

WEBVTT

1

00:00:13.200 --> 00:00:14.460

Jun Makino: So, there

2

00:00:15.690 --> 00:00:18.180

Jun Makino: Isn't something I guess what I just

3

00:00:19.410 --> 00:00:23.760

Jun Makino: Saw a baby review owns number particular we have using for us.

4

00:00:25.050 --> 00:00:25.260

Jun Makino: So,

5

00:00:26.370 --> 00:00:47.370

Jun Makino: well received. They get folded in the various kinds was an athlete gas emissions and then. Well, this guy will see there is some program and rebel and I will ask about what can be done on there and we did our outsides of the framework under which we call FPS and also then on I

6

00:00:48.390 --> 00:00:56.190

Jun Makino: Still live we discuss the current status of our flea market. Yes. And that if we are using them. And I tried to summarize

7

00:01:03.810 --> 00:01:12.180

Jun Makino: Okay. So let me start with the evolution of nanoparticles enough to keep us Mason's um well our

8

00:01:13.260 --> 00:01:24.150

Jun Makino: Most of course the data computer embedding something that's 94 days and they have become a better, but there is a few committee in

9

00:01:24.600 --> 00:01:35.310

Jun Makino: 1960s, or on soda. Most of us needs and starting somewhere between 1970 and then the 60s. And there are a number of articles. And that's not something that you know

10

00:01:35.940 --> 00:01:50.040

Jun Makino: Several hundred to 2000. And if we look at the the particle number, a number of products are we use now um well and they had a big gap between the number that we are using for for the cosmology, which is going

11

00:01:51.270 --> 00:02:01.200

Jun Makino: Went to the political will to the one want to do and for that this poor guy for everything else. We are still using maybe something that came 10 million or so.

12

00:02:02.910 --> 00:02:11.070

Jun Makino: So this means you know they are quite a large gap between the number of paths that we use for the for the

13

00:02:12.360 --> 00:02:15.690

Jun Makino: For the cosmos kind of bodies as Mason and everything else.

14

00:02:17.820 --> 00:02:18.450

Jun Makino: So,

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00:02:19.500 --> 00:02:21.960

Jun Makino: The question is why we

16

00:02:23.370 --> 00:02:29.880

Jun Makino: Have such an idea and of course the easy answer is that the cosmos kind of the seniors in much easier compared to other other stuff.

17

00:02:30.420 --> 00:02:48.060

Jun Makino: For the cosmos conversation we liquidity unsealed fans, the people of integrity and investing, nothing else. So that means are the people in this field of accounting can spend quite a large block some of their, their time to night program to optimize their code.

18

00:02:49.140 --> 00:02:56.190

Jun Makino: And of course, other things are. That's the direct in scale scheme has been still used for the Starcraft and also the parent information.

19

00:02:56.790 --> 00:03:12.420

Jun Makino: And of course, water flow class for the Starcraft omissions, we need another photo. And since we need to cover the electrician time scale. And in the case of the galaxy formation. We have name is a big number, good quote, but we have to know that.

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00:03:13.470 --> 00:03:23.280

Jun Makino: The our approach of every class and anytime step our feature is actually started back at us with Muslims invaded here you

21

00:03:24.690 --> 00:03:30.390

Jun Makino: cannot accept scale very well for the bit for a very large number of sabbatical, a very high resolution.

22

00:03:32.430 --> 00:03:40.830

Jun Makino: So the question is, what we can do on the basically the last thing is that we accept you need a new album and Fitch means that's the

23

00:03:41.340 --> 00:03:47.640

Jun Makino: key focus on cost falls apart and academic status is si N squared for stock Rasta unfortunately formation.

24

00:03:48.240 --> 00:04:04.800

Jun Makino: And we did it. We have something that list for for for some time, which is that essentially that to the hybrid using the community and speaking. And then the hard part is that for each program and for the machine architecture, we need to develop a highly efficient code.

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00:04:06.270 --> 00:04:13.590

Jun Makino: And the point here is that, and what we have learned in the last three decades. Well done little basic either my career.

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00:04:14.820 --> 00:04:22.470

Jun Makino: Developing a highly efficient and scared record for anything more complicated. Complicated than Cosmo to anybody estimation seems broccoli impossible.

27

00:04:25.140 --> 00:04:28.830

Jun Makino: And even well there are many, many, many, many buddies and

28

00:04:30.000 --> 00:04:38.100

Jun Makino: And the point is that we need to write a paper we aren't using MPI and the DC to be delivered on time because me and a different process. And we'll see where it

29

00:04:39.300 --> 00:04:46.620

Jun Makino: Needs to go to work to optimize our communication and Android devices and only after that difficult walks and if you as

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00:04:48.810 --> 00:04:49.230

Jun Makino: Well,

31

00:04:50.430 --> 00:05:01.770

Jun Makino: There are a few successful cases for that for the animal this nation that I can like the guy that will pick it up, but it's called acts that are basically he thought the

32

00:05:03.780 --> 00:05:09.660

Jun Makino: Therefore can do with a very, very good. So Jeff and and even felt

33

00:05:10.770 --> 00:05:15.780

Jun Makino: Good. I mean, Mr pearl has to have to hire if CNC machines, we have to

34

00:05:16.230 --> 00:05:25.320

Jun Makino: Even my work on tuning, including a single X modifications that data structure and the structure for to make a better use of gas memories and we also have to find some way to use the

35

00:05:25.770 --> 00:05:31.890

Jun Makino: Similar instruction set with a murmur want to process and somehow that there are there are many bodies also have the CMT instructions.

36

00:05:32.370 --> 00:05:43.590

Jun Makino: Even on on on on the same machine for from Intel, are we have there. We have the SEC, and the APS and they click through and apex 500 Android, which are all different.

37

00:05:44.400 --> 00:05:54.780

Jun Makino: And we, if we are to use the GTA abuse, we need to modify the there was no data structure and the data quality you include our open open overseer or whatever.

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00:05:56.400 --> 00:05:57.600

Jun Makino: So that

39

00:05:58.650 --> 00:06:06.120

Jun Makino: Well, something. Exactly. So what we hoped. Not something like piratical compatible with for all over the liberal so

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00:06:07.620 --> 00:06:14.880

Jun Makino: Much machine would can't count down there that simple, simple code. What a pilot Angus and I

41

00:06:16.590 --> 00:06:25.770

Jun Makino: Like for example, the hype. Hype of our photo booth, as all of us, but it will give things labor costs and the reason

42

00:06:26.850 --> 00:06:36.540

Jun Makino: These things it could just be a good firefighter compiler or weak muscle memory machines. However, there are expensive compared to their

43

00:06:37.860 --> 00:06:42.510

Jun Makino: PCs and the only uploaded which which gives us the best

44

00:06:43.560 --> 00:06:48.060

Jun Makino: Performers owns the most that expensive system survives.

45

00:06:49.830 --> 00:06:51.720

Jun Makino: So what are we doing

46

00:06:53.250 --> 00:06:57.540

Jun Makino: This guy approach, whether. Well, not quite up to us but style.

47

00:06:59.070 --> 00:07:06.480

Jun Makino: Where we are here is something that is a small group of their other very good so fearless into an attorney in the most case a single person.

48

00:07:06.900 --> 00:07:16.920

Jun Makino: Who are very complex into a quote that I got it or PK graph or gasoline or green or hypo, what do you want to work, whatever, whatever name you can you can call

49

00:07:17.730 --> 00:07:24.300

Jun Makino: Residual athletics under this is not quite enough to achieve a high high performers and

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00:07:24.870 --> 00:07:32.340

Jun Makino: If you, if someone who can get Wi Fi does funding whether if you record is somehow selected for the full scale or access get project.

51

00:07:32.970 --> 00:07:40.620

Jun Makino: You can pass out. According to the official it from companies or the or the bigness aromas and they try to make make make our costs down so much faster.

52

00:07:41.370 --> 00:07:51.090

Jun Makino: hire this guy. We know that this approach, you know, not enough to develop and I'm very efficient and scalable code, except for the cosmological Emily course.

53

00:07:53.760 --> 00:07:55.680

Jun Makino: So what you're working on is to

54

00:07:57.390 --> 00:08:00.180

Jun Makino: Provide some a different approach and

55

00:08:02.160 --> 00:08:04.860

Jun Makino: The other approach is to a form it um

56

00:08:05.910 --> 00:08:21.840

Jun Makino: I was description of the exchange undiscovered of our political situation call and just go up to me says a cosmological model code and apply it to you, many, many different programs and community defense, which means, of course, the particular bits of information that displays pH or

57

00:08:24.480 --> 00:08:33.600

Jun Makino: You actually want me well Jackson, of course, essentially what it does is it and the other is basic, I guess what, what a what a soccer after six Mason's what matter for me.

58

00:08:36.480 --> 00:08:42.090

Jun Makino: Honestly, my special especially, you know, a particular Smith decision is called increasingly like of course in February and I

59

00:08:42.480 --> 00:08:54.090

Jun Makino: Will Smith and pitches our meet and molecular dynamics and to see if you can talk may select a spiritual well other other kinds of the partner business method method method as things. Have you seen on other stuff.

60

00:08:54.780 --> 00:09:05.310

Jun Makino: And in all cases the older model Caucasian co spent in that Everson over the interaction between particles. And again, neighbors, of course, their own in trucks and buses that they can be done using it.

61

00:09:06.030 --> 00:09:15.930

Jun Makino: To equal to F em em or we're going to try. But as he is. And of course, this is why the grapes are hard. We are offering, which is in in my my my

62

00:09:17.220 --> 00:09:22.950

Jun Makino: Background has been useful for when we could afford to live up to them.

63

00:09:24.210 --> 00:09:39.330

Jun Makino: So our solution here is to, if we can develop a program which can actually generate a hyper homeless MPA program for the for the things that the domain. The compression on the particle migration and interaction Caucasian you using to do either.

64

00:09:40.800 --> 00:09:50.550

Jun Makino: Faster scheme under there under whether it's a communication for a given particular part of the introduction and the park across that that can be a physician.

65

00:09:52.020 --> 00:10:04.860

Jun Makino: So we started to design or our previous remark, and it is decaying the c++ and the database can provide that just felt that the definition of success. So, doctor, with a particular faculty across

66

00:10:05.670 --> 00:10:14.220

Jun Makino: The function directives and to collect as a political party but introduction, of course, in the case of the reputation of anybody can make our decisions just

67

00:10:15.210 --> 00:10:30.150

Jun Makino: About us get Kyle and before their spiritual you, everybody. Thanks so much more complicated stuff. And the deceiving because it is a function that get across. And in fact, some function I put on the machine generates that was unnecessary library functions.

68

00:10:31.500 --> 00:10:35.550

Jun Makino: Necessary for the interaction colocation using the pi bonds. How

69

00:10:36.600 --> 00:10:41.940

Jun Makino: Risky and the the flat broke their program using the DFW data functions under

70

00:10:43.110 --> 00:10:46.590

Jun Makino: And after the nation is done using a separate template from function.

71

00:10:48.600 --> 00:11:02.490

Jun Makino: So let me see the status of the code is that cool. They do not have enough publicly available in this era to get on GitHub and the city or the county right

72

00:11:03.930 --> 00:11:04.890

Jun Makino: I think we have a program

73

00:11:07.980 --> 00:11:10.710

Jun Makino: Which can be compared to a single core of why

74

00:11:12.060 --> 00:11:18.360

Jun Makino: We're, we're hoping people are going to target by programs and highly skilled at foreign exchange is actually pretty high.

75

00:11:19.170 --> 00:11:29.730

Jun Makino: And they use a couple of them. Can you did now dictum, he either c++ or C or Fortran and since we now have the sea API here in Brisbane.

76

00:11:30.720 --> 00:11:43.320

Jun Makino: You can also use it is for them either long, it's like, like, like would you do what employees, maybe even from Python and the GPS can be cannot be integrated and that we have now.

77

00:11:44.670 --> 00:11:47.550

Jun Makino: There are simple high level compiler for the for the index and color.

78

00:11:49.890 --> 00:11:55.890

Jun Makino: So if you want to do it right. You can just get grown for six foods.

79

00:11:57.090 --> 00:12:08.370

Jun Makino: Cleanse detox items or FTP FTP as an event, you can go to the sample equity and underground music and dance underground's Dr code.

80

00:12:09.780 --> 00:12:29.280

Jun Makino: Okay. And, well, I just want once again for what they're doing in the competition is a doctor that are taken from the paper for

office with a Boolean William quarter fourth quarter I enlisted. Mm hmm.
But they are. Yeah, we are using a same same scheme of Africa because

81

00:12:30.510 --> 00:12:36.630

Jun Makino: Because of much much friction may sort of it says, Therefore
without noticing officer, so there's

82

00:12:38.370 --> 00:12:42.720

Jun Makino: A lot of you all's also without because we might extend

83

00:12:43.830 --> 00:12:54.390

Jun Makino: My fiction. So under here that the size of Asian easily. I
just so that's a Caucasian time would it be essentially the same. And
this is emitted about inviting by CMS.

84

00:12:56.550 --> 00:13:03.270

Jun Makino: And this asking it rather than rather than Lisa where for up
to something 160,000 processes.

85

00:13:06.150 --> 00:13:14.070

Jun Makino: On let me spend some time to to show the sample code. So
yeah, the part of the definition of particles.

86

00:13:14.670 --> 00:13:24.060

Jun Makino: In for the standard and woody call it out. We have mass and
positions and a bit of it. So is it up and pop pop pop particular who the
who the Dead, dead across

87

00:13:24.600 --> 00:13:38.760

Jun Makino: And we need to provide some standard functions like I get for
Sunday getting and get to charge it is my detach active passive. Passive
mask which we use an interface to our about HTTPS liability unsafe on
some other

88

00:13:40.770 --> 00:13:43.770

Jun Makino: Interfaces and we can also have that you do.

89

00:13:45.180 --> 00:13:45.990

Jun Makino: Use a function

90

00:13:47.220 --> 00:13:50.940

Jun Makino: Of these are just used for their for their

91

00:13:52.020 --> 00:13:54.120

Jun Makino: Standard is not equal integrate

92

00:13:55.620 --> 00:13:58.110

Jun Makino: And interact and function of course are

93

00:13:59.160 --> 00:14:06.270

Jun Makino: Using these are these are functions are get post on and get charged feature we have we have defined so far.

94

00:14:07.980 --> 00:14:11.700

Jun Makino: dandy. And here we get we just use that stand out.

95

00:14:13.770 --> 00:14:15.750

Jun Makino: Something of 15 rocky

96

00:14:20.670 --> 00:14:31.830

Jun Makino: For that time integration, we have to use a deeper look so our details third part of that was after us a quote Anson Anson not something using HTTPS.

97

00:14:33.150 --> 00:14:41.550

Jun Makino: We have to do to predict for our whole focus on after we do that for Scott guessing we collect that and put it into quantum

98

00:14:42.720 --> 00:14:49.290

Jun Makino: Leap rock star and before she is a doctor, a function to use to use HTTPS.

99

00:14:51.180 --> 00:15:00.960

Jun Makino: Yeah, yeah, we, we are named as functional as a calculator or and that but well but but but it needs and we do call that the

100

00:15:02.220 --> 00:15:02.880

Jun Makino: Function to

101

00:15:05.400 --> 00:15:21.930

Jun Makino: Become the composer means fast and and felt in second. We call it functions to migrate, particularly for to the new on a new domains. And then we close out as a function to calculate fourth episode so indifferent.

102

00:15:23.340 --> 00:15:34.560

Jun Makino: On to the for the main function well it's better to just to show their IT group made up quantifiable. The default predict function we just created and Sarah.

103

00:15:35.520 --> 00:15:46.290

Jun Makino: Single function to quote the different functions unfair question. So yes, but looks very much same out for standard, you know, standard to the court or whatever.

104

00:15:50.070 --> 00:15:54.540

Jun Makino: Yeah, it's a modified can be defined under this program is really how party right

105

00:15:55.770 --> 00:15:56.670

Jun Makino: On the

106

00:15:57.420 --> 00:15:59.280

Jun Makino: Point is that we can use their

107

00:15:59.370 --> 00:16:12.990

Jun Makino: We can now write them in Jackson County in the high level wrong. It's like that, like this one, and from which we can generate the quota for a big school or work. Excellent. And what whatever I included, I think, select the coup de

108

00:16:14.130 --> 00:16:17.880

Jun Makino: And they're here they are sort of an example without guessing we do you using

109

00:16:19.140 --> 00:16:25.320

Jun Makino: And he had so that's good. I see. I saw investigated or the Bahamas on the computer on and create

110

00:16:27.210 --> 00:16:37.770

Jun Makino: You can just see it as though they matter de escalating for their from from something 100 or two. There were up after nearly hour, and it's not a cost.

111

00:16:39.780 --> 00:16:51.060

Jun Makino: And that we have now quite a few course Deborah using GPS that that that forwards represent information or was a master crafter well why speech.

112

00:16:53.250 --> 00:17:05.070

Jun Makino: And there are quite a few papers are will publish. I'm probably still using HTTPS. So let me let me summarize. So that would be marking on the framework for the

113

00:17:05.730 --> 00:17:13.920

Jun Makino: By the political situation and it of us that are functions for the for the domain. The competition and political change on the on the trucks and cars.

114

00:17:14.490 --> 00:17:25.470

Jun Makino: And they can be used to implement pod spirits away any particular mission which to do body interactions and did it with a medical scalability and resiliency on more down type of

115

00:17:27.300 --> 00:17:43.320

Jun Makino: platforms like like a footlocker and and also the gap is so pure consulting regarding the court where we're looking for high profile court take terracotta if it a PS, or was there a course liberal ups.

116

00:17:44.370 --> 00:17:51.990

Jun Makino: And we also have any marketing on the path, quote, but we didn't have time for for the phone so that it. Thank you very much.

117

00:17:56.700 --> 00:17:58.890

Morgan Macleod: Thank you are wonderful talk.

118

00:18:00.180 --> 00:18:00.660

Morgan Macleod: So,

119

00:18:02.220 --> 00:18:12.120

Morgan Macleod: We, we have time for question and answer. And I guess I wanted to start the conversation.

120

00:18:13.620 --> 00:18:17.040

Morgan Macleod: Really generally and and ask about

121

00:18:23.820 --> 00:18:37.530

Morgan Macleod: I guess ask about sort of the abstraction of some of these tasks from the user. And because this is the year of pessimism. I want to ask about your sort of slide about the last hope.

122

00:18:38.670 --> 00:18:57.330

Morgan Macleod: So in a sense, the if I'm understanding correctly. The goal of a framework like this is to at least centralize the effort of

adapting these algorithms to each different architecture that comes along, whether that's

123

00:18:57.960 --> 00:19:05.160

Morgan Macleod: Different instruction sets for for particular architectures that that are coming into new computers.

124

00:19:06.360 --> 00:19:12.000

Morgan Macleod: Then at least that's being handled, not by every research group, but by

125

00:19:13.290 --> 00:19:24.420

Morgan Macleod: This sort of framework and one research group in common and. And the hope is that you can achieve the best results by not everybody reproducing that that effort.

126

00:19:26.160 --> 00:19:29.160

Morgan Macleod: But I guess something that I

127

00:19:31.650 --> 00:19:45.210

Morgan Macleod: I wanted to ask about is a something that I guess I've learned from reading your work, but also thinking about this in general is that each problem seems to demand very different

128

00:19:46.950 --> 00:19:49.770

Morgan Macleod: Algorithm in terms of achieving the best

129

00:19:51.780 --> 00:19:56.670

Morgan Macleod: Like the most precision that's possible for a given solution and and

130

00:19:58.440 --> 00:20:00.180

Morgan Macleod: So how does

131

00:20:01.890 --> 00:20:05.700

Morgan Macleod: How did this sort of user written kernels interact with

132

00:20:05.730 --> 00:20:07.290

Morgan Macleod: The framework below and in

133

00:20:07.320 --> 00:20:19.470

Morgan Macleod: Terms of achieving scalable code like if I want to write my own sort of kernel in that example that you are giving, how do I, in both like validate that. And then how do I

134

00:20:20.820 --> 00:20:22.050

Morgan Macleod: construct something that's

135

00:20:23.730 --> 00:20:27.120

Morgan Macleod: As optimal in terms of scaling and performance as possible.

136

00:20:28.140 --> 00:20:29.460

Morgan Macleod: For a given problem.

137

00:20:31.020 --> 00:20:35.880

Morgan Macleod: If I'm not also doing the sort of deeper level optimization

138

00:20:37.380 --> 00:20:38.010

Jun Makino: Well,

139

00:20:41.130 --> 00:20:44.580

Jun Makino: Well with food. Well, you got to

140

00:20:46.140 --> 00:20:47.190

Jun Makino: Say well

141

00:20:48.240 --> 00:20:53.010

Jun Makino: I appreciate that. Well, it's true that, you know, each deployment of

142

00:20:54.420 --> 00:20:58.890

Jun Makino: You call as well. Something different. But as far as the

143

00:21:00.690 --> 00:21:03.600

Jun Makino: Presentation is concerns are actually there.

144

00:21:04.800 --> 00:21:09.960

Jun Makino: You know, limited lander, not much different.

145

00:21:11.070 --> 00:21:16.410

Jun Makino: And the data, you know, I have my slides.

146

00:21:22.380 --> 00:21:22.710

Okay.

147

00:21:23.910 --> 00:21:24.360

Jun Makino: Yeah, okay.

148

00:21:27.090 --> 00:21:37.740

Jun Makino: Yeah, because you know as much time as mentioned in many cases it is a two hour, you know, you can just use the three cold and wet with some for some

149

00:21:39.900 --> 00:21:41.940

Jun Makino: Form of there are

150

00:21:44.130 --> 00:21:54.510

Jun Makino: Some changes change for the for the band very hands on and we can use them. I mean, part of what we want to answer the

151

00:21:55.590 --> 00:21:57.120

Jun Makino: Client to for the accuracy.

152

00:21:58.410 --> 00:22:06.540

Jun Makino: Of the introduction for the forecast podcast movies with it all. You can sense it essentially the random sampling. So, so the

153

00:22:06.990 --> 00:22:19.710

Jun Makino: The value doctor. She is a doctor. Okay, except for the bailiff bit RDP to defeat in which they're the same things. I would love to homogeneous order so that we need to pick a force from a, from a small small from populations.

154

00:22:20.520 --> 00:22:40.110

Jun Makino: And the for the exclamation. Um, well, the fact that matter concerns that sort of similar. That's the folder for SPS bottle. Of course, we sometimes hire. I guess it and the for the Starcraft and by the homeless and things. Things are much, much more difficult since we asked for all the orbits.

155

00:22:41.280 --> 00:22:50.730

Jun Makino: for very long, long, you know little bit menial mean orbits. So the fourth fourth fourth is not must be much market, however.

156

00:22:53.190 --> 00:22:54.300
Jun Makino: The most important

157

00:22:55.560 --> 00:23:10.590
Jun Makino: Thing, because that's the fourth from from nearby parties must must be calculated. Okay, to the answer that, candy, candy, but be down with a hybrid skiing and this is essentially the same idea as

158

00:23:11.820 --> 00:23:30.990
Jun Makino: As a code for like like knock knock a marketing machine bar is it's using for for for their to combine the simplicity scheme and under high highly accurate document for their eyes. Close Encounters of the planets, so

159

00:23:32.220 --> 00:23:34.200
Jun Makino: That's a nice, that's the

160

00:23:35.970 --> 00:23:36.780
Jun Makino: Way the schemes.

161

00:23:37.950 --> 00:23:40.800
Jun Makino: This idea of who they're also

162

00:23:42.240 --> 00:23:54.480
Jun Makino: Speaking can be used for the pretty wide lens of the oldest over the Bruins on CC CC it back. There are also you to use the Find accuracy for the defiant about over there.

163

00:23:57.990 --> 00:24:19.290
Morgan Macleod: Interesting and along the same lines, David Hernandez was asking which kind of gravitational and body simulations in particular, do we think have the greatest potential for improvement as far as speed using the flexible framework.

164

00:24:21.390 --> 00:24:25.770
Jun Makino: Um, well, you know, our award or our I

165

00:24:27.480 --> 00:24:28.230
Jun Makino: It's, you know,

166

00:24:29.550 --> 00:24:53.790
Jun Makino: To to to apply this kind of framework for anything which youth, youth more than, you know, our, you know, our selection of 10 10,000 or one one more practical and you know if the number is very

small, like, you know, if you want to do with a baby dog timing integration. Integration.

167

00:24:55.410 --> 00:25:11.460

Jun Makino: Officer, the eight eight planets of the solar system, you know, because you can play can't get much simpler from with rapid using their to equal to what you using that they're empty at our lesson but for

168

00:25:13.110 --> 00:25:17.160

Jun Makino: Me at opponents formats for which you want to do the

169

00:25:19.560 --> 00:25:25.140

Jun Makino: Developer the pirate code. Now you. I hope you don't give Kim can be a form

170

00:25:26.820 --> 00:25:29.250

Morgan Macleod: That's fantastic. And so I guess been

171

00:25:30.480 --> 00:25:31.530

Morgan Macleod: Is asking sort of

172

00:25:33.960 --> 00:25:47.610

Morgan Macleod: About the architecture, rather than the application. What do you think the potential of the meta programming approach is for more complicated architectures like FP Gs.

173

00:25:48.870 --> 00:25:49.410

Jun Makino: You

174

00:25:50.700 --> 00:25:55.980

Morgan Macleod: Maybe guess you can clarify. I actually don't know quite what you're referring to.

175

00:25:57.540 --> 00:26:09.420

Gus Beane: Yeah. Um, so like Field Programmable Gate Arrays I also don't know too much about them. I just know that they're like they have the potential to be like faster or as fast as GPUs, but can handle more complicated architectures are like data structures.

176

00:26:10.710 --> 00:26:12.210

Gus Beane: But they're really hard to program so

177

00:26:13.680 --> 00:26:14.490

Jun Makino: Now for

178

00:26:15.720 --> 00:26:23.790

Jun Makino: Example for the PCs are now you know further path based admissions, you know,

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00:26:25.110 --> 00:26:26.100

Jun Makino: I'm a point of view, that's

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00:26:27.630 --> 00:26:27.990

Jun Makino: It.

181

00:26:29.250 --> 00:26:29.670

Jun Makino: Yeah.

182

00:26:31.590 --> 00:26:33.690

Jun Makino: Here, you know, we

183

00:26:35.550 --> 00:26:35.910

Jun Makino: Have been

184

00:26:37.950 --> 00:26:38.220

Jun Makino: Using

185

00:26:38.970 --> 00:26:40.260

Jun Makino: Web switch it actually

186

00:26:40.470 --> 00:26:51.390

Jun Makino: Especially right before the intoxication. And for that, things like a PGA, we can actually use the essential assessing approach for we can actually use

187

00:26:52.440 --> 00:26:52.830

Jun Makino: Up.

188

00:26:55.170 --> 00:26:56.310

Jun Makino: As the accelerator for

189

00:26:57.450 --> 00:27:11.760

Jun Makino: Didn't really matter. Like I said, the PGP us just to do the intoxication, and the North kind of the compiler is much, you know, much, much easier to implement and I'm going to try this.

190

00:27:14.490 --> 00:27:17.580

Jun Makino: On, for example, that that entire

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00:27:18.690 --> 00:27:22.020

Jun Makino: look kind of the division between the

192

00:27:23.100 --> 00:27:23.970

Jun Makino: CPU and

193

00:27:26.040 --> 00:27:27.060

Jun Makino: The important thing to do.

194

00:27:35.910 --> 00:27:41.340

Morgan Macleod: I'm sorry, there's a trash truck right outside the window, which is why I was on mute.

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00:27:43.440 --> 00:27:47.850

Morgan Macleod: Let me check in for a moment is our second speaker when been Luke here.

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00:27:48.180 --> 00:27:48.810

Morgan Macleod: On the call.

197

00:27:50.370 --> 00:27:51.480

Morgan Macleod: I don't think so.

198

00:27:55.770 --> 00:27:57.540

Morgan Macleod: Okay. So given that, um,

199

00:27:59.370 --> 00:28:00.720

Jun Makino: He's actually Morgan.

200

00:28:01.350 --> 00:28:01.650

Oh,

201

00:28:03.420 --> 00:28:06.570

loeb: Wendy Lewis just if you look at the gallery is that

202

00:28:07.770 --> 00:28:08.640

Ana Bonaca: Okay, just like

203

00:28:09.030 --> 00:28:11.550

Wenbin Lu: Oh yeah, I just I just joined

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00:28:12.630 --> 00:28:12.780

Morgan Macleod: Us.

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00:28:14.130 --> 00:28:16.830

Wenbin Lu: The Times oh I miscalculated I'm so sorry.

206

00:28:16.920 --> 00:28:25.650

Morgan Macleod: No, no, no problem. I'm Jen We have one more. I had one more question for you. And this is

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00:28:28.200 --> 00:28:40.740

Morgan Macleod: Almost we've been talking about made a programming. This is meta academia. So I think one of the reasons that you highlighted the individual researchers are doing the sort of work is that

208

00:28:42.510 --> 00:28:55.020

Morgan Macleod: In the academic system that rewards like publishing on particular applications, perhaps more than building the tools. How do we, how do you think we set up a system.

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00:28:55.590 --> 00:28:56.370

That

210

00:28:59.100 --> 00:29:03.360

Morgan Macleod: Lets us build the infrastructure for sort of modern computational astrophysics.

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00:29:03.360 --> 00:29:03.690

Morgan Macleod: With

212

00:29:03.720 --> 00:29:04.800

Morgan Macleod: Which requires

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00:29:04.830 --> 00:29:06.420

Morgan Macleod: These sorts of frameworks and

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00:29:06.450 --> 00:29:08.430

Morgan Macleod: Optimize the algorithms for very

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00:29:08.880 --> 00:29:13.110

Morgan Macleod: Complex sort of architectures, which are different computer to computer

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00:29:15.420 --> 00:29:21.900

Morgan Macleod: Do you think that like how how how do we react as as sort of a global community to

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00:29:23.100 --> 00:29:25.740

Morgan Macleod: To optimize the human side of this process.

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00:29:28.200 --> 00:29:39.150

Jun Makino: Now, well that's, you know, that is, basically, you know, essentially the same question. Is the motivational I told myself, you know, they, they also need to look at

219

00:29:40.230 --> 00:29:48.210

Jun Makino: Their desk office and and and the software and things like that on there well put together.

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00:29:49.410 --> 00:29:52.380

Jun Makino: And they're happy well adjusted, they're

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00:29:53.550 --> 00:29:58.800

Jun Makino: Doing for the summer walk in that I'm developing software sounds

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00:30:01.170 --> 00:30:13.800

Jun Makino: And having them. There will be people are working on constantly on software's and of course the part of the leading that's, you know, for the for the

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00:30:15.300 --> 00:30:28.860

Jun Makino: Project. We do you do get some baby Clippy current forward for hardware. I mean, there's cokes. And we can use that small fraction of this big money to maintain the

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00:30:29.970 --> 00:30:33.990

Jun Makino: Certain groups and that is not not the case for our, you know,

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00:30:35.100 --> 00:30:41.370

Jun Makino: In South Africa as a political systems that we basically spent all the money for for for for the

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00:30:42.600 --> 00:30:55.980

Jun Makino: Human human body. So that's the, I think I'm even so we need to do something similar for the to to in a sense that we should make it clear that we are

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00:30:56.550 --> 00:31:13.950

Jun Makino: Developing something very close, you know, their counterpart over the telescope's for for for the vertical walk until that into to organize that. So our call to to develop and maintain the 30th for for for the community.

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00:31:15.060 --> 00:31:22.020

Morgan Macleod: I think that's a beautiful analogy to close on it because like the value of telescopes and astronomy is crystal clear.

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00:31:23.130 --> 00:31:24.030

Morgan Macleod: And

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00:31:24.810 --> 00:31:29.880

Morgan Macleod: It really emphasizes how essential these software tools are well thank you for a really

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00:31:29.940 --> 00:31:35.130

Morgan Macleod: Interesting perspective and talk and we're so grateful for, especially for your joining us

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00:31:36.300 --> 00:31:38.610

Morgan Macleod: Across the time zones. Thank you.

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00:31:42.660 --> 00:31:43.290

Jun Makino: Thank you.

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00:31:43.320 --> 00:31:43.890

Ana Bonaca: Ben, Ben.

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00:31:44.220 --> 00:31:47.580

Ana Bonaca: For joining us. I think this is. This may be our largest

236

00:31:47.610 --> 00:31:53.670

Jun Makino: timezone baseline that we've had that the physical appearance so depended California having

237

00:31:53.700 --> 00:32:01.230

Ana Bonaca: Our next speaker is spent in Luke, who is a fellow at Caltech before, is he got his PhD.

238

00:32:01.260 --> 00:32:02.940

Jun Makino: in astrophysics from UT

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00:32:02.940 --> 00:32:05.790

Ana Bonaca: Austin and his bachelor's degree from

240

00:32:05.790 --> 00:32:06.420

Physics.

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00:32:07.980 --> 00:32:08.970

Ana Bonaca: In physics, from

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00:32:09.330 --> 00:32:16.530

Ana Bonaca: PKU, and he has been working on a range of topics and the time domain astronomy, so I think

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00:32:17.400 --> 00:32:18.570

Ana Bonaca: Kind of destruction events.

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00:32:19.140 --> 00:32:28.350

Ana Bonaca: gamma ray bursts and frustrated verse and his for his mind being theoretical and I think for theorists who is kind of engaging in a very dangerous.

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00:32:29.250 --> 00:32:36.300

Ana Bonaca: Activity of making the predictions and and keeping a track of what the observational records show up them.

246

00:32:37.200 --> 00:32:54.060

Ana Bonaca: But it's been pretty successful so far it looks like. And today we'll hear about how his theory for for Dr. Jennifer Australia first compares to the latest observations from a number of stories that are currently going on. So without further if you want to take it away.

247

00:33:01.470 --> 00:33:02.580

Morgan Macleod: You're still muted women.

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00:33:02.580 --> 00:33:03.210

Ana Bonaca: Okay, yeah.

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00:33:03.600 --> 00:33:04.350

So yeah, I was

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00:33:11.130 --> 00:33:16.140

Wenbin Lu: So, okay. Sorry for the a bit of a delay. So here I'm going to present

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00:33:17.610 --> 00:33:25.470

Wenbin Lu: My work with all these people, thanks for all of them. And so the talk will have three components. The first one is really from

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00:33:25.890 --> 00:33:30.810

Wenbin Lu: From a pure, pure statistical point of view, how often to FRB is happen.

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00:33:31.380 --> 00:33:42.630

Wenbin Lu: And how often do you get brighter ones versus fainter wise. So that is the basic question before you really go into the FRB emission mechanism. How often, where are they right

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00:33:43.050 --> 00:33:58.770

Wenbin Lu: So the next one I'll go into the emission mechanism stealing stealing clues from the nearest FRB that we know and I'll argue that it is actually an F AR D and then towards the end I'll make predictions from our from our model.

255

00:34:00.000 --> 00:34:09.030

Wenbin Lu: Hopefully they will be falsified or approved somehow. But you know, that's the only way we move forward. I don't think I will have time to go to the polarization. But let's see.

256

00:34:10.380 --> 00:34:14.190

Wenbin Lu: So I will have like a one slide introduction or whatever. These are

257

00:34:15.330 --> 00:34:23.250

Wenbin Lu: Just in case people don't know so FRB is basically in one sentence is a highly dispersed short radio house. That's it.

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00:34:23.580 --> 00:34:32.190

Wenbin Lu: You know this. There's this disappear disperse of delay due to publication effects along the line of sight. If there is plasma alone or line of sight.

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00:34:32.460 --> 00:34:42.060

Wenbin Lu: Then you get this frequency, you know, the arrival time would be frequency dependent having this one of our new squared characteristic behavior.

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00:34:42.900 --> 00:34:52.980

Wenbin Lu: And from this sweeping sweeping time arrival time behavior, you can infer, how many free electrons are there along the line of sight. That is the column density shown over here.

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00:34:53.280 --> 00:35:02.610

Wenbin Lu: From for this particular FRB it's like 1000 which is much, much more than what's what we know within the Milky Way. So you really have to go beyond the Milky Way.

262

00:35:03.180 --> 00:35:08.940

Wenbin Lu: Once you go beyond the Milky Way he encountered the IGF, which is a very, very dilute you really have to go out

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00:35:09.240 --> 00:35:19.740

Wenbin Lu: Tremendous distance in order to see this amount of electrons. And that tells you that dispersed most likely from redshift of order one so very far away.

264

00:35:20.430 --> 00:35:32.520

Wenbin Lu: And other related issue is that they are scattering the scattering can broaden the house and the broadening behave such that is more broaden a lower frequency than higher frequencies and they are pretty bright. They're typically

265

00:35:33.000 --> 00:35:48.120

Wenbin Lu: The initial ones at least the jet ski level bright and the width. I'm showing the width really this the width over here for each frequency channel after dispersion the witness of order a millisecond later on they are you know a wide variety of wit.

266

00:35:49.170 --> 00:35:57.480

Wenbin Lu: So that's it. So now I'm going to jump to the topic, so everybody can go and make this clock, because the all that data is in this FRB catalog.

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00:35:57.930 --> 00:36:04.410

Wenbin Lu: What you have is the DM, which is the free code the column density of free electrons alone have line of sight.

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00:36:04.800 --> 00:36:09.690

Wenbin Lu: And I now have subtracted the Milky Way contribution which is typically small for the majority of the ones

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00:36:10.200 --> 00:36:16.050

Wenbin Lu: So this is the fluency. So we'll use the fluence because there's a flux which is in jet ski and there is a duration.

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00:36:16.530 --> 00:36:25.590

Wenbin Lu: The fluence is conserved along the propagation, despite your you have scattering broadening so that's why we're used fluids, so that you can see that they are

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00:36:26.250 --> 00:36:38.640

Wenbin Lu: DM is roughly an indicator of the distance on the right there farther away on the left there closer by in the nearby universe, roughly speaking gm of 1000 corresponds to rush up to one and here is ratio of point one ish

272

00:36:39.270 --> 00:36:42.600

Wenbin Lu: There are uncertainties on the host galaxy contribution so

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00:36:43.260 --> 00:36:49.230

Wenbin Lu: Very easy thing. You can see that they are you know these telescopes, they discover a lot of them. So right now I haven't put chime

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00:36:49.530 --> 00:36:56.520

Wenbin Lu: Chime if I if I were time hasn't published their single verse. Yet, if I were to put time on it. This entire flow of the overflow.

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00:36:56.790 --> 00:37:07.680

Wenbin Lu: Overwhelmed by this blue square green squared, you won't be able to see the otherwise. But anyway, now the timelines, like a third of them are single, and they only release those those ones and

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00:37:08.400 --> 00:37:12.540

Wenbin Lu: Two thirds of them are actually repeaters I included the first one for those repeating sequence.

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00:37:12.870 --> 00:37:23.010

Wenbin Lu: So let's look at three different telescopes DSI time which can which caught this one actually it was able to localize this one to a host galaxy roughly corresponds to this. The indicated

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00:37:23.670 --> 00:37:33.780

Wenbin Lu: Redshift actually so TM is a pretty good indicator for the distance and ASCAP detected something like 20 and chime has something like 20 ish 30 maybe

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00:37:34.530 --> 00:37:44.970

Wenbin Lu: Bursts. And the parks, of course, has a lot. So each telescope. You can see that there's roughly a fluency threshold below which you're not able to see purse, you know, very reasonable because the first are

280

00:37:45.540 --> 00:37:54.540

Wenbin Lu: Very below noise and here on the left hand side your volume limited so you won't be able to see a lot of verse because you have a finite field of view. They're just not much of a volume.

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00:37:55.020 --> 00:38:02.280

Wenbin Lu: And below here your fluency limited and under very large DM side your DM smearing limited because the DM

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00:38:02.790 --> 00:38:18.210

Wenbin Lu: You always have a finite frequency channel. So for within one frequency channel you have some disperse of delay and that restricted your birth with the longer the with this, the more noise you end up getting. So that's the that restrict so there is a various very

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00:38:19.560 --> 00:38:29.790

Wenbin Lu: Very obvious thing that we're lacking first on the right upper right corner. So they are very far away. They're very bright. So that intrinsically numinous, where are they right

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00:38:30.990 --> 00:38:37.500

Wenbin Lu: That's another that's that will be a question that I will answer very soon. So another thing you notice that there are these repeaters. So this one was the

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00:38:37.980 --> 00:38:45.900

Wenbin Lu: Receiver repeater 12 1102 very famous repeater. So we have seen a wide range of fluency is from this single source.

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00:38:46.230 --> 00:38:53.370

Wenbin Lu: Of course, the majority of them are very faint. There are discovered by fast telescope. There are thousands of them already collected the one of them.

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00:38:54.150 --> 00:39:07.050

Wenbin Lu: Which is from different telescope less sensitive telescope, but they followed up for hundreds of hours they found like a 30 games can be the second. First, you can see that this guy was able to generate a broad range of influences or intrinsic energy

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00:39:07.650 --> 00:39:15.060

Wenbin Lu: And this one was found by Arecibo about ASCAP, the first one was like 300 milliseconds ASCAP followed up for

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00:39:15.960 --> 00:39:21.390

Wenbin Lu: More than 1000 hours didn't see anything. Later on they followed up with GBT and found a couple of person over here.

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00:39:21.900 --> 00:39:24.780

Wenbin Lu: You can see that there is repeaters, they can do all you want.

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00:39:25.290 --> 00:39:38.700

Wenbin Lu: They can actually generate nearly all birth at least phenomenon, logically, it can generate nearly all your verse. So there is this art. This is there is this debate whether all FRB come from repeater, or they are some intrinsically single ones.

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00:39:39.180 --> 00:39:43.500

Wenbin Lu: From this you can see that repeater can actually do all. There's no limit for them.

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00:39:44.610 --> 00:39:50.130

Wenbin Lu: So, so very quickly. I'm going to go through how the F sharp is are detected. There are two different ways.

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00:39:50.580 --> 00:39:56.430

Wenbin Lu: In general, so they are. These are simple and parks strategy where they have multi beam receiver.

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00:39:56.850 --> 00:40:06.900

Wenbin Lu: Right, you can see that parks has 13 beams. The problem for this is that you have gaps sensitivity gaps here the circles showing where the sensitivity is half of that at the beam center.

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00:40:07.470 --> 00:40:16.380

Wenbin Lu: And actually, for this Arecibo this, this one was 12 1102 So later on after localization people realize that actually 1211 a tool was discovered in a silo.

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00:40:16.710 --> 00:40:23.400

Wenbin Lu: But before localization, you're actually don't know you don't you don't know where exactly it is you only know that it was distracted by this beam.

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00:40:23.970 --> 00:40:35.250

Wenbin Lu: So you don't know what the telescope response function and hence you don't know the fluence many of the fluids for parks or just only and lower limits on these ones, they can make use of multi beam.

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00:40:35.760 --> 00:40:41.130

Wenbin Lu: Information, because he was detected by this beam, not by Jason beam. So you can, you can't. It can't be too bright.

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00:40:41.460 --> 00:40:49.650

Wenbin Lu: So that are, you know, there's the limits but majority of days, including chime and power experts their influences are very uncertain, because we don't actually know where they are.

301

00:40:50.070 --> 00:40:58.950

Wenbin Lu: At whereas for ASCAP is really nice because they have 36 telescopes. They only make use of the main beam each telescope has one main be

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00:40:59.790 --> 00:41:06.930

Wenbin Lu: They arrange the beam such that they overlap substantially for, for instance, this verse was detected by or nine teams.

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00:41:07.530 --> 00:41:16.470

Wenbin Lu: So now you can make use of the influence contrast between the nine beams and actually that can enables you to pin down the position. Much better.

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00:41:16.920 --> 00:41:27.750

Wenbin Lu: From one degree, which is a half beam size to about 10 minutes so that enables a precise relatively precise measurement of the fluence so only these ASCAP verse

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00:41:28.380 --> 00:41:39.870

Wenbin Lu: Have as precise fluence element fluence measurement not most of these are they don't. So let me use a let me make use of the ASCAP sample, just to influence, just to

306

00:41:41.040 --> 00:41:50.760

Wenbin Lu: Estimate, what, how often do FRB happen and for a volumetric rate density. So first, you look at the sample, just to see whether the sample is complete.

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00:41:50.970 --> 00:41:59.610

Wenbin Lu: What is the fluids to show below which is not complete. Right, very easy to do you plot the width. This is a total with the total with is a convolution of the

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00:41:59.940 --> 00:42:07.500

Wenbin Lu: Arrival that without arrival, which has already been affected by propagation effects which doesn't matter for our purpose because we're looking at a fluence anyway.

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00:42:08.010 --> 00:42:24.990

Wenbin Lu: And it has sampling time has this DM smearing as I mentioned the SNR the signal to noise ratio goes as fluence divided by the square root of with see if the person gets somehow widened the signal to noise ratio drops. So there is this fluence incomplete so

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00:42:26.070 --> 00:42:35.040

Wenbin Lu: Let's say if you draw a horizontal line at some fluence so you always have this fluence incomplete in this region, what. So what's good for this strategy for

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00:42:35.520 --> 00:42:48.750

Wenbin Lu: Selecting fluence and what is that the fluids in incompleteness only occurs at for sufficiently wide bursts sufficiently brought vers sa for here is, it has to be broader than something like

312

00:42:49.230 --> 00:42:59.670

Wenbin Lu: Maybe five to seven milliseconds. And we know that those births are very rare shown from here. You don't see those bursts. So we know that this sample is roughly complete

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00:42:59.970 --> 00:43:10.290

Wenbin Lu: The above fluence of 50 chance Melissa millisecond. So that enables us enabled me to actually only selected this verse, and we know roughly from the DMZ. We know their

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00:43:10.770 --> 00:43:17.100

Wenbin Lu: Distances and so we know the volume. And we know that integrate integrated time so that enable me to to a

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00:43:17.580 --> 00:43:25.530

Wenbin Lu: BSE analysis and this is the volumetric rate density function because we have a broad range of energy. So here, this is

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00:43:25.950 --> 00:43:34.980

Wenbin Lu: This is showing roughly like a Schecter function shown in the this is the volumetric ID and the log eat. So this he is this specific energy

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00:43:35.490 --> 00:43:43.590

Wenbin Lu: I basically go from genzken millisecond multiply by distance squared, you get this earth for hurts unit, you know, natural unit. So you can see that

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00:43:44.190 --> 00:43:51.870

Wenbin Lu: Roughly follows a power law. Here's the power index something like 1.6 but the arrow is very large, because you don't have lot much larger of our level arm.

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00:43:52.320 --> 00:43:56.550

Wenbin Lu: There seems to be a maximum energy above which the radius exponentially.

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00:43:57.150 --> 00:44:10.410

Wenbin Lu: Suppressed and this is shown over here. And I also did the same analysis on the same sample, but we use another use an independent method, which is this one over V max method, which has been widely used for Ag and galaxy account.

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00:44:11.040 --> 00:44:13.890

Wenbin Lu: And this is a normalization. So a speculation that I'm going to

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00:44:14.040 --> 00:44:15.150

Wenbin Lu: quickly mention is that

323

00:44:15.300 --> 00:44:24.030

Wenbin Lu: What causes this maximum energy. You can convert that because it's gigahertz with multiply by gigahertz, and then divided by the millisecond, you get a luminosity.

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00:44:24.480 --> 00:44:30.420

Wenbin Lu: This is no Manassas so fo our BES seem to have a maximum luminosity. So this maximum luminosity.

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00:44:30.960 --> 00:44:39.390

Wenbin Lu: You can convert that into an electric field strength at the surface of a neutron star, what you find is that about 10 to the year tend to the 12 as you

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00:44:39.870 --> 00:44:49.710

Wenbin Lu: Converted in cow says roughly 10 to the 12 Gauss in the magnetic field strength and that is a few percent of the quantum shrink or limit. So we speculated that this might be

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00:44:50.070 --> 00:44:56.850

Wenbin Lu: A this shrink or pair production might be the reason why FRB is cannot be generated about this luminosity.

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00:44:57.210 --> 00:45:01.980

Wenbin Lu: But the luminosity is very uncertain. There's some uncertainty over there, which will be pinned down in future data.

329

00:45:02.400 --> 00:45:10.530

Wenbin Lu: So you plot this maximum energy over here, you see that there is indeed a lack of bursts. So they're they're here I'm showing the ISO energy

330

00:45:11.190 --> 00:45:24.390

Wenbin Lu: Lines over here. These are the Aero bars over here. So that's the first thing. So later on people discover this FRB in April 28 of this year they discover this FRB

331

00:45:25.350 --> 00:45:31.950

Wenbin Lu: A mega jet ski burst from one of the SGR met one of the magnitude is in the Milky Way. You can plot that know volumetric

332

00:45:32.280 --> 00:45:39.510

Wenbin Lu: Volumetric rate overflow with my, you know, in for ASCAP inferred kind of luminosity function, you see that the roughly agree.

333

00:45:40.080 --> 00:45:56.190

Wenbin Lu: So that argues that this one was really an FRB it's a natural extension of the overall population and including this point you can

actually pin down this power index much more because this longer lever arm is something like 1.9 so close to to

334

00:45:56.700 --> 00:46:06.300

Wenbin Lu: To is a critical index indicative of the gamma is to it indicates there's equal amount of energy radiated from the highest end over here and the lowest end

335

00:46:06.660 --> 00:46:11.910

Wenbin Lu: That's, I don't know. I don't know what causes that and I want to argue that this. So, this

336

00:46:12.300 --> 00:46:24.570

Wenbin Lu: Galactic magnet our source is basically a repeater, it cannot just be that you know chime or stare to was just able to catch once in a lifetime. First thing that was a repeater, and also I have also included this

337

00:46:25.140 --> 00:46:31.830

Wenbin Lu: A child repeater, which is the famous periodic repeater, you can see that repeaters actually contribute a significant amount

338

00:46:32.190 --> 00:46:44.460

Wenbin Lu: Fraction actually a significant fraction of the total volume medical grade. So that argues, although these ones there. Most of them are only single it detected, I believe that the ocean, most likely, they should all repeat

339

00:46:45.810 --> 00:46:53.520

Wenbin Lu: So that and also the rate is very high risk is much higher than core collapse rate which is over here tend to the five gigahertz IQ per year.

340

00:46:53.820 --> 00:47:06.600

Wenbin Lu: So really too high to explain by any of these compact your objective is only a cataclysmic source. So I think they are repeaters, so I'm going to go to my next stop before going that. Can I ask for some questions.

341

00:47:11.760 --> 00:47:17.640

Morgan Macleod: Maybe with our format. I think it makes most sense to keep going and then we'll have questions at the end.

342

00:47:17.910 --> 00:47:22.530

Wenbin Lu: Okay, let me keep going. So let me look at the emission mechanism so completely different topic.

343

00:47:23.820 --> 00:47:29.220

Wenbin Lu: So it's the first we have new data from this galactic galactic source.

344

00:47:29.370 --> 00:47:30.690

Wenbin Lu: Which I now call it FRB

345

00:47:31.440 --> 00:47:45.720

Wenbin Lu: 2004 28 so it has the most amount of data because it has x ray counterpart as very good multi multi frequency coverage. So let me start from this guy. The other ones are could be similarly deal with

346

00:47:46.200 --> 00:48:00.960

Wenbin Lu: So this one had a it was detected by chime in the low frequency range you know 400 to 800 megahertz and then detected at the same time detected by stare to at higher frequencies have shown over here. The first house was not detected

347

00:48:02.010 --> 00:48:10.500

Wenbin Lu: The first powers was not detected by stare to, you know, there is not much fluence there is not much flux over here. Anyway, so it's not surprising, but a second pose.

348

00:48:10.980 --> 00:48:19.320

Wenbin Lu: The policies are separated by 30 milliseconds. You can show here. The second post was co detected by stare to buy stare to and shine.

349

00:48:21.060 --> 00:48:31.230

Wenbin Lu: So they actually after the dispersion the alignment is so good. So actually, it's much better than a millisecond, you can see that there's the initial across the wide range of frequency

350

00:48:31.800 --> 00:48:40.680

Wenbin Lu: From point five to 1.5 gigahertz, a factor of three really comes from the same position at the same time. So, and also accompanied by

351

00:48:41.460 --> 00:48:49.680

Wenbin Lu: The radio verse there is a there's extra emission, which actually reduces a lot more energy tend to the 40 Eric's lasted for something like point three seconds.

352

00:48:49.980 --> 00:48:56.130

Wenbin Lu: With lots of millisecond spikes and two of the spikes are actually roughly aligned with the radio poses.

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00:48:56.760 --> 00:49:03.000

Wenbin Lu: So this, I would argue that the X rays are most likely from the magnetosphere, because this tend to the 40 erc's

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00:49:03.240 --> 00:49:11.910

Wenbin Lu: Won't be able to escape. It's most likely confined by the clothes be felines so a minimum model that you make, even if you forget about all the previous work.

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00:49:12.180 --> 00:49:21.270

Wenbin Lu: And a minimum amount of you make is that all of them come from the magnetosphere right so let's start from the magnetosphere and see what magnetosphere can do

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00:49:21.660 --> 00:49:29.640

Wenbin Lu: So there are two approaches. I want to present one of the approach is a top down approach. So you approach the problem from the observers point of view.

357

00:49:29.910 --> 00:49:38.070

Wenbin Lu: So, what we saw was that there's FRB luminosity as a choppy equivalent tend to the 38 or six per second and four.

358

00:49:39.000 --> 00:49:52.230

Wenbin Lu: Gigahertz waves from the magnetosphere. We know that the curvature emission is the most likely scenario. So invoking curvature emission you need Laurens factor of other 100 hero is the curvature radius in units of 100 kilometers.

359

00:49:53.310 --> 00:49:59.610

Wenbin Lu: So Lauren's factor 100 so each but he electron only radiates a little bit very small conversational Manassas

360

00:50:00.000 --> 00:50:14.790

Wenbin Lu: You need a huge number of particles are radiating in face. This is the total number of particles you need for each so cold call it clump clump has to be sufficiently compact within a wavelength in along the tuna direction and the transverse direction could be longer.

361

00:50:16.680 --> 00:50:26.310

Wenbin Lu: Having this number of particles, you can calculate what's the total kinetic energy of this month particles. And this is a total luminosity corrected for be mean and time dilation.

362

00:50:26.820 --> 00:50:37.890

Wenbin Lu: This is the cooling time that you get, you see that the cooling time is extremely short such that the club basically won't be able to read it for like a nanosecond so you won't be able to generate gigahertz waves.

363

00:50:38.280 --> 00:50:48.420

Wenbin Lu: What happens is that there must be an electric field. It's basically like a wires. You have a you know antenna in the antenna, the electrons carry a little a very, very small my new school

364

00:50:48.870 --> 00:50:57.990

Wenbin Lu: Kinetic energy, you really need the EMF, you need the electric field to drive them. So the electric field can only come when the plasma charges starved.

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00:50:58.440 --> 00:51:04.740

Wenbin Lu: If it is not, then you end up you know any Kirby just give you a current. So, there will be a current flowing along the bluefields all the time.

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00:51:05.100 --> 00:51:12.000

Wenbin Lu: Only when you're charging starved. You're like a capacitor. Now you develop this displacement current which is electric field.

367

00:51:12.510 --> 00:51:22.110

Wenbin Lu: So electric field development requires that the charge density to be less than you know what Kirby requires for the current that's for the charges starvation.

368

00:51:22.560 --> 00:51:30.750

Wenbin Lu: And also we require that the charge density is sufficiently high, sex, the plasma frequency is higher than gigahertz, otherwise you won't get this is clumps.

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00:51:31.620 --> 00:51:38.820

Wenbin Lu: So that's the minimum model for top down approach. It's also approach from the bottom up approach, because we have X rays.

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00:51:39.300 --> 00:51:46.170

Wenbin Lu: So the X rays, roughly, we know the X rays are, let's say generated from near the surface of a neutron star, let's imagine you have a trigger.

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00:51:46.680 --> 00:51:57.690

Wenbin Lu: Some, it could be triggered by, you know, star quake or a magnetic reconnection on the surface. What happens is that this trigger not only releases gravitational energy, it shakes the surface of a neutron star.

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00:51:58.320 --> 00:52:09.930

Wenbin Lu: The shaking is done in the following way. It sends out this so called shear waves. So shear wave is type of wave that preserves volume, so it does not engage any compression

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00:52:10.200 --> 00:52:21.360

Wenbin Lu: Or this compression of force because compression is very difficult. Here is dumped the pressure is dominant by neutron degeneracy pressure very large, you cannot really do much of a compression on this material.

374

00:52:21.780 --> 00:52:32.310

Wenbin Lu: And this is a horizontal shear wave. So it does not to work against gravity, which is also very difficult. So it's a horizontal shear with shear with frequency and the shear with speed is going over here.

375

00:52:33.300 --> 00:52:38.910

Wenbin Lu: Frequency is roughly the, you know, the thickness of the cross divided by the shear speed.

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00:52:39.780 --> 00:52:54.900

Wenbin Lu: The shear can only propagate the cross, which is solid in the liquid course year with doesn't exist. Now imagine that they are field lines anchored on the surface of a neutron star is shear waves horizontal shape shaking or send our fame waves into the magnetosphere.

377

00:52:56.160 --> 00:53:05.940

Wenbin Lu: And you can look at the trends that impedance match in and look at the transmission coefficient is very high, or an order unity fraction of the shear wave energy will be transmitted into the magnetosphere.

378

00:53:06.390 --> 00:53:12.450

Wenbin Lu: And what will happen is that this man, you know, imagine that you have those are facing waves into in the entire magnetosphere.

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00:53:12.930 --> 00:53:22.860

Wenbin Lu: And these alpha waves in the clothes feline region close to the neutron star surface. They won't escape. What will happen is that the cascade into smaller scales and a Gen X rays.

380

00:53:23.310 --> 00:53:33.540

Wenbin Lu: So that's the typical view where how x rays are generated and the sheer was mass propagate it will get all the way to the polls were felines extend too much larger distances.

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00:53:33.930 --> 00:53:43.560

Wenbin Lu: What will happen is that imagine you have our Fang wave packet lungs from near the pose. They can propagate too much larger distances and

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00:53:44.190 --> 00:53:50.730

Wenbin Lu: The group speed is moves along the beefy line. So the way packet actually gets wider and wider the bundle widens

383

00:53:51.060 --> 00:54:01.380

Wenbin Lu: You can calculate what the current. What's the current density needed to sustain such an alpha wave and the current density goes as, you know, curl of the alpha wave amplitude

384

00:54:02.250 --> 00:54:11.400

Wenbin Lu: So at some point at some large distance you will end up having charged starvation, because the charts. The answer is too low, as some large distances and then you have

385

00:54:11.940 --> 00:54:22.800

Wenbin Lu: Instead of current you have displacement current which is electric field and let you feel it can do work on charge clumps, which launches gigahertz waves. So we're curvature mechanism.

386

00:54:23.340 --> 00:54:34.920

Wenbin Lu: So that's the basic picture shown over here. So having this basic picture I'm ready to make a unified picture make for presentation, I have two more slides so

387

00:54:35.550 --> 00:54:43.260

Wenbin Lu: Very quickly. So again, the picture is likely you have a trigger. And there are sheer waves propagating through the neutron star.

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00:54:43.830 --> 00:54:49.710

Wenbin Lu: Most of the region is covered by close few lines. I mean, the felines don't extend too much too far of a distance.

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00:54:49.980 --> 00:54:58.380

Wenbin Lu: These words. This will be the alpha waves were generated X rays. Whereas, where the felines extend to large distances 10s hundreds of neutron star VDI

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00:54:58.800 --> 00:55:09.300

Wenbin Lu: The alpha waves can get to large distances, where they become charges starved and then generate fri BS. Right. We don't know the charge distribution density distribution in the magnetosphere.

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00:55:09.600 --> 00:55:17.670

Wenbin Lu: What I can only do is that if you tell me what the charges starvation radius is I can estimate. What's the density plasma density

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00:55:17.970 --> 00:55:30.450

Wenbin Lu: And from that, I can estimate what the luminosity is because I know how many particles within one clump, so I can estimate luminosity. And it depends on the elfin amplitude at the footprint.

393

00:55:31.050 --> 00:55:42.690

Wenbin Lu: Of these few lines and depends on charges starvation radius which are the free parameters. If you can see the strong dependence leader, allow me to predict a wide range of luminosity from this model.

394

00:55:43.530 --> 00:55:51.330

Wenbin Lu: There are other predictions on the BB NGO, which is could be pretty wide depending on which field line on which they're charging starvation happens

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00:55:52.050 --> 00:56:01.320

Wenbin Lu: And there's the duration is a voter a millisecond. So basically the sheer way publication time and it can generate narrow frequency structure and their of

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00:56:02.520 --> 00:56:21.390

Wenbin Lu: temporal structure and effort the radio to x ray luminosity ratio can also be reproduced and later. I don't have time. But we can generate linear polarization, because the extra the the radio mission is basically given in one mode which is so called X mode which is linearly polarized.

397

00:56:22.770 --> 00:56:29.460

Wenbin Lu: This is my last slide. So here I'm giving you the overall picture of for the entire so the entire parameter space.

398

00:56:30.090 --> 00:56:38.340

Wenbin Lu: What the prediction is so here I'm predicting the luminosity in log units over here. So this model can generate from the faintest ones.

399

00:56:38.730 --> 00:56:44.370

Wenbin Lu: To to the 36 or eight per second to the brightest events. These are the brightest localized events.

400

00:56:45.000 --> 00:56:50.340

Wenbin Lu: There the near the maximum luminosity actually they are this repeaters they show a wide range of luminosity.

401

00:56:51.000 --> 00:57:01.290

Wenbin Lu: Repetitions and there are those boundaries and I mentioned that this boundaries, the shrink or pair production and this boundary is the two local charge density has to be sufficiently high

402

00:57:01.860 --> 00:57:13.770

Wenbin Lu: And they are long linearity that alpha wave can become nonlinear about this limit. So these are the predictions from our model. So you can explain this galactic FRB as well as cosmological effort abuse.

403

00:57:14.940 --> 00:57:24.120

Wenbin Lu: So I'm going to show my summary slide I'm going to walk through, not through the these are I think you already know, but the model really comes from, you know, sheer waves.

404

00:57:24.540 --> 00:57:33.390

Wenbin Lu: Goes to magnetosphere. Our thang waves and charges, starvation, which could happen actually a large distances, maybe a few 10s of nutrients that radio

405

00:57:34.200 --> 00:57:48.060

Wenbin Lu: And then charges starvation keeps you electric field which can drive current curvature emission this stage this pic simulation. So I'm working on this stage at this moment, and I'm pretty sure that this I think this should happen.

406

00:57:49.320 --> 00:57:53.250

Wenbin Lu: There's not the other predictions. That's all my present presentation, thanks.

407

00:57:54.660 --> 00:57:55.470

Morgan Macleod: Thank you. And then

408

00:57:56.490 --> 00:58:12.480

Morgan Macleod: We have time for a couple moments of questions now and then, but I think there's been a really rich, beautiful talk him. So I want to ask everyone to move the extended discussion to the slack and I know that you're signed up there so

409

00:58:14.160 --> 00:58:25.650

Morgan Macleod: So first of all, it asks the infrared co moving density of single pulse that fire beads requires a production rate of sources that's comparable with core collapse.

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00:58:25.710 --> 00:58:35.520

Morgan Macleod: Supernovae. So how can rare relatively rare magnetometers like the Galactic source be responsible for all of our bees.

411

00:58:37.530 --> 00:58:40.230

Wenbin Lu: Okay, thanks for the question. Because that repeaters

412

00:58:41.340 --> 00:58:46.860

Wenbin Lu: Let's say I don't believe that the Galactic McIntyre is capable of generating all days.

413

00:58:47.340 --> 00:58:53.760

Wenbin Lu: That the Galactic magnet are roughly speaking at this energies, so, It repeats at all different energies roughly at

414

00:58:54.270 --> 00:59:03.570

Wenbin Lu: Writer ones they repeat it repeats less often at the center was a repeat more often. So roughly at this energy scale tend to the 26 or four hertz.

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00:59:03.840 --> 00:59:10.290

Wenbin Lu: Roughly, like a mega Jen skill level within the politics within the, within the Milky Way it repeats roughly once per year.

416

00:59:10.740 --> 00:59:16.860

Wenbin Lu: So you really have to wait like a horrible time if you extrapolate that if you assume this power of slope.

417

00:59:17.250 --> 00:59:26.580

Wenbin Lu: The rate really repeating rate goes in like this power or slope, you have to wait a huge long time what you need. What you need is that they are tremendous number of this magnitude

418

00:59:27.210 --> 00:59:41.970

Wenbin Lu: In each trigger persecute they are tend to the eight of these galactic millimeters. So statistically, you still have some final chance of catching some of them from this even like less energetic normal magnetometers. So there's still hope.

419

00:59:42.990 --> 00:59:48.330

Wenbin Lu: Whereas this guy, which is a one of the prolific repeater. I think this one is is not a

420

00:59:48.900 --> 01:00:03.450

Wenbin Lu: Normal typical magnetar like what we see in the Milky Way. It's a special active magnetometer which we don't have much information now because it will our knowledge are mandatory only restricted to the Milky Way. We don't know much about magnet cars across the universe.

421

01:00:04.590 --> 01:00:06.330

Wenbin Lu: That's my understanding. Thanks for the question.

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01:00:08.970 --> 01:00:09.780

Morgan Macleod: And then

423

01:00:12.180 --> 01:00:12.810

Morgan Macleod: So,

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01:00:14.190 --> 01:00:22.620

Morgan Macleod: One last question for now. And then there's quite a few coming in on the slack. So I'll ask you to engage that, but what are

425

01:00:24.480 --> 01:00:29.130

Morgan Macleod: From Julian. Who knows what are the odds that you give to having

426

01:00:29.520 --> 01:00:43.920

Morgan Macleod: More than one type of mechanism. So I think a beautiful aspect of your work is that it explains how these sort of disparate models can be explained potentially under one umbrella, but what

427

01:00:44.640 --> 01:00:54.990

Morgan Macleod: What do you think, do you think it's possible that there's more than one mechanism and then doing also asks if so could we test if there are two populations using the chime data.

428

01:00:56.160 --> 01:01:02.940

Wenbin Lu: Yes. So yes, that's a very critical. It's very important question. So, first as a theorist, I

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01:01:03.360 --> 01:01:11.940

Wenbin Lu: Am completely open minded, there could be multiple mechanisms and only in like trying to push along this direction, which I think that's the most natural

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01:01:12.480 --> 01:01:20.790

Wenbin Lu: Way of generating F RBS, there could be multiple other mechanisms, but I don't believe those ones that are that the rates are too small.

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01:01:21.150 --> 01:01:35.010

Wenbin Lu: If it is a cataclysmic I think it's less likely. If it is a repeating, you know, if it, if it has the repeated behavior. I think that's more likely, and people should continue to pursue but I pursue the ones that are I think most natural

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01:01:36.090 --> 01:01:46.500

Wenbin Lu: So I'm on this one, but I'm completely open minded. So in terms of multiple populations probed by chime I think China has the greatest potential

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01:01:46.980 --> 01:01:49.170

Wenbin Lu: None of the other Telescope have this, you know,

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01:01:49.680 --> 01:01:56.940

Wenbin Lu: Huge sample of repeater, and now repeater. So what chime needs to do the Chinese team needs to do is to compare

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01:01:57.180 --> 01:02:07.140

Wenbin Lu: The repeating sample and now repeating sample. So for the first number they know is the, what's the fraction that are repeating right. What's the fraction of the sources that repeat and that

436

01:02:07.770 --> 01:02:19.530

Wenbin Lu: Depends on the repeating rates. If you want to make a unified model where all of them are repeating, you have to arrange such that not all of them are detected as repeaters, but they actually intrinsically repeat

437

01:02:19.800 --> 01:02:35.520

Wenbin Lu: So that is a I think there is a lot of work to do on along that line. Um, I just touched that line a little bit like recently, but I haven't done much. I think there is room for singly like cataclysmic sources, but the room is not much

438

01:02:36.660 --> 01:02:38.160

Wenbin Lu: That's my. That's my understanding.

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01:02:39.690 --> 01:02:47.730

Morgan Macleod: Well thank you very fascinating talk. So on the slack. We have questions about the polarization periodicity.

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01:02:50.190 --> 01:02:50.850

Morgan Macleod: Like

441

01:02:52.500 --> 01:02:54.450

Morgan Macleod: Mapping them.

442

01:02:55.650 --> 01:03:08.010

Morgan Macleod: And and more so, so feel free to post links there to to, you know, the work you've been doing. And we're, we're really excited to continue the discussion and thank you so much for joining us.

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01:03:08.400 --> 01:03:09.660

Thanks to our speakers.

444

01:03:10.980 --> 01:03:13.500

Morgan Macleod: And for our local participants.

445

01:03:14.730 --> 01:03:21.150

Morgan Macleod: We will convene here in the in cyberspace next week. Thank you all.

446

01:03:22.080 --> 01:03:25.230

Wenbin Lu: Thank you, Ryan. Thanks so much. Thanks for the questions.

447

01:03:35.460 --> 01:03:38.520

Morgan Macleod: Thank you again. One minute. I've got that it worked out.