
AbSciCon
2017
MESA, ARIZONA

1
00:00:12,549 --> 00:00:09,640
[Music]

2
00:00:14,980 --> 00:00:12,559
so today this is an astrobiology

3
00:00:18,310 --> 00:00:14,990
conference I think Africanist anyone

4
00:00:21,999 --> 00:00:18,320
here as to the importance of looking for

5
00:00:25,900 --> 00:00:22,009
life outside of Earth be its within the

6
00:00:28,179 --> 00:00:25,910
solar system or beyond it so far we

7
00:00:30,670 --> 00:00:28,189
believe that our best possibility of

8
00:00:34,680 --> 00:00:30,680
finding life on another planet is in

9
00:00:37,510 --> 00:00:34,690
finding a doppelganger or edit earth a

10
00:00:41,290 --> 00:00:37,520
terrestrial planet around the same size

11
00:00:45,849 --> 00:00:41,300
as Earth and residing within its

12
00:00:47,829 --> 00:00:45,859
habitable zone which has been gone over

13
00:00:51,340 --> 00:00:47,839

many times today but in case you weren't

14
00:00:53,650 --> 00:00:51,350
listening is the zone where if there is

15
00:00:56,739 --> 00:00:53,660
water on the planet then it would be in

16
00:01:01,090 --> 00:00:56,749
its liquid state this is because a lot

17
00:01:04,270 --> 00:01:01,100
of our theories as to the necessary

18
00:01:07,600 --> 00:01:04,280
factors to support life include having

19
00:01:10,240 --> 00:01:07,610
access to liquid water now I'm going to

20
00:01:12,969 --> 00:01:10,250
apologize before I start I sometimes

21
00:01:16,450 --> 00:01:12,979
have a really hard time being habitable

22
00:01:19,300 --> 00:01:16,460
I don't know why but if I butcher it too

23
00:01:22,210 --> 00:01:19,310
many times I'm going to switch over to

24
00:01:26,980 --> 00:01:22,220
the liquid water zone instead but we'll

25
00:01:29,770 --> 00:01:26,990
see how I go all right so in a paper

26
00:01:31,780 --> 00:01:29,780
that we published last year dr. Steven

27
00:01:33,790 --> 00:01:31,790
Kane myself and all the other wonderful

28
00:01:37,210 --> 00:01:33,800
people that you see listed at the top

29
00:01:41,440 --> 00:01:37,220
here we catalog all the Kepler Hubble

30
00:01:45,090 --> 00:01:41,450
zoom exoplanets we use the data release

31
00:01:49,780 --> 00:01:45,100
24 q1 through 17 start a vetting process

32
00:01:53,320 --> 00:01:49,790
which we combined with the dr 25 jello

33
00:01:56,470 --> 00:01:53,330
properties table we from a dr 25 we took

34
00:01:58,450 --> 00:01:56,480
out the effective temperature of the

35
00:02:01,200 --> 00:01:58,460
star and the stellar radius and

36
00:02:06,490 --> 00:02:01,210
recalculated the radius of planets

37
00:02:10,150 --> 00:02:06,500
semi-major axes and the effectives or

38
00:02:16,290 --> 00:02:10,160

the flux that was received by the planet

39
00:02:19,839 --> 00:02:16,300
to create a more up-to-date data set we

40
00:02:21,940 --> 00:02:19,849
define four different parameters into

41
00:02:25,510 --> 00:02:21,950
which each planet cell and

42
00:02:28,420 --> 00:02:25,520
in turn gave us four different tables

43
00:02:32,110 --> 00:02:28,430
the first two parameters were to do with

44
00:02:34,150 --> 00:02:32,120
the hubble zone either the planet fell

45
00:02:37,330 --> 00:02:34,160
into the conservative habitable zone or

46
00:02:38,860 --> 00:02:37,340
the optimistic capital zone so this has

47
00:02:41,380 --> 00:02:38,870
already been gone over a fair bit today

48
00:02:45,160 --> 00:02:41,390
but for those who weren't here or we're

49
00:02:47,500 --> 00:02:45,170
not listening as again so the

50
00:02:51,509 --> 00:02:47,510
conservative boundary on the inner edge

51
00:02:56,830 --> 00:02:51,519
which was divine but copper up ooh in

52
00:03:01,360 --> 00:02:56,840
2014 as 0.99 au is the runaway

53
00:03:04,660 --> 00:03:01,370
greenhouse limit where the liquid oceans

54
00:03:07,750 --> 00:03:04,670
would evaporate on the outer edge we

55
00:03:10,890 --> 00:03:07,760
have at one point seven a you the

56
00:03:15,150 --> 00:03:10,900
maximum greenhouse effect where a co2

57
00:03:18,539 --> 00:03:15,160
greenhouse effect is at its maximum the

58
00:03:22,509 --> 00:03:18,549
optimistic boundary the inner edge is at

59
00:03:25,330 --> 00:03:22,519
0.75 au which we call the recent Venus

60
00:03:27,880 --> 00:03:25,340
limit which is based on observations

61
00:03:31,060 --> 00:03:27,890
that Venus may have had water on its

62
00:03:35,620 --> 00:03:31,070
surface around one gig year ago and the

63
00:03:39,009 --> 00:03:35,630

outer edge is at 1.8 au we called the

64
00:03:42,250 --> 00:03:39,019
early Mars limits which based on the

65
00:03:45,490 --> 00:03:42,260
empirical observations that Mars may

66
00:03:50,380 --> 00:03:45,500
have been habitable about 3.8 GB years

67
00:03:54,190 --> 00:03:50,390
ago so the second two are based on

68
00:03:57,520 --> 00:03:54,200
planet size because we all know size

69
00:04:01,330 --> 00:03:57,530
matters so the planets could either be

70
00:04:06,460 --> 00:04:01,340
within of the less than two rest

71
00:04:08,530 --> 00:04:06,470
Earth radii bracket or a ball radii so

72
00:04:11,220 --> 00:04:08,540
even though there is a growing consensus

73
00:04:14,259 --> 00:04:11,230
that the boundary between the

74
00:04:17,890 --> 00:04:14,269
terrestrial planets and the gaseous

75
00:04:20,529 --> 00:04:17,900
planet is around 1.6 Earth radii we

76
00:04:22,690 --> 00:04:20,539
chose to use two Earth radii to account

77
00:04:24,550 --> 00:04:22,700
for any uncertainties that came up in

78
00:04:27,640 --> 00:04:24,560
this della parameters that we're using

79
00:04:30,460 --> 00:04:27,650
and also the planetary parameters so we

80
00:04:31,700 --> 00:04:30,470
didn't want to inject any potentially

81
00:04:34,880 --> 00:04:31,710
terrestrial planets from

82
00:04:40,520 --> 00:04:34,890
tables so the four tables that we ended

83
00:04:43,220 --> 00:04:40,530
up with a table one at 20 with 20

84
00:04:47,230 --> 00:04:43,230
candidates sorry table 229 candidates

85
00:04:48,530 --> 00:04:47,240
table 363 candidates and table for with

86
00:04:50,570 --> 00:04:48,540
104

87
00:04:53,510 --> 00:04:50,580
candidates and each of these tables

88
00:04:55,430 --> 00:04:53,520

you'll find can be subsets of the others

89
00:04:57,710 --> 00:04:55,440
so table one which had our most

90
00:05:03,800 --> 00:04:57,720
stringent parameters is actually a

91
00:05:06,740 --> 00:05:03,810
subset of each of the other table so we

92
00:05:09,680 --> 00:05:06,750
can see much more clearly with this

93
00:05:13,130 --> 00:05:09,690
beautiful graphic which I've stolen from

94
00:05:17,180 --> 00:05:13,140
sunny harmon thank you sunny

95
00:05:18,710 --> 00:05:17,190
the have dual zone boundaries and we've

96
00:05:21,340 --> 00:05:18,720
seen Lee a couple iterations of this

97
00:05:27,160 --> 00:05:21,350
before today but in case you were asleep

98
00:05:32,380 --> 00:05:27,170
we'll go through it again as I go back

99
00:05:35,870 --> 00:05:32,390
okay so we have on the y-axis with

100
00:05:37,820 --> 00:05:35,880
increasing temperature of the staff you

101
00:05:39,620 --> 00:05:37,830
can see the change of the Hamill's and

102
00:05:42,470 --> 00:05:39,630
with the increase in temperature and on

103
00:05:47,240 --> 00:05:42,480
the bottom is not distance but there's

104
00:05:51,080 --> 00:05:47,250
still a flux and you can see f lines up

105
00:05:52,940 --> 00:05:51,090
with 100% so planets on the left-hand

106
00:05:54,380 --> 00:05:52,950
side of the graph are receiving more

107
00:05:54,770 --> 00:05:54,390
flux than the plants on the right-hand

108
00:05:57,950 --> 00:05:54,780
side

109
00:06:00,410 --> 00:05:57,960
and so the planets that are depicted

110
00:06:03,320 --> 00:06:00,420
here actually those depictions of the

111
00:06:05,960 --> 00:06:03,330
planets from our table - which is the

112
00:06:12,640 --> 00:06:05,970
less than two Earth radii in the

113
00:06:16,220 --> 00:06:12,650

optimistic capitalism so we plotted the

114
00:06:18,740 --> 00:06:16,230
histogram of the data set in the green

115
00:06:22,910 --> 00:06:18,750
we have our habitable zone candidates

116
00:06:25,610 --> 00:06:22,920
from Kepler and the grey is the entire

117
00:06:28,430 --> 00:06:25,620
Kepler catalog and we found that the

118
00:06:33,020 --> 00:06:28,440
distributions looked pretty much the

119
00:06:37,520 --> 00:06:33,030
same which was awesome and so we plotted

120
00:06:40,550 --> 00:06:37,530
a power law on each data set as you can

121
00:06:44,030 --> 00:06:40,560
see here we excluded the first two bins

122
00:06:45,280 --> 00:06:44,040
from our power laws due to lack of

123
00:06:49,990 --> 00:06:45,290
completeness or

124
00:06:52,660 --> 00:06:50,000
any planets less than 1.5 Earth radii so

125
00:06:54,310 --> 00:06:52,670
the power laws are not meant to

126
00:06:58,240 --> 00:06:54,320
represent complete list but just be a

127
00:07:00,700 --> 00:06:58,250
direct comparison of the entire Kepler

128
00:07:04,810 --> 00:07:00,710
catabolic versus the ones down in the

129
00:07:07,420 --> 00:07:04,820
Hubble's room so we saw that there was a

130
00:07:10,240 --> 00:07:07,430
very slight difference in the slope of

131
00:07:11,770 --> 00:07:10,250
each of the two datasets which implied

132
00:07:15,100 --> 00:07:11,780
that there was less we were less likely

133
00:07:16,930 --> 00:07:15,110
inside the smaller planets in the

134
00:07:20,230 --> 00:07:16,940
habitable zone but you need to remember

135
00:07:21,880 --> 00:07:20,240
also that planets in the habitable zone

136
00:07:27,130 --> 00:07:21,890
tend to be further away from their star

137
00:07:29,860 --> 00:07:27,140
and so we are less likely be able to see

138
00:07:32,050 --> 00:07:29,870

in them because their orbital period can

139
00:07:35,550 --> 00:07:32,060
mean that they don't transit the star

140
00:07:38,230 --> 00:07:35,560
often enough to be seen or confirmed and

141
00:07:40,780 --> 00:07:38,240
they're sometimes the orbital period can

142
00:07:42,550 --> 00:07:40,790
actually correspond with orbital period

143
00:07:46,030 --> 00:07:42,560
of Kepler spacecraft itself which

144
00:07:47,800 --> 00:07:46,040
increases the noise significantly so

145
00:07:50,680 --> 00:07:47,810
after doing the maximum likelihood

146
00:07:52,690 --> 00:07:50,690
estimator we found that there was no

147
00:07:55,620 --> 00:07:52,700
statistically significant difference

148
00:07:57,970 --> 00:07:55,630
between the two data sets which is

149
00:08:01,180 --> 00:07:57,980
excellent news because it means that we

150
00:08:05,290 --> 00:08:01,190
can use the distributions of any wide

151
00:08:07,870 --> 00:08:05,300
sample of planets and relate it to the

152
00:08:10,540 --> 00:08:07,880
distribution of the herald zone planets

153
00:08:13,480 --> 00:08:10,550
and considering the Hubble zoom planets

154
00:08:15,880 --> 00:08:13,490
are harder to find this will be really

155
00:08:21,030 --> 00:08:15,890
helpful in future statistical

156
00:08:25,680 --> 00:08:21,040
distributions or pebbles own one so our

157
00:08:28,570 --> 00:08:25,690
next steps the table that we've created

158
00:08:30,910 --> 00:08:28,580
have both confirmed and unconfident

159
00:08:35,620 --> 00:08:30,920
planets so validation of the unconfirmed

160
00:08:37,300 --> 00:08:35,630
planets is our next priority validation

161
00:08:39,640 --> 00:08:37,310
of category 1 and 2 candidates is

162
00:08:42,219 --> 00:08:39,650
actually underway as we at the moment

163
00:08:48,180 --> 00:08:42,229

using primarily adaptive optics and

164
00:08:53,790 --> 00:08:50,560
aslak

165
00:08:58,090 --> 00:08:53,800
with comparison of catalogs with

166
00:09:00,610 --> 00:08:58,100
estimate as Kepler's primary mission was

167
00:09:02,800 --> 00:09:00,620
to determine a to us we can use our

168
00:09:08,460 --> 00:09:02,810
catalog with the occurrence rate

169
00:09:11,920 --> 00:09:08,470
calculations of the Kepler mission and

170
00:09:15,579 --> 00:09:11,930
improving stellar parameters sir I'm

171
00:09:18,490 --> 00:09:15,589
clearing those parameters needs to be

172
00:09:21,189 --> 00:09:18,500
continued obviously our Hubble's own

173
00:09:25,870 --> 00:09:21,199
calculations of the story of the

174
00:09:27,629 --> 00:09:25,880
boundaries is needs what is reliant

175
00:09:29,650 --> 00:09:27,639
sorry I'm still the parameters so

176
00:09:31,449 --> 00:09:29,660
improving these stellar parameters is

177
00:09:35,970 --> 00:09:31,459
only going to be able to help us to

178
00:09:40,120 --> 00:09:35,980
refine our gallery or our catalog and

179
00:09:42,639 --> 00:09:40,130
lastly the category for candidates which

180
00:09:45,370 --> 00:09:42,649
this is my the most exciting bit for me

181
00:09:49,090 --> 00:09:45,380
was the amount of giant planets that we

182
00:09:52,600 --> 00:09:49,100
found in the optimistic habitable zone

183
00:09:57,120 --> 00:09:52,610
so royal giant planets themselves are

184
00:10:00,670 --> 00:09:57,130
not ideal candidates for finding life

185
00:10:03,460 --> 00:10:00,680
they do open the possibility of large

186
00:10:08,769 --> 00:10:03,470
terrestrial eggs or moons and so these

187
00:10:11,199 --> 00:10:08,779
moons expect this and famine yet but if

188
00:10:13,990 --> 00:10:11,209

they exist then they would also be in

189
00:10:17,110 --> 00:10:14,000
the Hubble zone and so could be great

190
00:10:21,579 --> 00:10:17,120
candidates for finding life out in the