
AbSciCon
2017
MESA, ARIZONA

1
00:00:12,250 --> 00:00:06,150
you

2
00:00:16,000 --> 00:00:14,129
[Music]

3
00:00:17,560 --> 00:00:16,010
well first I'd like to thank my

4
00:00:18,700 --> 00:00:17,570
conference organizers for giving me the

5
00:00:20,380 --> 00:00:18,710
opportunity to speak with you today

6
00:00:22,480 --> 00:00:20,390
about some of my thesis research and

7
00:00:25,390 --> 00:00:22,490
low-mass stars and containing this trend

8
00:00:30,160 --> 00:00:25,400
of basically learning more about the

9
00:00:31,540 --> 00:00:30,170
m-dwarf population and this is doing and

10
00:00:32,470 --> 00:00:31,550
I'd also like to take a moment to

11
00:00:36,220 --> 00:00:32,480
acknowledge my collaborators on this

12
00:00:38,680 --> 00:00:36,230
project as well okay so first off as

13
00:00:39,939 --> 00:00:38,690

we've heard M Norris are really forming

14
00:00:42,460 --> 00:00:39,949
the dominant constituent of the sellout

15
00:00:44,850 --> 00:00:42,470
of population and this is visualized

16
00:00:46,720 --> 00:00:44,860
here on the right and a snapshot from a

17
00:00:49,270 --> 00:00:46,730
graphic from a drew Cordell and the

18
00:00:51,160 --> 00:00:49,280
recons team of the solar neighborhood so

19
00:00:52,959 --> 00:00:51,170
looking at the 25 parsecs with our Sun

20
00:00:55,240 --> 00:00:52,969
here at the center showing the over 20

21
00:00:56,799 --> 00:00:55,250
over 75 percent of the stars in our

22
00:00:58,959 --> 00:00:56,809
solar neighborhood are these low mass M

23
00:01:00,610 --> 00:00:58,969
dwarf stars and that we and as we've

24
00:01:02,170 --> 00:01:00,620
heard already this week there's great

25
00:01:04,090 --> 00:01:02,180
intrinsic interest in understanding the

26
00:01:05,499 --> 00:01:04,100
planet properties of these stars as well

27
00:01:07,090 --> 00:01:05,509
as investigating and assessing their

28
00:01:09,570 --> 00:01:07,100
however will zones and intrinsic

29
00:01:11,950 --> 00:01:09,580
properties so one of the things that

30
00:01:13,630 --> 00:01:11,960
despite the the great abundance

31
00:01:15,279 --> 00:01:13,640
preponderance of these low mass stars

32
00:01:16,359 --> 00:01:15,289
there's still a lot that we haven't

33
00:01:18,130 --> 00:01:16,369
learned yet about their binary

34
00:01:19,870 --> 00:01:18,140
properties the properties of their pro

35
00:01:21,850 --> 00:01:19,880
planetary discs and the platforming

36
00:01:23,620 --> 00:01:21,860
potential of these systems and so of

37
00:01:25,390 --> 00:01:23,630
course all of these three key aspects

38
00:01:26,760 --> 00:01:25,400

play into what we can understand about

39
00:01:29,249 --> 00:01:26,770
the habitable zones when these systems

40
00:01:31,179 --> 00:01:29,259
the disk truncation that might be

41
00:01:33,100 --> 00:01:31,189
altered by the presence of a binary

42
00:01:35,109 --> 00:01:33,110
companion the content of the disks

43
00:01:36,850 --> 00:01:35,119
youselves and a dynamical history and

44
00:01:38,800 --> 00:01:36,860
evolution and interplay between the star

45
00:01:40,179 --> 00:01:38,810
the disk and planet and so to

46
00:01:44,200 --> 00:01:40,189
investigate this today I'm going to be

47
00:01:46,990 --> 00:01:44,210
talking about two main results so there

48
00:01:49,480 --> 00:01:47,000
we go one field m-dwarf multiplicity so

49
00:01:51,370 --> 00:01:49,490
we're looking at just this interior 15

50
00:01:53,109 --> 00:01:51,380
parsec region of the closest brightest m

51
00:01:54,969 --> 00:01:53,119
dwarf to measure their binary properties

52
00:01:56,620 --> 00:01:54,979
and then we're going to move outward to

53
00:01:57,940 --> 00:01:56,630
the tourist star forming region one

54
00:01:59,260 --> 00:01:57,950
hundred and forty parts like distant

55
00:02:01,090 --> 00:01:59,270
which is about one to two million years

56
00:02:03,340 --> 00:02:01,100
old to understand the protoplanetary

57
00:02:06,700 --> 00:02:03,350
disk properties of much younger analog

58
00:02:09,340 --> 00:02:06,710
systems so starting off of the binaries

59
00:02:12,370 --> 00:02:09,350
the first thing that I talk about is our

60
00:02:14,920 --> 00:02:12,380
M dwarfs in multiples or mm survey so

61
00:02:17,229 --> 00:02:14,930
this is a volume limited survey of 245

62
00:02:19,539 --> 00:02:17,239
stars within fifteen parsecs and we can

63
00:02:21,920 --> 00:02:19,549

see that plotted here on this these are

64
00:02:24,050 --> 00:02:21,930
all about 500 stars

65
00:02:25,760 --> 00:02:24,060
within 15 parsecs of the Sun from the

66
00:02:27,440 --> 00:02:25,770
Hipparchus satellite we're looking at

67
00:02:29,060 --> 00:02:27,450
the brightness and V magnitude versus

68
00:02:31,220 --> 00:02:29,070
the color and we're focusing on this

69
00:02:33,230 --> 00:02:31,230
region here of the early M dwarf stars

70
00:02:34,820 --> 00:02:33,240
and the early to mid M dwarfs also have

71
00:02:36,200 --> 00:02:34,830
a nice match with the target selection

72
00:02:37,760 --> 00:02:36,210
that will be upcoming for for example

73
00:02:39,920 --> 00:02:37,770
the test mission which will look at the

74
00:02:41,840 --> 00:02:39,930
nearest brightest M stars with this

75
00:02:43,970 --> 00:02:41,850
population we're searching for stellar

76
00:02:45,740 --> 00:02:43,980
and sub speller companions so looking

77
00:02:47,600 --> 00:02:45,750
for binaries with orbital separations

78
00:02:49,880 --> 00:02:47,610
from about one of you all the way up to

79
00:02:51,590 --> 00:02:49,890
10,000 au and we're doing this with a

80
00:02:54,710 --> 00:02:51,600
combination of multi epoch imaging

81
00:02:56,900 --> 00:02:54,720
approaches so we have high-resolution

82
00:02:58,760 --> 00:02:56,910
archival high-resolution new and

83
00:03:00,800 --> 00:02:58,770
archival adaptive optics imaging and

84
00:03:02,750 --> 00:03:00,810
this lets us look very close in from

85
00:03:04,940 --> 00:03:02,760
about 1 to 100 au for close binary

86
00:03:07,280 --> 00:03:04,950
companions and we complement this with

87
00:03:09,560 --> 00:03:07,290
our tribal wide field plate imaging from

88
00:03:11,300 --> 00:03:09,570

a historic digitized surveys that really

89
00:03:14,360 --> 00:03:11,310
give us about more than 50 years of

90
00:03:18,080 --> 00:03:14,370
baseline to find comoving wide objects

91
00:03:19,850 --> 00:03:18,090
out to ten thousand eight so shown here

92
00:03:21,470 --> 00:03:19,860
we can see some of the example companion

93
00:03:23,720 --> 00:03:21,480
systems with a variety of architectures

94
00:03:26,630 --> 00:03:23,730
mass ratios between the primary and

95
00:03:28,610 --> 00:03:26,640
companion star and of this 245 stars we

96
00:03:31,520 --> 00:03:28,620
find about 65 of them have comoving

97
00:03:33,350 --> 00:03:31,530
stellar companions ranging from as close

98
00:03:35,900 --> 00:03:33,360
as about point Q all the way out to

99
00:03:37,820 --> 00:03:35,910
about 2500 au and on the right we're

100
00:03:39,890 --> 00:03:37,830
looking at our survey sensitivity so

101
00:03:41,420 --> 00:03:39,900
this is the mass in solar masses of a

102
00:03:43,160 --> 00:03:41,430
companion that we could detect in our

103
00:03:44,510 --> 00:03:43,170
imaging survey you can see that we get

104
00:03:46,310 --> 00:03:44,520
all the way down to the bottom of the

105
00:03:49,220 --> 00:03:46,320
main sequence so the transition between

106
00:03:51,500 --> 00:03:49,230
hydrogen burning stars to brown dwarfs

107
00:03:54,440 --> 00:03:51,510
and planets and then we are sensitive to

108
00:03:55,730 --> 00:03:54,450
about 3 au with a by 106 there's an

109
00:03:58,940 --> 00:03:55,740
almost hundred percent completeness to

110
00:04:01,520 --> 00:03:58,950
finding companions in this range so we

111
00:04:02,900 --> 00:04:01,530
can take these binary detection and we

112
00:04:05,120 --> 00:04:02,910
can start to look at kind of aggregate

113
00:04:06,740 --> 00:04:05,130

population properties of our nearest m

114
00:04:08,150 --> 00:04:06,750
dwarf neighbors and so what we're

115
00:04:09,830 --> 00:04:08,160
looking at here is the separation

116
00:04:12,410 --> 00:04:09,840
distribution so this is just a histogram

117
00:04:14,420 --> 00:04:12,420
of the fraction of systems as a function

118
00:04:17,150 --> 00:04:14,430
of the separation of the systems in the

119
00:04:19,310 --> 00:04:17,160
AU and what I want to take it like the

120
00:04:21,260 --> 00:04:19,320
take away home take a waypoint here to

121
00:04:22,850 --> 00:04:21,270
be is that the closer orbital

122
00:04:25,310 --> 00:04:22,860
separations are found with these lower

123
00:04:27,800 --> 00:04:25,320
mass primary stars so if we start with a

124
00:04:29,870 --> 00:04:27,810
type stars in about 300 au is where we

125
00:04:32,719 --> 00:04:29,880
find the typical binary separation if we

126
00:04:34,410 --> 00:04:32,729
move inward to solar-type fgk stars then

127
00:04:35,850 --> 00:04:34,420
it's about 30 au and

128
00:04:37,680 --> 00:04:35,860
you can see in our read mr. Graham here

129
00:04:39,720 --> 00:04:37,690
we actually don't see the population

130
00:04:41,610 --> 00:04:39,730
turnover but we see the bulk of the

131
00:04:43,650 --> 00:04:41,620
binaries are at this sort of six to ten

132
00:04:48,180 --> 00:04:43,660
au separation range so very very close

133
00:04:49,890 --> 00:04:48,190
tight binary systems we can then take

134
00:04:51,480 --> 00:04:49,900
our population and look at just a

135
00:04:54,540 --> 00:04:51,490
fraction of systems that have binary as

136
00:04:56,100 --> 00:04:54,550
all and so what we're looking at here is

137
00:04:57,570 --> 00:04:56,110
the companion star fraction as a

138
00:04:59,970 --> 00:04:57,580

function of primary mass so the most

139
00:05:01,590 --> 00:04:59,980
massive stars here solar-type stars are

140
00:05:04,380 --> 00:05:01,600
new I'm dwarf points and then the brown

141
00:05:06,480 --> 00:05:04,390
dwarf population and what we see is that

142
00:05:07,980 --> 00:05:06,490
we have decreasing multiplicities with

143
00:05:11,000 --> 00:05:07,990
decreasing primary mess well me about

144
00:05:14,010 --> 00:05:11,010
23% of M dwarfs have binary companions

145
00:05:16,110 --> 00:05:14,020
but what we're really looking at here is

146
00:05:17,490 --> 00:05:16,120
that we have fewer binary systems the

147
00:05:18,870 --> 00:05:17,500
ones that we do have are much much

148
00:05:20,460 --> 00:05:18,880
closer and this is of course going to

149
00:05:21,960 --> 00:05:20,470
have really important dynamical

150
00:05:23,850 --> 00:05:21,970
interactions with the extent of the

151
00:05:26,480 --> 00:05:23,860
habitable zone dynamical interaction

152
00:05:29,130 --> 00:05:26,490
between the disk and planets

153
00:05:31,320 --> 00:05:29,140
okay so we're going to move outward now

154
00:05:32,610 --> 00:05:31,330
140 parsecs distant to the torah' star

155
00:05:34,830 --> 00:05:32,620
forming region shown in the background

156
00:05:37,080 --> 00:05:34,840
here and what we wanted to do here was

157
00:05:39,120 --> 00:05:37,090
really understand the dust inventory

158
00:05:40,560 --> 00:05:39,130
within disks of these analog systems

159
00:05:43,410 --> 00:05:40,570
that are much younger around low-mass

160
00:05:44,910 --> 00:05:43,420
stars and what we wanted to be able to

161
00:05:46,920 --> 00:05:44,920
do with these measurements of the disk

162
00:05:48,870 --> 00:05:46,930
mass within the planetary disc is kind

163
00:05:50,700 --> 00:05:48,880

of get a handle on the planet forming

164
00:05:52,170 --> 00:05:50,710
potential of M dwarfs and how that might

165
00:05:54,450 --> 00:05:52,180
compare to that of higher mass stars

166
00:05:55,560 --> 00:05:54,460
then we can take those properties and we

167
00:05:57,180 --> 00:05:55,570
can try to understand how they might

168
00:06:01,530 --> 00:05:57,190
vary with the mass of the central star

169
00:06:03,480 --> 00:06:01,540
the region age and environment and so

170
00:06:05,460 --> 00:06:03,490
this is part of an ongoing survey the

171
00:06:09,000 --> 00:06:05,470
torus boundary is substellar or T Buster

172
00:06:10,920 --> 00:06:09,010
race and was started in 2014 we took far

173
00:06:12,720 --> 00:06:10,930
infrared detection of the lowest mass

174
00:06:14,390 --> 00:06:12,730
stars the latest M dwarfs and brown

175
00:06:17,070 --> 00:06:14,400
dwarfs in this young star forming region

176
00:06:18,600 --> 00:06:17,080
with known for our detections we know

177
00:06:21,240 --> 00:06:18,610
that they have protoplanetary disks and

178
00:06:23,310 --> 00:06:21,250
we followed them up with Alma 885 micron

179
00:06:25,050 --> 00:06:23,320
continuum observations and these really

180
00:06:27,150 --> 00:06:25,060
give us a handle on the submillimetre

181
00:06:30,210 --> 00:06:27,160
emission from the dust grains in the

182
00:06:31,680 --> 00:06:30,220
propietary disk systems and show here is

183
00:06:33,570 --> 00:06:31,690
that the population that we're looking

184
00:06:38,120 --> 00:06:33,580
at this time spans the breadth of the

185
00:06:44,480 --> 00:06:40,670
okay so what we found from the survey of

186
00:06:46,220 --> 00:06:44,490
24 targets which include 10-round or

187
00:06:48,200 --> 00:06:46,230
systems and twelve very low mass star

188
00:06:50,450 --> 00:06:48,210

systems is that we have 22 detections

189
00:06:53,900 --> 00:06:50,460
which is really quite a surprise these

190
00:06:55,790 --> 00:06:53,910
objects are so faint and young and the

191
00:06:57,230 --> 00:06:55,800
disks where the properties are pretty

192
00:06:59,000 --> 00:06:57,240
uncertain before we were able to use the

193
00:07:01,610 --> 00:06:59,010
sensitivity of allness to measure the

194
00:07:03,530 --> 00:07:01,620
disk the disk dust masses in these

195
00:07:04,970 --> 00:07:03,540
systems and so what we're looking at

196
00:07:07,070 --> 00:07:04,980
here is an example detection this is

197
00:07:09,470 --> 00:07:07,080
just the spectral energy distribution so

198
00:07:10,940 --> 00:07:09,480
the flux at different wavelengths in

199
00:07:12,590 --> 00:07:10,950
microns and so we see the contribution

200
00:07:14,900 --> 00:07:12,600
from the star here the tell-tale

201
00:07:16,340 --> 00:07:14,910
signature of a disk around the system

202
00:07:18,350 --> 00:07:16,350
and the new alma measurement here and

203
00:07:21,230 --> 00:07:18,360
something else you can see is that this

204
00:07:22,670 --> 00:07:21,240
is our beam size the resolving capacity

205
00:07:24,320 --> 00:07:22,680
of the all mobster patient's to

206
00:07:25,220 --> 00:07:24,330
understand the extent of the emission in

207
00:07:26,450 --> 00:07:25,230
the disk and you can see that we're

208
00:07:28,070 --> 00:07:26,460
actually starting to resolve these

209
00:07:30,680 --> 00:07:28,080
systems and get a handle on what the

210
00:07:31,760 --> 00:07:30,690
disk sizes are actually and so what we

211
00:07:33,350 --> 00:07:31,770
can do with these submillimetre

212
00:07:35,780 --> 00:07:33,360
continuum flexes is we hear a little bit

213
00:07:37,340 --> 00:07:35,790

before is we can use these to estimate

214
00:07:39,560 --> 00:07:37,350
the mass of dust and submillimetre

215
00:07:41,210 --> 00:07:39,570
grains for these lowest mass systems we

216
00:07:43,580 --> 00:07:41,220
find that they range from about 0.3 to

217
00:07:46,670 --> 00:07:43,590
22 earth masses in total of some

218
00:07:48,200 --> 00:07:46,680
millimetre greens so we can visualize

219
00:07:49,640 --> 00:07:48,210
this and I'll step through kind of

220
00:07:50,420 --> 00:07:49,650
everything that's going on this plot one

221
00:07:52,400 --> 00:07:50,430
step at a time

222
00:07:55,580 --> 00:07:52,410
right here we're looking at the disk

223
00:07:57,830 --> 00:07:55,590
dust mass in Earth masses so 110 100 as

224
00:08:00,140 --> 00:07:57,840
a function of the disco stellar mass in

225
00:08:02,930 --> 00:08:00,150
solar masses so we have the solar type

226
00:08:04,490 --> 00:08:02,940
FG k stars here we've got the M dwarfs

227
00:08:06,530 --> 00:08:04,500
that really span a broad range of

228
00:08:09,380 --> 00:08:06,540
stellar masses and the brown dwarf

229
00:08:11,540 --> 00:08:09,390
regime demarcate adhere the red points

230
00:08:13,670 --> 00:08:11,550
are our new observations from Alma and

231
00:08:15,230 --> 00:08:13,680
the background points are the what was

232
00:08:17,150 --> 00:08:15,240
previously known for the rest of torus

233
00:08:18,560 --> 00:08:17,160
for the higher mass population can see

234
00:08:20,650 --> 00:08:18,570
that we're extending this well into the

235
00:08:22,910 --> 00:08:20,660
brown dwarf regime with these detection

236
00:08:24,560 --> 00:08:22,920
also plotted here for reference

237
00:08:27,050 --> 00:08:24,570
comparison in high Smulders talkie

238
00:08:29,930 --> 00:08:27,060

tooter are the heavy element masses that

239
00:08:32,390 --> 00:08:29,940
are metric from the capillarity km stars

240
00:08:34,820 --> 00:08:32,400
and what we've shown up here to kind of

241
00:08:35,990 --> 00:08:34,830
guide the eye is an estimate of what the

242
00:08:39,740 --> 00:08:36,000
minimum a solar nebula

243
00:08:41,000 --> 00:08:39,750
should be so we're saying that from what

244
00:08:43,159 --> 00:08:41,010
we know about the solar system what's

245
00:08:44,930 --> 00:08:43,169
required to form Jupiter and the planets

246
00:08:47,450 --> 00:08:44,940
in our solar system if you estimate that

247
00:08:50,810 --> 00:08:47,460
to be about 30 earth masses were suggest

248
00:08:52,580 --> 00:08:50,820
then you can demarcate this regime as

249
00:08:54,500 --> 00:08:52,590
whether or not your disks actually have

250
00:08:56,750 --> 00:08:54,510
enough solid material to kind of make it

251
00:08:59,000 --> 00:08:56,760
into this into this region and what we

252
00:09:00,350 --> 00:08:59,010
see is that the early under worse and of

253
00:09:02,390 --> 00:09:00,360
course the fgk stars are making into

254
00:09:04,310 --> 00:09:02,400
this region but due to this decline in

255
00:09:06,440 --> 00:09:04,320
dust masses we go to the lowest mass Co

256
00:09:07,790 --> 00:09:06,450
stars the lower mass M dwarfs and brown

257
00:09:09,770 --> 00:09:07,800
dwarfs really aren't making it up into

258
00:09:12,050 --> 00:09:09,780
this regime and this is providing some

259
00:09:14,000 --> 00:09:12,060
signature potentially explaining why

260
00:09:16,070 --> 00:09:14,010
direct imaging surveys have looked have

261
00:09:18,350 --> 00:09:16,080
really focused on the lowest mass M

262
00:09:21,110 --> 00:09:18,360
dwarfs to find directly imaged Jupiter

263
00:09:22,550 --> 00:09:21,120

analogues but it's been very very

264
00:09:23,900 --> 00:09:22,560
difficult to find movies directly image

265
00:09:27,440 --> 00:09:23,910
giant planets around the lowest mass

266
00:09:28,880 --> 00:09:27,450
stars and for reference because we're

267
00:09:30,770 --> 00:09:28,890
all very keen on understanding where

268
00:09:33,530 --> 00:09:30,780
Trappist 1 and similar systems these

269
00:09:35,420 --> 00:09:33,540
exciting new transiting m dwarf

270
00:09:37,880 --> 00:09:35,430
exoplanet systems live chopped this one

271
00:09:39,380 --> 00:09:37,890
is right here at the brown dwarf brown

272
00:09:41,570 --> 00:09:39,390
dwarfs regime and if you take the

273
00:09:43,610 --> 00:09:41,580
estimated masses and the planets from

274
00:09:45,710 --> 00:09:43,620
the most recent papers you can see it

275
00:09:47,540 --> 00:09:45,720
kind of fits here sort of at the top of

276
00:09:49,940 --> 00:09:47,550
that envelope so this is giving us some

277
00:09:51,170 --> 00:09:49,950
idea of maybe starting to look into

278
00:09:53,840 --> 00:09:51,180
things like planet formation if this

279
00:09:58,010 --> 00:09:53,850
efficiency of the dust masses into

280
00:09:59,870 --> 00:09:58,020
planetary bodies and one more thing that

281
00:10:02,030 --> 00:09:59,880
we can do with these data is we can look

282
00:10:03,590 --> 00:10:02,040
at comparison between the very young 1

283
00:10:05,570 --> 00:10:03,600
million year old tourists are from your

284
00:10:08,000 --> 00:10:05,580
region and that of upper Scorpius which

285
00:10:09,620 --> 00:10:08,010
is in the 510 million range and so we're

286
00:10:10,970 --> 00:10:09,630
looking at here again is the same axis

287
00:10:13,040 --> 00:10:10,980
Deaf's mass and Earth's mass earth

288
00:10:15,020 --> 00:10:13,050

masses versus the mass of the star the

289
00:10:16,700 --> 00:10:15,030
red points are all of the young Taurus

290
00:10:19,160 --> 00:10:16,710
populations and then these older

291
00:10:21,650 --> 00:10:19,170
population is shown here in teal points

292
00:10:22,820 --> 00:10:21,660
for older for schoo population and what

293
00:10:25,730 --> 00:10:22,830
we can see is there's about a factor of

294
00:10:26,990 --> 00:10:25,740
3 decrease in the dust mask content from

295
00:10:29,030 --> 00:10:27,000
1 million years to about 10 million

296
00:10:31,040 --> 00:10:29,040
years and so this is giving us some idea

297
00:10:32,930 --> 00:10:31,050
about potential time skills for planet

298
00:10:34,400 --> 00:10:32,940
formation as these submillimetre grains

299
00:10:37,430 --> 00:10:34,410
are converted into potentially larger

300
00:10:38,990 --> 00:10:37,440
bodies and also on I suggest that you

301
00:10:39,920 --> 00:10:39,000
look forward to Ilario stock where she's

302
00:10:42,080 --> 00:10:39,930
going to be doing more of these

303
00:10:46,070 --> 00:10:42,090
comparisons with other types of star

304
00:10:47,870 --> 00:10:46,080
forming regions okay so in summary from

305
00:10:50,690 --> 00:10:47,880
these two investigations into low mass

306
00:10:52,130 --> 00:10:50,700
stars we have the binary occurrence is

307
00:10:53,900 --> 00:10:52,140
lower for M dwarfs but they're closer

308
00:10:55,520 --> 00:10:53,910
and this is going to have important

309
00:10:57,470 --> 00:10:55,530
impact on our understanding of the

310
00:10:58,940 --> 00:10:57,480
properties of these systems if we go to

311
00:11:01,010 --> 00:10:58,950
the younger population and do some

312
00:11:02,210 --> 00:11:01,020
investigations in the submillimetre we

313
00:11:03,980 --> 00:11:02,220

see that there's not only the stuff

314
00:11:05,810 --> 00:11:03,990
depletion but we see significant

315
00:11:07,639 --> 00:11:05,820
we've decreased dust masses for the

316
00:11:09,410 --> 00:11:07,649
lowest mass stars and brown dwarfs and

317
00:11:10,910 --> 00:11:09,420
maybe this is helping us understand

318
00:11:13,490 --> 00:11:10,920
what's happening in terms of the giant

319
00:11:15,199 --> 00:11:13,500
planet population as well as what's

320
00:11:16,670 --> 00:11:15,209
going on for the younger analog

321
00:11:25,639 --> 00:11:16,680
environments for systems like Trappist

322
00:11:29,920 --> 00:11:25,649
thank you for your time all right we

323
00:11:45,280 --> 00:11:38,240
three minutes in fact please come to the

324
00:11:50,600 --> 00:11:48,590
Maggie toka Alera Pascucci I wanted to

325
00:11:52,610 --> 00:11:50,610
know when you say that to resolve the

326
00:11:55,699 --> 00:11:52,620
Browns of disks with Alma what was the

327
00:11:59,630 --> 00:11:55,709
beam that you had a beam was about point

328
00:12:01,850 --> 00:11:59,640
three 2.4 arc seconds and you always

329
00:12:03,470 --> 00:12:01,860
resolve the disc where you see origamis

330
00:12:04,850 --> 00:12:03,480
some are resolving some are unresolved

331
00:12:06,829 --> 00:12:04,860
and a quite a fear in this kind of

332
00:12:09,199 --> 00:12:06,839
marginal regime where they're only just

333
00:12:12,079 --> 00:12:09,209
resolved in the uv-plane okay all right

334
00:12:15,560 --> 00:12:12,089
so you can give a percentage erina Amish

335
00:12:17,150 --> 00:12:15,570
oh the fraction of systems um let's see

336
00:12:19,010 --> 00:12:17,160
it was actually a bit surprising that

337
00:12:20,690 --> 00:12:19,020
both the brown dwarfs and M dwarfs had

338
00:12:23,210 --> 00:12:20,700

kind of equal fractions of resolved

339
00:12:25,460 --> 00:12:23,220
disks which then again may say something

340
00:12:26,780 --> 00:12:25,470
about the formation processes that are

341
00:12:28,970 --> 00:12:26,790
undergoing in this different stellar

342
00:12:34,910 --> 00:12:28,980
masses of systems but kind of close to

343
00:12:36,710 --> 00:12:34,920
the 50 G's ffth percent range tadka

344
00:12:37,970 --> 00:12:36,720
masak university of arizona so when you

345
00:12:40,430 --> 00:12:37,980
showed that the M dwarf companion

346
00:12:41,269 --> 00:12:40,440
fraction was increasing towards closer

347
00:12:43,220 --> 00:12:41,279
separations

348
00:12:46,069 --> 00:12:43,230
that's from direct imaging of course so

349
00:12:50,000 --> 00:12:46,079
what about RV oh yeah yeah that's great

350
00:12:51,680 --> 00:12:50,010
so there's a section that mysterious gap

351
00:12:53,569 --> 00:12:51,690
within three au where we're not actually

352
00:12:56,269 --> 00:12:53,579
sensitive to companions is a perfect

353
00:12:58,130 --> 00:12:56,279
place to do the radial velocity and

354
00:13:00,050 --> 00:12:58,140
spectroscopic binary population and

355
00:13:01,610 --> 00:13:00,060
there hasn't been a comprehensive survey

356
00:13:03,560 --> 00:13:01,620
to look at like a volume limited sample

357
00:13:05,780 --> 00:13:03,570
in the same way but some preliminary

358
00:13:07,699 --> 00:13:05,790
estimates and some actually estimates

359
00:13:10,010 --> 00:13:07,709
from the kepler eclipsing binary sample

360
00:13:12,199 --> 00:13:10,020
place that even higher so maybe kind of

361
00:13:14,780 --> 00:13:12,209
closer to the like the 16% range at max

362
00:13:16,220 --> 00:13:14,790
but it's desperate for like a

363
00:13:19,180 --> 00:13:16,230

combination of all the techniques to

364
00:13:23,689 --> 00:13:21,680
absolutely thank you wait I had one

365
00:13:26,150 --> 00:13:23,699
Chris yeah I just wanted to know those

366
00:13:28,770 --> 00:13:26,160
deaths masses in the indoors are there

367
00:13:31,170 --> 00:13:28,780
any correlations with ages of the system

368
00:13:33,030 --> 00:13:31,180
yeah so we we looked at that and the

369
00:13:34,740 --> 00:13:33,040
ages are difficult the tourist is

370
00:13:36,240 --> 00:13:34,750
thought to have some spread in age not

371
00:13:39,900 --> 00:13:36,250
just to be one to two million years but

372
00:13:41,460 --> 00:13:39,910
also to have some intrinsic spread but

373
00:13:43,320 --> 00:13:41,470
from the values that were reported for

374
00:13:44,520 --> 00:13:43,330
the ages of the systems that we looked

375
00:13:47,280 --> 00:13:44,530
out there was no correlation between

376
00:13:49,950 --> 00:13:47,290
seeing the slightly older tourists have

377
00:13:51,660 --> 00:13:49,960
a lower desk population but the agents

378
00:13:53,280 --> 00:13:51,670
right knees are pretty big yeah okay

379
00:13:54,400 --> 00:13:53,290
thank you all right let's thank our