'm all

941

00:45:12,389 --> 00:45:16,139
dressed up today is because we had folks

942
00:45:13,800 --> 00:45:18,210
from NASA headquarters come visit us and

943
00:45:16,139 --> 00:45:21,529
we had to brief them on what we're doing

944
00:45:18,210 --> 00:45:24,900
so the latest of the James Webb is that

945
00:45:21,530 --> 00:45:27,600
as I think it was today

946
00:45:24,900 --> 00:45:28,680
there was a successful deployment of the

947
00:45:27,599 --> 00:45:32,219
secondary mirror

948
00:45:28,679 --> 00:45:33,419
so they both the pieces of James Webb

949
00:45:32,219 --> 00:45:34,559
you can look at the model over there

950
00:45:33,420 --> 00:45:35,940
it's kind of turned on its side but

951
00:45:34,559 --> 00:45:38,279
there's the top part which is the

952
00:45:35,940 --> 00:45:39,840
optical element which has all of the

953
00:45:38,280 --> 00:45:41,400
mirrors that gather the light and all of

954
00:45:39,840 --> 00:45:43,050
the instruments that analyze the light

955
00:45:41,400 --> 00:45:45,210

and then you have the bottom part which

956

00:45:43,050 --> 00:45:47,820

is the Sun shield blocking the Sun and

957

00:45:45,210 --> 00:45:49,710

all with its infrared radiation and the

958

00:45:47,820 --> 00:45:52,110

spacecraft and so currently both of

959

00:45:49,710 --> 00:45:54,860

those are two big pieces they're sitting

960

00:45:52,110 --> 00:45:58,680

in California at the Northrop Grumman

961

00:45:54,860 --> 00:46:00,329

facility and they just did a test where

962

00:45:58,679 --> 00:46:01,710

they're not together yet but they're

963

00:46:00,329 --> 00:46:03,509

talking to each other so they just said

964

00:46:01,710 --> 00:46:06,150

a test where they deployed successfully

965

00:46:03,510 --> 00:46:07,740

the secondary mirror and got everything

966

00:46:06,150 --> 00:46:14,369

working and weightless and all that

967

00:46:07,739 --> 00:46:16,379

stuff and to mean you and me in the next

968

00:46:14,369 --> 00:46:20,069

are we still recording maybe I should be

969

00:46:16,380 --> 00:46:22,260

more discreet we are in the process of

970
00:46:20,070 --> 00:46:25,530
integrating the two halves of the

971
00:46:22,260 --> 00:46:29,190
observatory so sometime in the next few

972
00:46:25,530 --> 00:46:30,750
weeks we will be mating the the top half

973
00:46:29,190 --> 00:46:33,840
and the bottom half of the observatory

974
00:46:30,750 --> 00:46:37,320
that is the final integration step for

975
00:46:33,840 --> 00:46:39,480
the observatory then they actually take

976
00:46:37,320 --> 00:46:41,370
several weeks to connect all those wires

977
00:46:39,480 --> 00:46:45,059
and make the big thing and the big thing

978
00:46:41,369 --> 00:46:47,069
work nicely together and that's

979
00:46:45,059 --> 00:46:48,929
happening over the next month or two is

980
00:46:47,070 --> 00:46:51,120
that I think they actually touchdown

981
00:46:48,929 --> 00:46:52,529
sometime in the next week or two and

982
00:46:51,119 --> 00:46:54,989
then they'll be connecting all the wires

983
00:46:52,530 --> 00:46:56,850
everything should be all set and then

984
00:46:54,989 --> 00:46:59,489
later in the fall they put it all

985
00:46:56,849 --> 00:47:02,369
through the whole testing rigmarole a

986
00:46:59,489 --> 00:47:03,889
vacuum chamber and acoustic testing

987
00:47:02,369 --> 00:47:07,609
again

988
00:47:03,889 --> 00:47:09,579
and we are still set for a march 2021

989
00:47:07,610 --> 00:47:14,090
launch date that was my meeting today

990
00:47:09,579 --> 00:47:15,440
from French Guiana and if there's any

991
00:47:14,090 --> 00:47:17,210
other specific questions I'm happy to

992
00:47:15,440 --> 00:47:19,809
answer them but that's that's for James

993
00:47:17,210 --> 00:47:19,809
about this right now

994
00:47:20,949 --> 00:47:24,919
we only get one shot at this one so

995
00:47:23,510 --> 00:47:31,160
we're making sure that it's right the

996
00:47:24,920 --> 00:47:33,740
first time I have two questions for you

997
00:47:31,159 --> 00:47:36,529
the first one is are there any

998

00:47:33,739 --> 00:47:39,409
particular interactions between galaxies

999
00:47:36,530 --> 00:47:43,250
like our own and these draweth galaxies

1000
00:47:39,409 --> 00:47:46,699
like for instance do galaxies like ours

1001
00:47:43,250 --> 00:47:49,309
break up into small galaxies or do they

1002
00:47:46,699 --> 00:47:52,639
merge and become galaxies like ours or

1003
00:47:49,309 --> 00:47:54,860
are they totally independent so there's

1004
00:47:52,639 --> 00:47:57,710
many parts to that question of which are

1005
00:47:54,860 --> 00:48:00,200
it's a very good question so at the

1006
00:47:57,710 --> 00:48:04,010
beginning of the universe when galaxies

1007
00:48:00,199 --> 00:48:07,250
were just forming we think that dwarf

1008
00:48:04,010 --> 00:48:11,230
like galaxies existed and they combined

1009
00:48:07,250 --> 00:48:13,940
to make larger galaxies like our own now

1010
00:48:11,230 --> 00:48:16,730
there are still a lot of dwarfs left

1011
00:48:13,940 --> 00:48:20,599
over they in all like combine into these

1012
00:48:16,730 --> 00:48:25,880

and they may have formed later etc now

1013

00:48:20,599 --> 00:48:29,960

that the the Milky Way galaxy also has a

1014

00:48:25,880 --> 00:48:32,990

ton of dwarf galaxies around it and so

1015

00:48:29,960 --> 00:48:34,400

eventually it'll eat those galaxies and

1016

00:48:32,989 --> 00:48:39,649

it's currently in the process of eating

1017

00:48:34,400 --> 00:48:41,720

several galaxies one galaxy that I can

1018

00:48:39,650 --> 00:48:45,079

think of as the nearest galaxy to us

1019

00:48:41,719 --> 00:48:49,489

which is 25,000 light-years to earth and

1020

00:48:45,079 --> 00:48:52,639

it is the Canis Major dwarf and that is

1021

00:48:49,489 --> 00:48:56,269

just being torn apart by the Milky Way

1022

00:48:52,639 --> 00:48:58,250

and we it's possible now I'm not quite

1023

00:48:56,269 --> 00:49:02,619

sure where the research is on this but

1024

00:48:58,250 --> 00:49:05,389

that galaxy may have left three rings

1025

00:49:02,619 --> 00:49:08,150

around the Milky Way from going around

1026

00:49:05,389 --> 00:49:09,920

at three times so it's just being torn

1027
00:49:08,150 --> 00:49:12,079
apart by the Milky Way and it eventually

1028
00:49:09,920 --> 00:49:14,570
will merge with it and make the Milky

1029
00:49:12,079 --> 00:49:15,578
Way more massive does that answer your

1030
00:49:14,570 --> 00:49:18,338
question yes

1031
00:49:15,579 --> 00:49:21,640
but the other question I have it is this

1032
00:49:18,338 --> 00:49:23,798
in comparison of the large galaxies and

1033
00:49:21,639 --> 00:49:26,708
small galaxies if you think the

1034
00:49:23,798 --> 00:49:29,288
aggregate of the drop galaxies that are

1035
00:49:26,708 --> 00:49:31,358
within our region you said that you can

1036
00:49:29,289 --> 00:49:33,369
only see but so far away and see dwarf

1037
00:49:31,358 --> 00:49:35,889
galaxies but if you take that region

1038
00:49:33,369 --> 00:49:38,440
that you can see like how many stars

1039
00:49:35,889 --> 00:49:40,538
might be in dropped Alexei's and how

1040
00:49:38,440 --> 00:49:43,479
many would be in large galaxies like our

1041
00:49:40,539 --> 00:49:45,609
own like a 10% of them only in drunk

1042
00:49:43,478 --> 00:49:48,068
galaxies or do they make up more like

1043
00:49:45,608 --> 00:49:49,478
50% of all I don't know I would have to

1044
00:49:48,068 --> 00:49:51,369
look that up that's a really good

1045
00:49:49,478 --> 00:49:53,348
question I have not done that math yet

1046
00:49:51,369 --> 00:49:55,420
because I would have to figure out how

1047
00:49:53,349 --> 00:49:57,489
many galaxies we know of nearby and then

1048
00:49:55,420 --> 00:49:58,900
figure out their approximate masses and

1049
00:49:57,489 --> 00:49:59,259
then add them up I would have to look

1050
00:49:58,900 --> 00:50:01,420
that up

1051
00:49:59,259 --> 00:50:04,239
yeah the feeling for whether they have a

1052
00:50:01,420 --> 00:50:06,999
significant number of stars I mean I I

1053
00:50:04,239 --> 00:50:14,108
don't know yeah I would have I have no

1054
00:50:06,998 --> 00:50:16,629
idea so is anybody studying the

1055

00:50:14,108 --> 00:50:21,159
formation of solar systems within the

1056
00:50:16,630 --> 00:50:24,039
dwarf galaxies we do not have the

1057
00:50:21,159 --> 00:50:27,639
technology as far as I know to go out

1058
00:50:24,039 --> 00:50:29,920
that far because Kepler can only see so

1059
00:50:27,639 --> 00:50:32,528
far out so we're mainly looking in our

1060
00:50:29,920 --> 00:50:34,479
own galaxy for solar systems the Milky

1061
00:50:32,528 --> 00:50:35,228
Way we can barely study them in our own

1062
00:50:34,478 --> 00:50:38,439
galaxy

1063
00:50:35,228 --> 00:50:46,179
um I studied proprietary disks plane of

1064
00:50:38,440 --> 00:50:51,630
formation only in our galaxy yeah and

1065
00:50:46,179 --> 00:50:51,629
only within several hundred light years

1066
00:50:56,070 --> 00:51:01,620
is the technology to look at other

1067
00:50:58,110 --> 00:51:04,530
galaxies for capillary like they're just

1068
00:51:01,619 --> 00:51:07,469
this yeah it is anything that's in other

1069
00:51:04,530 --> 00:51:11,040

galaxies well we can see the stars in

1070

00:51:07,469 --> 00:51:12,659

them and we can see the gas but in terms

1071

00:51:11,039 --> 00:51:15,690

of Kepler I would assume we're pretty

1072

00:51:12,659 --> 00:51:17,909

far off by the sounds of it so looking

1073

00:51:15,690 --> 00:51:28,110

at solar systems and other galaxies

1074

00:51:17,909 --> 00:51:31,529

we're quite far off any other questions

1075

00:51:28,110 --> 00:51:34,610

first speaker all right well let's give

1076

00:51:31,530 --> 00:51:34,610

her a huge round of applause

1077

00:51:39,889 --> 00:51:44,308

Thank You dr. Ashley and thank you all

1078

00:51:42,809 --> 00:51:46,109

for coming I appreciate your support

1079

00:51:44,309 --> 00:51:49,259

very glad you're so invested in

1080

00:51:46,108 --> 00:51:51,150

astronomy as are we and again if you are

1081

00:51:49,259 --> 00:51:54,329

interested in going on the observatory

1082

00:51:51,150 --> 00:51:57,269

tour in a few minutes just meet up here

1083

00:51:54,329 --> 00:51:59,910

and you will be guided by Eleni from

1084
00:51:57,268 --> 00:52:02,028
Johns Hopkins thank you have a good

1085
00:51:59,909 --> 00:52:02,028
evening