Amber Young

Session 4 Warm-Up Talk: Exoplanets & Habitability

1
00:00:00,240 --> 00:00:10,900
[Music]

2
00:00:17,270 --> 00:00:13,280
thank you guys so much for having me is

3
00:00:19,070 --> 00:00:17,280
this away so my name is now amber young

4
00:00:21,410 --> 00:00:19,080
formally Britt I just got married in

5
00:00:23,570 --> 00:00:21,420
June so so excited to be here this is my

6
00:00:26,990 --> 00:00:23,580
first conference as a married woman

7
00:00:28,790 --> 00:00:27,000
hahaha but I'm really excited about the

8
00:00:31,520 --> 00:00:28,800
talks that we'll have in our session

9
00:00:34,340 --> 00:00:31,530
today so we'll basically be going

10
00:00:36,919 --> 00:00:34,350
through the first couple of talks and

11
00:00:39,799 --> 00:00:36,929
then we'll be a break at 2:15 followed

12
00:00:41,689 --> 00:00:39,809
by a second part of the session and this

13
00:00:43,610 --> 00:00:41,699

is like the last set overall session of

14
00:00:45,950 --> 00:00:43,620
a Brad Kahn's so congrats up making it

15
00:00:49,880 --> 00:00:45,960
through look good so I'm just going to

16
00:00:52,700 --> 00:00:49,890
go over a general overview for my intro

17
00:00:57,799 --> 00:00:52,710
I'm sort of defining what's necessary

18
00:01:00,829 --> 00:00:57,809
for habitability what what we think is a

19
00:01:03,139 --> 00:01:00,839
good definition for that observational

20
00:01:04,850 --> 00:01:03,149
techniques for exoplanets because we

21
00:01:06,980 --> 00:01:04,860
have a couple of exoplanet talks later

22
00:01:09,290 --> 00:01:06,990
on in the session and then I'll also be

23
00:01:12,770 --> 00:01:09,300
talking about making predictions with

24
00:01:15,290 --> 00:01:12,780
modeling efforts so first off defining

25
00:01:18,140 --> 00:01:15,300
habitability I've seen time and time

26
00:01:19,880 --> 00:01:18,150
again from exoplanet scientists and

27
00:01:22,100 --> 00:01:19,890
astronomers alike where we're thinking

28
00:01:24,050 --> 00:01:22,110
that the first base is to look for water

29
00:01:27,590 --> 00:01:24,060
because where there's life there's water

30
00:01:29,240 --> 00:01:27,600
and so the first thing that I'm going to

31
00:01:33,110 --> 00:01:29,250
define for you guys is the habitable

32
00:01:36,500 --> 00:01:33,120
zone in case you're not familiar from

33
00:01:39,350 --> 00:01:36,510
testing at all 2014 or sort of defining

34
00:01:42,350 --> 00:01:39,360
these regions of a habitable zone where

35
00:01:45,320 --> 00:01:42,360
you're at the particular distance from a

36
00:01:47,990 --> 00:01:45,330
host star such that liquid water can

37
00:01:51,290 --> 00:01:48,000
exist on the surface so if you see for a

38
00:01:52,310 --> 00:01:51,300

sun-like star Earth is located right in

39
00:01:55,220 --> 00:01:52,320
that Goldilocks zone

40
00:01:57,290 --> 00:01:55,230
we're habitable but conversely if you're

41
00:01:59,630 --> 00:01:57,300
looking at like a smaller star like an M

42
00:02:01,310 --> 00:01:59,640
dwarf then the habitable zones located

43
00:02:05,100 --> 00:02:01,320
close to him because you have a cooler

44
00:02:10,469 --> 00:02:08,210
and I feel like one of the biggest

45
00:02:12,450 --> 00:02:10,479
genres of this session is sort of

46
00:02:15,360 --> 00:02:12,460
understanding like the relationship

47
00:02:17,910 --> 00:02:15,370
between the host star and the planet

48
00:02:20,730 --> 00:02:17,920
because they don't exist in isolation

49
00:02:22,740 --> 00:02:20,740
from each other they are affected by

50
00:02:26,190 --> 00:02:22,750
each other and so in order to understand

51
00:02:28,590 --> 00:02:26,200
habitability in the fullest context we

52
00:02:31,740 --> 00:02:28,600
need to understand both the star and the

53
00:02:34,400 --> 00:02:31,750
host planet and so we'll see later on in

54
00:02:37,140 --> 00:02:34,410
the session Thea will be talking about

55
00:02:40,830 --> 00:02:37,150
stellar evolution and the post main

56
00:02:43,170 --> 00:02:40,840
sequence phase of star we're at the post

57
00:02:48,420 --> 00:02:43,180
main sequence the habitable zone region

58
00:02:51,030 --> 00:02:48,430
will actually move further out and we'll

59
00:02:53,490 --> 00:02:51,040
also be talking about the importance of

60
00:02:55,260 --> 00:02:53,500
albedo later on in the session so I'll

61
00:02:57,840 --> 00:02:55,270
just give a little intro on that where

62
00:03:01,650 --> 00:02:57,850
Al Beto is just a fancy term for the

63
00:03:04,320 --> 00:03:01,660

reflectivity of a planet so if you have

64
00:03:07,260 --> 00:03:04,330
a high albedo then there's a large

65
00:03:09,930 --> 00:03:07,270
amount of stellar radiation being

66
00:03:13,590 --> 00:03:09,940
reflected from the surface I there from

67
00:03:16,500 --> 00:03:13,600
a lot of high rec reflective ground

68
00:03:18,180 --> 00:03:16,510
material like Isis or perhaps a lot of

69
00:03:21,090 --> 00:03:18,190
cloud cover will give you a high albedo

70
00:03:24,990 --> 00:03:21,100
and then conversely if you have a low

71
00:03:26,670 --> 00:03:25,000
albedo that would indicate that most of

72
00:03:28,830 --> 00:03:26,680
your stellar radiation is being absorbed

73
00:03:31,620 --> 00:03:28,840
at the surface and we'll hear more about

74
00:03:34,460 --> 00:03:31,630
the importance of albedo from Jack and

75
00:03:36,870 --> 00:03:34,470
he'll be talking about sort of the

76
00:03:38,910 --> 00:03:36,880
wavelength dependence of albedo and how

77
00:03:41,699 --> 00:03:38,920
it's correlated with stellar type and

78
00:03:43,800 --> 00:03:41,709
temperatures so understanding albedo can

79
00:03:45,479 --> 00:03:43,810
really help us shape what we know about

80
00:03:49,710 --> 00:03:45,489
habitability and how we'll be able to

81
00:03:51,420 --> 00:03:49,720
define it next what we can also talk

82
00:03:53,910 --> 00:03:51,430
about in terms of defining habitability

83
00:03:56,130 --> 00:03:53,920
is looking at the relationship between

84
00:03:58,440 --> 00:03:56,140
early earth and the Sun because we know

85
00:04:01,979 --> 00:03:58,450
that again stellar evolution that

86
00:04:04,710 --> 00:04:01,989
process is dynamic so we can sort of ask

87
00:04:09,090 --> 00:04:04,720
how habitability can be maintained over

88
00:04:12,210 --> 00:04:09,100

long geologic timescales and so one

89
00:04:16,920 --> 00:04:12,220
thing I'm going to talk about is in the

90
00:04:17,849 --> 00:04:16,930
past the Sun was 30% dimmer and so there

91
00:04:20,279 --> 00:04:17,859
was a question

92
00:04:22,409 --> 00:04:20,289
how did earth remain habitable because

93
00:04:25,710 --> 00:04:22,419
we know there's geologic evidence that

94
00:04:28,439 --> 00:04:25,720
suggests life was still able to thrive

95
00:04:30,570 --> 00:04:28,449
and be able to survive even in this

96
00:04:32,969 --> 00:04:30,580
distant past and this is something

97
00:04:35,240 --> 00:04:32,979
called the faint young Sun paradox so

98
00:04:38,279 --> 00:04:35,250
sort of giving an overview of that

99
00:04:40,080 --> 00:04:38,289
because we'll have a talk by Julia later

100
00:04:42,059 --> 00:04:40,090
on about solving the faint young Sun

101
00:04:46,350 --> 00:04:42,069
paradox and I don't want to give away

102
00:04:48,570 --> 00:04:46,360
too many spoilers but the overview

103
00:04:50,369 --> 00:04:48,580
answer is the greenhouse effect where

104
00:04:52,800 --> 00:04:50,379
you have atmospheric constituents that

105
00:04:54,629 --> 00:04:52,810
are able to trap the heat and stellar

106
00:04:56,580 --> 00:04:54,639
radiation such that it can warm the

107
00:04:59,360 --> 00:04:56,590
planet and keep it at temperatures that

108
00:05:03,559 --> 00:04:59,370
are habitable and hospitable for life

109
00:05:05,939 --> 00:05:03,569
and not only that we can also look at

110
00:05:08,070 --> 00:05:05,949
environments that are in our own solar

111
00:05:10,499 --> 00:05:08,080
neighborhood our own solar backyard in

112
00:05:14,610 --> 00:05:10,509
terms of Martian habitability we know

113
00:05:16,770 --> 00:05:14,620

early Mars was warm was wet and so we'll

114
00:05:20,580 --> 00:05:16,780
have a talk by maths natsume actually

115
00:05:26,120 --> 00:05:20,590
next about scale crater it's early

116
00:05:32,700 --> 00:05:29,640
so now I'll go into observing exoplanets

117
00:05:35,309 --> 00:05:32,710
and two techniques that'll be discussed

118
00:05:36,600 --> 00:05:35,319
so here's an overview of the various

119
00:05:39,870 --> 00:05:36,610
techniques that have been used to

120
00:05:41,820 --> 00:05:39,880
discover exoplanets over the years but

121
00:05:44,129 --> 00:05:41,830
I'll focus on transit because you have a

122
00:05:46,700 --> 00:05:44,139
talk coming up by Pedro who are you

123
00:05:49,769 --> 00:05:46,710
talking about Kepler and that's mostly

124
00:05:52,290 --> 00:05:49,779
Kepler mostly uses transit method to

125
00:05:54,029 --> 00:05:52,300
detect and discover exoplanets so as a

126
00:05:57,649 --> 00:05:54,039
planet is passing in front of the host

127
00:06:00,570 --> 00:05:57,659
star I'll see a dip in the total stellar

128
00:06:02,969 --> 00:06:00,580
luminosity and those dips are actually

129
00:06:04,649 --> 00:06:02,979
wavelength dependent and corresponds to

130
00:06:07,019 --> 00:06:04,659
whatever chemical constituents are

131
00:06:09,390 --> 00:06:07,029
present in the atmosphere so you can

132
00:06:11,879 --> 00:06:09,400
convolve those wavelength dependencies

133
00:06:14,999 --> 00:06:11,889
and then get planetary parameters like

134
00:06:16,800 --> 00:06:15,009
the radius you can do a studies

135
00:06:19,430 --> 00:06:16,810
theoretical studies on like the

136
00:06:22,649 --> 00:06:19,440
temperature profile of the planet etc

137
00:06:25,050 --> 00:06:22,659
and then we'll also hear a talk by

138
00:06:27,689 --> 00:06:25,060

Shreyas about ground-based photography

139
00:06:29,910 --> 00:06:27,699
photometry so we'll hear a little bit

140
00:06:32,830 --> 00:06:29,920
about the amazing

141
00:06:34,870 --> 00:06:32,840
efforts from ground-based telescopes to

142
00:06:38,230 --> 00:06:34,880
look and characterize exoplanets with

143
00:06:41,400 --> 00:06:38,240
like imaging ground-based averaging and

144
00:06:46,390 --> 00:06:41,410
finally when we are looking at

145
00:06:50,230 --> 00:06:46,400
habitability and what we look to find in

146
00:06:51,820 --> 00:06:50,240
the future for either exoplanets or even

147
00:06:54,160 --> 00:06:51,830
within the solar system we do a lot of

148
00:06:56,070 --> 00:06:54,170
predictions and so how we make these

149
00:06:59,170 --> 00:06:56,080
predictions is normally through

150
00:07:01,480 --> 00:06:59,180
understanding the atmospheric state and

151
00:07:04,090 --> 00:07:01,490
that would mainly be done through

152
00:07:06,450 --> 00:07:04,100
photochemical modeling or where you'll

153
00:07:09,130 --> 00:07:06,460
calculate you know species abundances

154
00:07:11,740 --> 00:07:09,140
pressure profiles the production and

155
00:07:14,650 --> 00:07:11,750
loss rates of species in the atmosphere

156
00:07:17,500 --> 00:07:14,660
and then you could also have climate

157
00:07:19,540 --> 00:07:17,510
modeling which gives you really good

158
00:07:21,580 --> 00:07:19,550
estimates of your temperature profile

159
00:07:23,110 --> 00:07:21,590
and how that changes with altitude and

160
00:07:26,200 --> 00:07:23,120
then if you want to get fancy about it

161
00:07:28,390 --> 00:07:26,210
you couple them both together so that

162
00:07:30,400 --> 00:07:28,400
you can get accurate temperature

163
00:07:32,680 --> 00:07:30,410

profiles and the species abundance is

164
00:07:34,930 --> 00:07:32,690
understanding the photochemistry and the

165
00:07:37,330 --> 00:07:34,940
climate component and once you put those

166
00:07:40,030 --> 00:07:37,340
together you can do even cooler things

167
00:07:42,610 --> 00:07:40,040
like couple the outputs from these

168
00:07:46,000 --> 00:07:42,620
modeling simulations to Astro ecology

169
00:07:48,400 --> 00:07:46,010
models or you can you know get even more

170
00:07:50,470 --> 00:07:48,410
details about the contextual environment

171
00:07:52,510 --> 00:07:50,480
and the planetary environment and use

172
00:07:55,090 --> 00:07:52,520
that to make predictions as to like what

173
00:07:58,000 --> 00:07:55,100
would we see an exoplanets if we wanted

174
00:08:00,160 --> 00:07:58,010
to take modern earth and put it around a

175
00:08:02,680 --> 00:08:00,170
different star or put it at several

176
00:08:03,760 --> 00:08:02,690
parsecs how do we observe it that sort

177
00:08:08,380 --> 00:08:03,770
of stuff is all done through the

178
00:08:11,290 --> 00:08:08,390
modeling aspect so with that I'm going