WEBVTT

1
00:00:00.000 --> 00:00:00.750
Geraldine Servant: Which to capital.

2
00:00:03.540 --> 00:00:08.220
Geraldine Servant: T deck give a snapshot of the universe at this temperature

3
00:00:11.940 --> 00:00:25.620
Geraldine Servant: Okay, so as the photons decoupled from the electron wrote on plasma when the universe is around 400,000 years old, we cannot use the electromagnetic proof to learn about the early times

4
00:00:27.060 --> 00:00:46.170
Geraldine Servant: On the other hand, because gravity so weak and greatest on web decouple extremely early and you can estimate from the size of interactions with here. This is a ratio of the rate of interactions of the Gravity Forms and the rate of expansion. Geez, the Newton constant and find that temperature

5
00:00:47.190 --> 00:00:47.880
Geraldine Servant: Below.

6
00:00:49.140 --> 00:00:49.950
Geraldine Servant: And blank.

7
00:00:51.090 --> 00:01:03.780
Geraldine Servant: Where additional ways essentially coupled. Okay, so that pro can propagate freely in the living in the universe and T today, and they do not use memory of conditions when produced

8
00:01:05.970 --> 00:01:25.740
Geraldine Servant: They retain the spectral shape. The typical frequency and intensity which is characteristic of their production mechanism, they encode information about particle physics at high energy scales that we never be able to probe in traditional experiments or size Particle colliders

9
00:01:27.390 --> 00:01:43.140
Geraldine Servant: So here, this I'm denoting here row is the energy density in gravitational wave today, which is related to the energy and gravitational waves as a time of their production and then you have the user Richie factors are achieved like

10
00:01:44.190 --> 00:01:45.000
Geraldine Servant: Radiation

11
00:01:46.020 --> 00:01:48.480
Geraldine Servant: One over eight is, of course, okay so

12
00:01:49.530 --> 00:01:59.130
Geraldine Servant: By VCs is factor here is going to tell you about the cosmic evolution, so you are able to probe vs and beyond the standard model of cosmology.

13
00:01:59.970 --> 00:02:16.170
Geraldine Servant: And in really year. This tells you about the production mechanisms and this goes all information about particle physics and physics beyond the standard model, which would like to learn about gravitational wave observations.

14
00:02:18.090 --> 00:02:31.710
Geraldine Servant: So the whole idea here is to throw the cosmological history with religion and waves and to relate to the scene of the school here is the report cosmological Dark Ages period when we expect

15
00:02:32.940 --> 00:02:53.220
Geraldine Servant: By using the system of care. Dark matter to be produced phase transitions to happens related to submit your breaking events and reheating after inflation and interestingly future gravitational wave of so batteries have the potential to probe this period.

16
00:02:54.960 --> 00:03:00.270
Geraldine Servant: So they really constitutes a new avenue of investigation in particle physics and cosmology.

17
00:03:02.610 --> 00:03:13.380
Geraldine Servant: So what does this bring all your reputation on ways they are tensor perturbations of the food man orders in working metric and the satisfies this way, the equation.

18
00:03:14.730 --> 00:03:26.340
Geraldine Servant: So here we have the source term which is the supply here is a tensor and is a tropic stress, which is the transverse tasteless component of the energy momentum tensor of the source.

19
00:03:27.750 --> 00:03:33.510

Geraldine Servant: So depending on the phenomena that we will be discussing you have different types of sources here.

20
00:03:34.860 --> 00:03:46.410
Geraldine Servant: And yeah, this is the equation that you have to solve. So what does the well known cosmological sources of gravitational waves. So, the most famous ones are cosmological phase transitions.

21
00:03:47.460 --> 00:03:57.480
Geraldine Servant: First order fest musicians which occur by the new creation then expansion and collisions, which leads to some violence, I would effectively and processes.

22
00:03:58.470 --> 00:04:08.070
Geraldine Servant: Which can lead to reputational risk reduction then cosmic strings which are also phone during a face transition. But in contrast to the first type here of sources.

23
00:04:08.550 --> 00:04:21.030
Geraldine Servant: That long lasting source because they form a network of the political factors which are long lived and keep emitting gravitational waves. So there's a whole history, other than

24
00:04:23.100 --> 00:04:25.230
Geraldine Servant: Probably most famous one is inflation.

25
00:04:26.430 --> 00:04:32.280
Geraldine Servant: And also we not covered by lack of time, I will not cover this and this is very much covered in

26
00:04:33.570 --> 00:04:40.260
Geraldine Servant: Textbooks and lecture notes. You can find easily. So I will be focusing on this first two

27
00:04:41.640 --> 00:04:46.710
Geraldine Servant: Types here and I would like to restrict how much you can learn with with this type of sources.

28
00:04:48.240 --> 00:04:54.840
Geraldine Servant: There are many interesting reviews. And here's an example reviewing the different possible sources.

29
00:04:56.400 --> 00:05:06.660

Geraldine Servant: So the first thing to mention he went talking about from our job for additional ways is the fact that we're talking about a stochastic background, meaning

30
00:05:07.920 --> 00:05:10.470
Geraldine Servant: Eyes a topic and polarized stationary

31
00:05:11.820 --> 00:05:28.320
Geraldine Servant: So repetition. We've seen our female gender origin can only be observed today as a superposition of gravitational wave generated by an enormous number of independent sources which arrived from I found them times and not from random directions.

32
00:05:29.580 --> 00:05:38.220
Geraldine Servant: So individual ways are not detectable the sources cannot be resolved. But instead, we can only observe the stochastic rotation with Backbone.

33
00:05:40.410 --> 00:05:43.920
Geraldine Servant: So it appears as a nose in the detector.

34
00:05:45.240 --> 00:05:55.590
Geraldine Servant: And therefore it's pretty challenging and you need several typically several detectors to make correlations and yeah you

35
00:05:56.280 --> 00:06:11.460
Geraldine Servant: Need to wait for the next generation of greatness and our web server to is to detect such type of signals. So the way we characterize those losses by the energy density in frequency range which is defined lazy. So here is

36
00:06:13.260 --> 00:06:30.330
Geraldine Servant: The motivation H dot time derivative cheese Newton constant will see the critical energy density. So I will, you know, always be talking about omega. So, what I'm trying to detect is the energy density in gravitational waves today.

37
00:06:32.550 --> 00:06:35.700
Geraldine Servant: Compared to the critical energy density of the Universe.

38
00:06:36.720 --> 00:06:46.410
Geraldine Servant: What is a typical fraction we are sensitive to. So this is what I will show you what typically is a very small fraction of the order of 10 to the minus 10 actually below 10 to the minus

39
00:06:46.980 --> 00:06:55.950
Geraldine Servant: So we are trying to detect such a gravitational where energy density, which is characterized by the frequency spectrum so

40
00:06:57.870 --> 00:07:06.360
Geraldine Servant: The first important quantity here is what is the characteristic frequency for a given causal process. So you have a

41
00:07:07.200 --> 00:07:23.250
Geraldine Servant: Some face opposition some event in early times like this, which is short lasting and and what is the frequency of gravitational waves that we will observe today from such an event. So let's define the stars, the temperature of the universe at the time of the mission.

42
00:07:24.450 --> 00:07:34.410
Geraldine Servant: And if stars a frequency as a time of information. OK, so the frequency we observed today's restricted. So f f star times as a user, which 15 factor.

43
00:07:35.160 --> 00:07:47.760
Geraldine Servant: Now f star typically will be related to the size of the universe at the time of emotion. So it's some fraction typically of the hover sighs Okay.

44
00:07:48.960 --> 00:07:56.370
Geraldine Servant: So in the case of phase transitions. This is a typical size of a verbal, so it's a fraction of the other signs.

45
00:07:58.080 --> 00:08:12.990
Geraldine Servant: And so now when you plug number so you express he has a function of temperature, you find this is simple formula here which relate the frequency you observe today to the temperature of the universe Wednesday repetition always wearing meetings.

46
00:08:14.100 --> 00:08:35.430
Geraldine Servant: And so here I express this in GV and now I was back in hertz plugging a typical temperature that we live very much, which corresponds to the electronics gave 100 GV and I find that the frequency of gravitational wave emitted at the electronic a book corresponds to the media hertz frequency

47
00:08:37.050 --> 00:08:50.700

Geraldine Servant: And this is where it's remarkable because this is exactly the really sensitivity range of Lisa. Lisa was not designed originally to detect what additional questions really to get bug, but it turns out that it's a fantastic

48
00:08:51.900 --> 00:08:54.960
Geraldine Servant: Opportunity to to probiotic to escape it.

49
00:08:57.210 --> 00:08:58.800
Geraldine Servant: So here I'm showing you

50
00:08:59.910 --> 00:09:19.650
Geraldine Servant: The sensitive and secures of future experiment. So Lisa here in in green. We have lygo and I have to understand Einstein telescope cosmic explorer, which corresponds to future grandbabies and different parameters.

51
00:09:21.270 --> 00:09:36.780
Geraldine Servant: Or soy pathetically that dicey go and video which corresponds actually to space based in depth parameter. So after Lisa next generation. And here we have through some time in your race which has sensitive that much lower frequencies.

52
00:09:38.790 --> 00:09:59.040
Geraldine Servant: And so this you know you've seen the sensitivity character various experiments, but usually they're not expressing this quantity. So now I'm really showing the sensitivity to this stochastic backgrounds omega GW times x squared. And these are integrated Toronto sensitivity, so

53
00:10:00.180 --> 00:10:16.830
Geraldine Servant: To get such a very high sensitivity, we are taking into account the fact that we are going to observe the signal for several years, and also that we are going to integrate over a range of frequency, taking into account the fact that spectrum.

54
00:10:19.290 --> 00:10:26.520
Geraldine Servant: We range over several decades of frequency and you can explode the special features of of your signal.

55
00:10:28.230 --> 00:10:37.170
Geraldine Servant: Okay, so you see we have a beautiful landscape here of experiments which really for many, many education frequency

56
00:10:39.180 --> 00:11:00.900

Geraldine Servant: And here I'm showing how this can relate to the energy scale of the universe at any time. So as I said, this is a window on the reschedule the scale and potentially here you are sensitive to be the scale why he has those experiments, much lower below the QC to see the scale.

57
00:11:02.460 --> 00:11:19.140
Geraldine Servant: So I'm now showing on top of these examples of typical reputational bad rounds of chemo general region. So I mentioned first or the first transition. So there was a big is a big frequency corresponding to read this time when face opposition orchid

58
00:11:20.280 --> 00:11:35.370
Geraldine Servant: The peak frequencies related to the temperature of the universe temperatures of faith transition. And in contrast to have. Here's a typical spectrum from a network of cosmic students and you see this is now expanding many, many

59
00:11:36.690 --> 00:11:48.090
Geraldine Servant: This is the frequencies and therefore it's also extremely interesting laboratory because you can learn about a very long history of the universe, going back to very early times he had very high

60
00:11:49.620 --> 00:12:01.470
Geraldine Servant: So it just let the rest of the lecture, I will explain more how to get this sector and what we can see when they are able to detect

61
00:12:03.510 --> 00:12:13.080
Geraldine Servant: Okay, I still shoot you know mentioned inflation, obviously. So I'm just going to show one single slide on this because, as I mentioned,

62
00:12:14.670 --> 00:12:24.300
Geraldine Servant: during inflation. In fact, you produce an irreducible very additional with background and now you notice on the right hand side of the wave equation you have no source.

63
00:12:25.440 --> 00:12:28.980
Geraldine Servant: But to speak for Jews were additional ways by amplification of

64
00:12:30.030 --> 00:12:38.040
Geraldine Servant: Initial quantum fluctuations of the gravitational field during creation and the resulting spectrum is scanning variant.

65
00:12:40.080 --> 00:12:48.540
Geraldine Servant: Was amplitude is really beyond the reach of direct detection is known future experience.

66
00:12:49.950 --> 00:12:56.850
Geraldine Servant: However, there is a lot of work these days to show that as soon as we will be beyond

67
00:12:58.470 --> 00:13:08.040
Geraldine Servant: The simple slow roll single field inflation models you can expect to have an amplified signal. And in fact,

68
00:13:09.060 --> 00:13:18.480
Geraldine Servant: From particle production SPECT out of physical inflation, you can hope to maybe detect gravitational waves from the inflationary

69
00:13:19.560 --> 00:13:22.770
Geraldine Servant: And you're mentioning it is a review on this topic.

70
00:13:24.330 --> 00:13:33.600
Geraldine Servant: Of course we know that were additional waves leave an imprint on CNBC polarization. But one of the most, which is a primary probe for the detection today.

71
00:13:34.740 --> 00:13:40.590
Geraldine Servant: Okay, so that's all I'm gonna say about inflation, as I, as I said, I want to focus on the other potential sources.

72
00:13:41.700 --> 00:13:47.160
Geraldine Servant: So let me start with gravitational waves from from first other face transitions.

73
00:13:48.570 --> 00:13:55.260
Geraldine Servant: So the idea here is that if a phase transition is first order, meaning that receives the mutilation of the

74
00:13:56.970 --> 00:14:05.700
Geraldine Servant: most diverse eventually collide and during this collision you have produced and I need to stress and which is sourcing repetition.

75
00:14:07.350 --> 00:14:09.900

Geraldine Servant: So to get the first of the first edition, you need

76
00:14:11.250 --> 00:14:26.580
Geraldine Servant: To have at some temperature to coexist in phases and this is interested in here. If you have to study the effective scholar potential describing the faith transition and there exists a temperature at which you have this to degenerate minima.

77
00:14:27.930 --> 00:14:42.870
Geraldine Servant: And sort of see matrix phase that sends a broken face. And as we lower the temperature. Eventually, you can have tourney and you can you create your brothers, which then expand and eventually convert the whole universe into the broken things

78
00:14:45.060 --> 00:14:49.410
Geraldine Servant: So this is actually quite natural. And we have plenty of models for this.

79
00:14:50.970 --> 00:15:01.380
Geraldine Servant: And. Okay, so what would I would go back to models later. Let me first describe more on the source of gravitational waves.

80
00:15:02.790 --> 00:15:22.710
Geraldine Servant: So if this is happening in a plasma, you will have some violent emotions here in the vicinity of the better, worse fluid flows, you can have magnetic fields and turbulent motions and the different sources will in fact lead to a stochastic by Rhonda Byrne additional radiation.

81
00:15:24.840 --> 00:15:43.560
Geraldine Servant: So the typical for instance on source. Does any sort of expressing the case of the fluid motion. So this is a dominant source which is the sound waves and juvenile. So this is the velocity of the food here, the energy density and the pressure is a gamma factor.

82
00:15:44.700 --> 00:15:56.610
Geraldine Servant: You can have also HD turbulence. So here, this is a source coming from the electromagnetic field and the scallop field itself so scanner field.

83
00:15:57.630 --> 00:16:01.350
Geraldine Servant: Which makes these servers. This is a great sentence the scanner.

84
00:16:02.400 --> 00:16:05.400

Geraldine Servant: Scanner SHOULD WE NEED TO THIS ALSO under topics.

85
00:16:06.630 --> 00:16:10.050
Geraldine Servant: So unprincipled you can adapt to different source and contribute

86
00:16:10.530 --> 00:16:12.330
dong su: To the spectrum of politicians.

87
00:16:14.190 --> 00:16:29.070
Geraldine Servant: Does our tweet button quantities, is that characterize a spectrum. So first one is what we call beach, as it says in verse duration of the first condition. And this is, this corresponds to the characteristic size of

88
00:16:29.370 --> 00:16:30.900
Geraldine Servant: Inverse size of the Berbers

89
00:16:31.320 --> 00:16:32.700
Geraldine Servant: As a time of the collisions.

90
00:16:33.720 --> 00:16:39.960
Geraldine Servant: So this is related to the sun and improbability so you can estimate is actually given by

91
00:16:42.450 --> 00:16:44.970
Geraldine Servant: The time derivative of the of the

92
00:16:46.080 --> 00:16:47.190
Geraldine Servant: nuclear option right

93
00:16:48.990 --> 00:16:57.300
Geraldine Servant: And sort of the ratio between pizza and Heather scale at the time of collisions is typically a photo 101

94
00:16:59.580 --> 00:17:11.610
Geraldine Servant: And so this is important because this data factor is really setting the characteristic frequency of your signal and and here you can easily recover as a formula I

95
00:17:12.960 --> 00:17:21.360
Geraldine Servant: mentioned before that the frequency we observe today is proportional to temperature and to this beta factor.

96
00:17:22.620 --> 00:17:22.920
Okay.

97
00:17:24.450 --> 00:17:36.870
Geraldine Servant: So that's one important factor. And the other important quantity is the amount of Latin seats that you will use us as a physician and because the sentence, it will go into gravitational wave radiation.

98
00:17:37.320 --> 00:17:48.120
Geraldine Servant: So the more licenses and more where traditional refrigeration, so alpha is the ratio between the bank rec room energies that release over addition energy density

99
00:17:50.460 --> 00:17:57.540
Geraldine Servant: Groups. So this is characterized the strengths of the physicians larger and faster, stronger facing

100
00:17:58.920 --> 00:18:08.700
Geraldine Servant: So those two parameters alpha and beta are entirely determined by particle physics. So given the model office gala fields. It kept going to a plasma.

101
00:18:09.300 --> 00:18:22.140
Geraldine Servant: You can compute the 50 scanner potential at high temperature, you can get a mind temperatures of transition and you can control this quotation alpha and beta which are crucial parameters setting spectrum of meditation.

102
00:18:24.390 --> 00:18:29.730
Geraldine Servant: So you can make it back of the envelope estimates of this amplitude of the signal.

103
00:18:30.300 --> 00:18:39.300
Geraldine Servant: So he is omega, the time of emissions energy density in gravitational waves at the time of creation divided by the total energy density of the Universe. At the time of admission.

104
00:18:40.170 --> 00:18:55.200
Geraldine Servant: So just from ninth dimensional analysis, taking the web equation. You can see that it will be skating like genius and constant. The antidote to stress is a source here squared and the task one password.

105
00:18:56.460 --> 00:19:00.990
Geraldine Servant: Which is characteristic in restoration of the face condition.

106
00:19:02.160 --> 00:19:06.660
Geraldine Servant: So now you can rewrite this in terms of your habits K

107
00:19:07.860 --> 00:19:19.590
Geraldine Servant: And I know define my my source to be a fraction. So essentially the energy density sourcing gravitational waves is a fraction of the vacuum energy density that you release your interface transition

108
00:19:20.640 --> 00:19:37.110
Geraldine Servant: And so you can define different chapter factor depending on the different source. So here's this will be the fraction of vacuum energy with screws into graduate energy levels or kinetic energy of the fleet or into two different motions. There is a title.

109
00:19:39.510 --> 00:19:40.020
Geraldine Servant: So,

110
00:19:41.280 --> 00:19:50.880
Geraldine Servant: This is a very generic expression. He is telling you how what how the spectrum scales in terms of the important factor data over age.

111
00:19:51.660 --> 00:20:04.170
Geraldine Servant: Which is related to the number of variables you have as a time of the presentation, their horizon volume. And here, how much energy. How much bacon energy goes into

112
00:20:05.670 --> 00:20:07.530
Geraldine Servant: fluid velocity

113
00:20:08.970 --> 00:20:09.300
Geraldine Servant: Okay.

114
00:20:10.470 --> 00:20:16.650
Geraldine Servant: So you see this depends now on alpha and beta which are entirely entirely determined by your particle physics model.

115
00:20:19.590 --> 00:20:27.360

Geraldine Servant: Okay, so I've told you what is a characteristic frequencies as a peak frequency. What is the typical amplitude of the signal.

116
00:20:27.930 --> 00:20:44.130
Geraldine Servant: Now of course you have to get the mind, the shape the precise shape. I have no time to do this. They are very interesting simulations of days and vertical in the last five years, it has been really a lot of development, thanks to the higher power.

117
00:20:45.150 --> 00:20:50.550
Geraldine Servant: Of traditional polar, which didn't mind more precisely as the shape of the spectrum.

118
00:20:52.560 --> 00:20:56.400
Geraldine Servant: So typically, this is a typical spectrum expect

119
00:20:57.420 --> 00:21:07.830
Geraldine Servant: They have if you are interested in this topic. They are reduced by the establishment of working bunch of theories are reviewing the possible signals and

120
00:21:08.400 --> 00:21:17.700
Geraldine Servant: The sensitivity of you start to produce things, but the key, the key message here is that Lisa is really a complimentary window angelic to escape.

121
00:21:20.250 --> 00:21:28.590
Geraldine Servant: So now you see what I've discussed, I can just shift in frequency by just shifting the temperature of the face opposition so

122
00:21:30.390 --> 00:21:36.810
Geraldine Servant: The shape of the spectrum does not depend on the scale of attention only on the strength of the faith condition.

123
00:21:37.980 --> 00:21:55.320
Geraldine Servant: So I can just know translate in frequency by just pushing up the temperature and you see here now attempt to transition happening around 500 TV will no be in the hopes of ability window of ground based future observations.

124
00:21:58.020 --> 00:22:01.500
Geraldine Servant: OK, so now if you want the

125

00:22:02.520 --> 00:22:21.690
Geraldine Servant: Strategies. The following given a particle physics model you can complete your parameters Dita Alpha Kappa, and then you can easily estimate what is the word additional color spectrum and compare with sensitivity to care and to get the signal to noise ratio for a given month

126
00:22:22.770 --> 00:22:30.540
Geraldine Servant: There's actually a tool on the web, which is very easily to check your favorite model.

127
00:22:31.590 --> 00:22:35.310
Geraldine Servant: So now I would like to spend a little time on directory face opposition.

128
00:22:36.360 --> 00:22:42.750
Geraldine Servant: Because, of course, is the Season One Key Question, what is the nature of the little faith in system.

129
00:22:45.870 --> 00:22:46.620
Geraldine Servant: Okay, so

130
00:22:48.030 --> 00:23:01.680
Geraldine Servant: We have dropped. Today we know we have measured the heat maps and we have throat or you want, you know, part of the scanner potential of the heels. But one of the question is how did we end up here is to heat up the sound that model.

131
00:23:02.880 --> 00:23:12.870
Geraldine Servant: It actually symmetry is restored at temperature on 160 GV understand another. We know that a fair assumption is a smooth process over know first order condition.

132
00:23:15.690 --> 00:23:30.720
Geraldine Servant: However, is pretty easy to add minimal amount of new physics to change this conclusion. And why are we interested to negative to express themselves first order one main reason is electric variances.

133
00:23:33.000 --> 00:23:38.970
Geraldine Servant: So it actually very is a very beautiful mechanism to explain the bionic symmetry of the universe.

134
00:23:39.780 --> 00:23:46.590
Geraldine Servant: As needed to scale and rely only on electronic scale visits and it relies on a first order to transition

135
00:23:47.430 --> 00:23:59.670
Geraldine Servant: The idea is that during our new creation of the Berbers and extension of those verbal suicides, the web and he has a sheets bacon expectation value is not zero you is a broken Ferris and outside doing similar things.

136
00:24:01.620 --> 00:24:08.280
Geraldine Servant: Then you would have bodyguards here which interact with the bubble ball in a city violating it

137
00:24:09.360 --> 00:24:22.410
Geraldine Servant: And you could have been some Kerala symmetry which has been converted into barrio my son. He buys follow ons which opportunity. Standard Model considerations.

138
00:24:23.730 --> 00:24:26.640
Geraldine Servant: Responsible for bio number violation at high temperature

139
00:24:28.020 --> 00:24:31.380
Geraldine Servant: So this is quite complicated but beautiful physics here.

140
00:24:32.640 --> 00:24:39.060
Geraldine Servant: But they keep on to you that you need your first you first audition to be first order.

141
00:24:41.160 --> 00:24:55.380
Geraldine Servant: So there has been a lot of excitement about this possibility here. This is the final formula, giving you the Barrio two photon ratio. And this is a number you want to explain, of the order of 10 to the minus 10

142
00:24:56.820 --> 00:25:03.330
Geraldine Servant: vileness mystery of the universe. And in just one line, you have the respect of the conditions here.

143
00:25:04.410 --> 00:25:13.080
Geraldine Servant: Out of equilibrium condition from this Burberry war disco existence of two phases, but simply violating services here.

144
00:25:14.490 --> 00:25:15.000
Geraldine Servant: And

145
00:25:16.020 --> 00:25:21.210
Geraldine Servant: Of course, by your number violation from this failure on rate which is here.

146
00:25:22.320 --> 00:25:28.020
Geraldine Servant: So here is just a better word profile, you have the heat second expectation value here.

147
00:25:29.160 --> 00:25:32.520
Geraldine Servant: It's not zero and outside in this interface.

148
00:25:33.690 --> 00:25:48.240
Geraldine Servant: And here is the rate of Berlin and evaluation. OK, I will not give more details, but this is to stress that there is a very strong motivation to really determine the nature of the presentation is something we can test with the energy

149
00:25:49.260 --> 00:25:51.090
Geraldine Servant: And the reason next time.

150
00:25:53.190 --> 00:25:58.890
Geraldine Servant: Okay, this is by lack of time, but I want to stress that there is one major

151
00:26:00.180 --> 00:26:01.500
Geraldine Servant: Attention here.

152
00:26:02.820 --> 00:26:14.310
Geraldine Servant: That says you need new sources of safety evaluation beyond the standard nada as there is typically a conflict with strong bounce from electric dipole moment probably

153
00:26:16.110 --> 00:26:21.000
Geraldine Servant: News from the acne experiment within two years ago has been

154
00:26:22.050 --> 00:26:30.840
Geraldine Servant: Shaking news for electronic version is practitioners because this bond is really sitting very strong constraints on this electric divergences mechanism.

155
00:26:32.220 --> 00:26:33.360

Geraldine Servant: Which typically

156
00:26:34.710 --> 00:26:35.280
Geraldine Servant: Project

157
00:26:37.170 --> 00:26:37.860
Geraldine Servant: Idioms

158
00:26:39.570 --> 00:26:40.020
Geraldine Servant: So,

159
00:26:41.700 --> 00:26:52.590
Geraldine Servant: I would come back to this Steve. There are ways to evade the acne bounce and now I would like to discuss how to get a first order electronic face on

160
00:26:54.270 --> 00:27:02.100
Geraldine Servant: You need to order one with disputation to the hits potential. You want to create a barrier in the hits potential to make it first order.

161
00:27:03.600 --> 00:27:10.710
Geraldine Servant: And what you typically need to do is to add extra calories in addition to the hits and they are two main classes of models.

162
00:27:11.370 --> 00:27:25.110
Geraldine Servant: And so the first class of mothers is to just add an extra singlet or to consider students doublet mothers and to consider stone that podium. Your potentials to this is really extensively discussing the literature.

163
00:27:26.160 --> 00:27:35.280
Geraldine Servant: So, typically in those mothers who get modalities shown face conditions, meaning that I'll file, file over to look much larger than one

164
00:27:37.470 --> 00:27:41.370
Geraldine Servant: Then there is a very interesting class of models that are you'd like to discuss here.

165
00:27:43.470 --> 00:27:59.670
Geraldine Servant: Which are mothers were the Higgs emerges after confinement face opposition offer new strangling directing sector. And

this is interesting because this is very naturally to very strongly first order conditions.

166
00:28:02.400 --> 00:28:07.680
Geraldine Servant: So let me let me discuss this now because I think this is probably one of the best motivated

167
00:28:08.730 --> 00:28:11.430
Geraldine Servant: Model for a first order entry facing

168
00:28:12.450 --> 00:28:15.750
Geraldine Servant: Which can be tested by this and also by Philip see

169
00:28:18.690 --> 00:28:25.740
Geraldine Servant: Okay, this is a key point here is that the Higgs potential. So the sheath arise as a pseudo non Western goes on.

170
00:28:28.140 --> 00:28:35.070
Geraldine Servant: And here's the Higgs potential. So you can you can you can complete the his potential. He is a heat and here is f the

171
00:28:35.790 --> 00:28:45.720
Geraldine Servant: Confinement scale of the new strong interacting sector, which is described by as a vacant expectation value of the Latin field which is also obsidian on was done.

172
00:28:46.140 --> 00:28:49.860
Geraldine Servant: Both on that have spontaneously broken conformance imagery of the sunset.

173
00:28:50.640 --> 00:28:57.570
Geraldine Servant: So here, you know, have to scatter phase, you have the heat and you have this delectable food and there's some very interesting in between diamonds

174
00:28:58.110 --> 00:29:09.240
Geraldine Servant: Now I want to study the high temperature behavior of this potential. We're now F is dynamic. Can you see f is given buys a variable of this deal at on food.

175
00:29:10.020 --> 00:29:20.430
Geraldine Servant: So as soon as that only comes dynamics, you have an interesting dynamic between he and the latency. But the key point I want to stress here.

176
00:29:21.030 --> 00:29:32.010
Geraldine Servant: Is that typically because of the special properties of the delight on potential, which is nearly conformal you very naturally have super to have a

177
00:29:33.330 --> 00:29:35.550
Geraldine Servant: Very strong for sort of face interaction.

178
00:29:36.600 --> 00:29:43.050
Geraldine Servant: From the delight on dynamics, which then leads to first other fascination for the heath. Awesome.

179
00:29:45.030 --> 00:29:50.700
Geraldine Servant: So this is illustrated here, you have to feel the heat and the gelato.

180
00:29:52.560 --> 00:30:02.910
Geraldine Servant: And depending on the trajectory of your fields in the early times you can have a very strong first are facing mission. So if you go

181
00:30:03.840 --> 00:30:13.770
Geraldine Servant: You know, if you ignore the dynamics of the gelatin you assume it's across a very early times then. Okay, in this case, just go through this past one

182
00:30:14.400 --> 00:30:23.940
Geraldine Servant: And he gets the faith transition alone independently of the delight on any standard crossover and nothing interesting happens.

183
00:30:24.570 --> 00:30:41.940
Geraldine Servant: On the other hand, if you go through two or three. The two fields change at the same time. And then you really have very interesting diamonds. And what I want to stress here that's competitive mothers for rather light, the light on, you typically have these diamonds to me.

184
00:30:43.980 --> 00:30:56.130
Geraldine Servant: And this just comes from the fact that those mothers who have a new song interacting sector and you have a large number of companies have articles which become

185
00:30:57.180 --> 00:30:57.690

Geraldine Servant: Composing

186
00:30:58.980 --> 00:31:08.520
Geraldine Servant: The Latin phase transition. So you those models to typically have a lot of super cool. So, meaning that you wait a long time before you can eventually turn allow

187
00:31:09.810 --> 00:31:19.260
Geraldine Servant: This used to very strong signal. In addition to this type of presentation has been studied quite extensive literature and giving his References

188
00:31:23.310 --> 00:31:23.790
Geraldine Servant: And

189
00:31:25.710 --> 00:31:39.120
Geraldine Servant: Now if you look, the type of potential along this straight line you indeed find here you have this large barrier and leading to this first phase transition

190
00:31:42.630 --> 00:31:53.520
Geraldine Servant: Okay, good. So here's this is just to illustrate. Now the parameters, based on this model, which is the Latin Mass number of courses and useful interactive sector.

191
00:31:54.030 --> 00:32:04.440
Geraldine Servant: The parameters in this parameter space. These are the controls of the ratio variable but temperature and you see that this is a very large. Thank you. Justin is the face of

192
00:32:07.110 --> 00:32:07.650
Geraldine Servant: Generic

193
00:32:09.210 --> 00:32:20.190
Geraldine Servant: Now is there is one thing you have to be careful about so you're very happy. You have the first or the first condition for the heat. You can do collectively very generous, however.

194
00:32:21.930 --> 00:32:32.280
Geraldine Servant: You release a lot of vacuum energy coming from the Latin sector, and this might be here, the universe for both 160 TV.

195
00:32:33.270 --> 00:32:46.800

Geraldine Servant: So this can restore it to excel and wash, I would hold the volume of symmetry. We have pages. So there is an extra constraint here, you have to impose which tells you some condition on the math of the device.

196
00:32:49.170 --> 00:33:00.240
Geraldine Servant: And this constraint is in blue here. Okay, so. But you see, this is something very generic as soon as you consider to scan. I feel the heat press and those are

197
00:33:01.140 --> 00:33:11.190
Geraldine Servant: So the heavier scanner fit, which is driving the first condition you will always have to be careful about the possibility of presenting and

198
00:33:12.390 --> 00:33:16.740
Geraldine Servant: Erase the value on a symmetry, you have produced during the first condition.

199
00:33:19.200 --> 00:33:27.450
Geraldine Servant: Okay, so now how did you test this scenario, and of course colliders we can search for the express gala is a typical

200
00:33:28.710 --> 00:33:36.780
Geraldine Servant: Strategy here for two days. Literally religion is who should first find the extra scholar what defines its potential

201
00:33:37.920 --> 00:33:41.670
Geraldine Servant: And test the copies of the heat and other six plus dollar

202
00:33:44.040 --> 00:33:54.870
Geraldine Servant: And using just to show to illustrate the amount of super coding, which is characterized here by the ratio critical temperature of education temperature which is which can be extremely loud.

203
00:33:56.640 --> 00:34:05.730
Geraldine Servant: So you expect this is a natural class of mothers, which is our default without any training of parameters, give you a lot of very additional

204
00:34:08.100 --> 00:34:13.800
Geraldine Servant: OK, so now I would like to just mention another interesting phone

205
00:34:15.600 --> 00:34:20.820
Geraldine Servant: I told you that it actually virgin is constrained by EDM bonds.

206
00:34:22.860 --> 00:34:27.690
Geraldine Servant: This is a major issue. So if you want to say really to be very Genesis

207
00:34:28.920 --> 00:34:43.320
Geraldine Servant: One way would be if you were able to push the temperature of the 21st century, much higher values. So you may wonder, how can I push the temperature of victory face conditions. This is actually not easy.

208
00:34:45.570 --> 00:34:56.430
Geraldine Servant: So the motivation is that you will be able to relate to regarding this at high scale. So you would be relying on services of civilization of higher scale, which are less constrained by audience.

209
00:34:58.830 --> 00:35:01.590
Geraldine Servant: And so we would like to do this.

210
00:35:03.480 --> 00:35:13.080
Geraldine Servant: And I mentioned that this is actually possible by adding some extra simulate fields and I'm comparing different

211
00:35:13.680 --> 00:35:26.670
Geraldine Servant: Results if temperature evolution of the hips vegan expectation value. See what happens in the standard model. So we should is there is zero and then eventually you turn on to his death.

212
00:35:27.870 --> 00:35:28.710
Geraldine Servant: Various mostly

213
00:35:31.140 --> 00:35:38.910
Geraldine Servant: Now you could consider a different scenario. And if you have such type of evolution that you see, you never

214
00:35:40.440 --> 00:35:43.290
Geraldine Servant: You can have electric symmetry and breaking

215
00:35:45.060 --> 00:35:53.850

Geraldine Servant: Even at high temperature and you always have h of t larger than one, which essentially prevents Spell your own to wash out your bio on the symmetry.

216
00:35:54.900 --> 00:35:57.690
Geraldine Servant: You will be in a very interesting situation.

217
00:35:58.740 --> 00:36:04.110
Geraldine Servant: So I'm pointing this out because there are ways to achieve this.

218
00:36:05.670 --> 00:36:15.780
Geraldine Servant: And one observable consequence would be a great addition with peak frequency, which can be shifted to a higher value that much. We usually expect for the little lessons.

219
00:36:18.390 --> 00:36:18.870
Geraldine Servant: Okay.

220
00:36:20.250 --> 00:36:37.440
Geraldine Servant: Look, I think now I should move to the next topic. So let me summarize what we've learned about repetition away from first of the first season was the one takeaway message is that it remains very open how willing to extend it. We got broken zero even worse.

221
00:36:38.460 --> 00:36:53.400
Geraldine Servant: It's very possible that digital First Options first order and this is particularly much running composite six monitors. So this is a scenario which is under exploration, a village and which can be tested as

222
00:36:55.440 --> 00:37:01.620
Geraldine Servant: I mentioned it actually religion is a beautiful mechanism that we could test.

223
00:37:02.820 --> 00:37:19.140
Geraldine Servant: Those experiments, but which is under threat by Ed and bounds. There are ways around it. And I just summarize. Here's the remaining open options. And one interesting idea to explore and has not much explored yet is the visibility to increase the temperature to look to it.

224
00:37:21.840 --> 00:37:30.510
Geraldine Servant: OK, so now my last topic, I would like to discuss something very different which a gravitational waves from cosmic students

225
00:37:31.200 --> 00:37:44.640
Geraldine Servant: As a key difference with respect to read additional as I discussed earlier from. Sure. So the first conditions is that they are long lasting source and therefore able to prove the entire ecosystem.

226
00:37:45.660 --> 00:37:48.000
Geraldine Servant: And as we, as I would show you can throw

227
00:37:49.320 --> 00:37:52.950
Geraldine Servant: A big party particles up to Ed mass

228
00:37:54.360 --> 00:37:57.960
Geraldine Servant: And yeah, that's an interesting prospect.

229
00:38:00.480 --> 00:38:07.230
Geraldine Servant: Okay so cosmic strings. These are also produced during face opposition, but there are two projects and effect.

230
00:38:09.060 --> 00:38:15.540
Geraldine Servant: So they are generated during the spontaneous ministry breaking function, which has known to do for multiple Taiwan.

231
00:38:17.310 --> 00:38:28.020
Geraldine Servant: So notice that the presentation. I mentioned earlier, does not need to enter political to fix the here. What would lead to strings would be the breadwinner for you one century.

232
00:38:29.250 --> 00:38:34.590
Geraldine Servant: So here I'm showing you a typical potential as the temperature goes down, we

233
00:38:35.790 --> 00:38:40.470
Geraldine Servant: Have this shape developing and you can create cosmic strength.

234
00:38:42.330 --> 00:38:47.490
Geraldine Servant: Now they have been simulation of the evolution of the network of customer experience.

235
00:38:49.680 --> 00:39:02.760

Geraldine Servant: And so these can be described as one classical objects and they are characterized by the attention you which is the square of the vegan expectation value of the scanner.

236
00:39:05.910 --> 00:39:06.300
Geraldine Servant: So,

237
00:39:08.610 --> 00:39:16.650
Geraldine Servant: What is interesting to hear that. So strength will be an entire community crossing and they will be forming loops.

238
00:39:18.060 --> 00:39:21.480
Geraldine Servant: And the network continuously for me loops.

239
00:39:22.860 --> 00:39:30.930
Geraldine Servant: And those loops. The decay by limiting either gravitational waves or partners.

240
00:39:32.190 --> 00:39:35.880
Geraldine Servant: depending whether the symmetry break either local or global

241
00:39:40.080 --> 00:39:43.770
Geraldine Servant: So when Richards circle scaling regime, which means that

242
00:39:45.780 --> 00:39:49.830
Geraldine Servant: The energy density in this network is case like to to the minus two. So,

243
00:39:51.540 --> 00:40:02.760
Geraldine Servant: You do not over. Close the universe. Essentially, this energy density this case like the background energy density. So if you are in addition to like the addition to our matter, which is like

244
00:40:04.770 --> 00:40:16.170
Geraldine Servant: So as I said, well, if you have looked at students what i mean i look at me come from the breaking of the local symmetry, they will indicate your initial verification and then

245
00:40:17.520 --> 00:40:23.550
Geraldine Servant: If they are globalizing became anybody initial of ghosts and Bobby you have massive audience.

246
00:40:25.110 --> 00:40:27.960
Geraldine Servant: So we be assuming your questions.

247
00:40:29.070 --> 00:40:34.350
Geraldine Servant: As we are interested in networks that the two main religions.

248
00:40:35.400 --> 00:40:46.650
Geraldine Servant: So what is very interesting here is that so you keep know producing loops and keep anything religion works for you have a long lasting very dismal source.

249
00:40:47.190 --> 00:40:57.180
Geraldine Servant: To be contrasted with the ready to show my face and happen every single temperature very dangerous. They just went gerber's collide and then

250
00:40:57.780 --> 00:41:09.090
Geraldine Servant: The producer ready to read and this source, which causes fluid motion is relatively short compared to what we are considering here is customer experience.

251
00:41:10.350 --> 00:41:22.590
Geraldine Servant: So the key point here is that those gravitational waves can probe the entire cosmic history due to this continues to be very aware production. So here's a typical spectra.

252
00:41:24.990 --> 00:41:27.480
Geraldine Servant: So omega frequency

253
00:41:28.500 --> 00:41:32.100
Geraldine Servant: And this is a blue spectrum is a blue curve. And he has a different

254
00:41:33.480 --> 00:41:35.580
Geraldine Servant: Sensitivity of the experience I mentioned

255
00:41:38.250 --> 00:41:39.120
Geraldine Servant: Okay, so

256
00:41:40.560 --> 00:41:48.030

Geraldine Servant: At very high. So this is a year of time and this is evolution of the universe, very high frequencies corresponds to very early times

257
00:41:49.260 --> 00:41:52.590
Geraldine Servant: In fact, at many times the loops.

258
00:41:54.660 --> 00:41:59.250
Geraldine Servant: are smaller and they correspond to a higher isolation frequency

259
00:42:01.530 --> 00:42:13.440
Geraldine Servant: So you may wonder, how come the spectrum is not suppress here by just the red shifting. It turns out that you have more loops coming from early time so you have a balance here between

260
00:42:14.730 --> 00:42:24.870
Geraldine Servant: The red sheet and the fact that you have more loops at all times. So in fact, you get this flat spectrum during radiation. He is a cut of just comes from the fact that

261
00:42:26.040 --> 00:42:29.520
Geraldine Servant: The network was formed here at this particular time.

262
00:42:30.930 --> 00:42:37.290
Geraldine Servant: So this is just a cut off from the network Foundation, but depending on when your network was form you can extrapolate

263
00:42:38.340 --> 00:42:46.890
Geraldine Servant: This is just so impossible kicked off in the case where you have also, in addition to great additional information. Some particle production.

264
00:42:48.270 --> 00:42:48.900
Geraldine Servant: Which is

265
00:42:49.920 --> 00:42:58.980
Geraldine Servant: Posted The when you consider the microstructure of strings, you may have emission of particles depending on

266
00:43:00.150 --> 00:43:00.990
Geraldine Servant: Models here.

267

00:43:03.480 --> 00:43:12.360
Geraldine Servant: So these are singular structure on the loops. So when you go beyond the number go to Africa nations and you can have the similar structure which we need to bother production.

268
00:43:15.120 --> 00:43:20.130
Geraldine Servant: And here we superimpose reputation waste from the radiation, you run from the matter.

269
00:43:22.440 --> 00:43:24.030
Geraldine Servant: OK, so now

270
00:43:25.410 --> 00:43:26.730
Geraldine Servant: As I mentioned this.

271
00:43:28.290 --> 00:43:36.870
Geraldine Servant: Is causing extreme networks are entirely characterized by the tension New Energy, new is a product of attention times

272
00:43:38.880 --> 00:43:39.690
Geraldine Servant: On constant

273
00:43:40.830 --> 00:43:54.960
Geraldine Servant: So these are different spectra for different New York's case it is to 10 minus nine. And you see that down to 10 to the minus 19

274
00:43:56.580 --> 00:43:58.410
Geraldine Servant: So we are presently probing

275
00:44:00.480 --> 00:44:00.780
Geraldine Servant: For

276
00:44:03.090 --> 00:44:13.020
Geraldine Servant: These experiments will be able to Trove very high so new, I remind you knew. So here it you, is it a square. It is a web of this canopy.

277
00:44:14.160 --> 00:44:14.820
Geraldine Servant: And so

278
00:44:15.960 --> 00:44:18.990
Geraldine Servant: Large new corresponds to llanishen of this case.

279
00:44:21.540 --> 00:44:29.400
Geraldine Servant: And it's interesting that you already have constraints on this intention from. You see, no, no. Grab the PTA

280
00:44:30.930 --> 00:44:35.280
Geraldine Servant: Already constrain a lot and the value of this intention.

281
00:44:38.550 --> 00:44:44.220
Geraldine Servant: Okay, so now what can we learn that if we were ever to measure with precision such a bad wrong.

282
00:44:44.580 --> 00:44:45.600
Geraldine Servant: What can we learn

283
00:44:47.220 --> 00:45:01.830
Geraldine Servant: Let me mention here first effect of the changes of number of degrees of freedom. So when you take properly into account the fact that number of degrees of freedom. Change the temperature, you get this effect.

284
00:45:03.030 --> 00:45:19.350
Geraldine Servant: So here is just the plot of g star. The function of temperature and you have an imprint on the spectrum. So first one information. And this is just a division effect, you know, the reputational risk from injected entropy

285
00:45:21.810 --> 00:45:38.040
Geraldine Servant: So I would like now to show how we can use the spectrum from cosmic strings to probe non standard because religion histories and therefore to prove also non standard particle physics because this is all about the physics reading news is no sound after this

286
00:45:39.750 --> 00:45:45.360
Geraldine Servant: One first effect is, in fact, try to detect additional degrees of freedom.

287
00:45:46.680 --> 00:45:58.050
Geraldine Servant: probings the equation of state of the universe. So as we just discussed, depending on the issue change at early attempts to have more realistic degrees of freedom.

288
00:45:59.160 --> 00:46:03.480

Geraldine Servant: This will have an impact on the spectrum which you can try to imagine

289
00:46:06.030 --> 00:46:21.090
Geraldine Servant: Now I would like to now you straight as a possibility to test an intermediate matter you right inside the radiation. So imagine this is quite natural possibility that you have a message particle

290
00:46:22.260 --> 00:46:24.420
Geraldine Servant: Which is unstable.

291
00:46:25.680 --> 00:46:30.840
Geraldine Servant: So first of all, it's very difficult to get that collateral security consider extremely heavy body.

292
00:46:33.840 --> 00:46:39.420
Geraldine Servant: But I want to show that here you could throw this reputational with such the existence of such particle

293
00:46:40.500 --> 00:46:51.090
Geraldine Servant: So if this particular dominates temporarily in evidence to the university inducing mattering so you put a constant. There's a case where you have such matter era.

294
00:46:52.410 --> 00:46:56.130
Geraldine Servant: Before radiation or in the middle of radiation.

295
00:46:58.110 --> 00:47:03.930
Geraldine Servant: And so this is induced by this heavy article which is declared such temperature and

296
00:47:05.190 --> 00:47:16.830
Geraldine Servant: What's this will lead to in the repetition or spectrum from Pacific three eastern part. So here's the zoo showing that such a matter, Iran, we need to a suppression of the spectrum.

297
00:47:17.970 --> 00:47:36.540
Geraldine Servant: And so you can detect such a turning point. And if you are able to detect such a turning point with respect to what you stand out spectrum of religion, you can infer the lifetime of the article responsible for such temporary matter, you know,

298
00:47:39.090 --> 00:47:39.870
Geraldine Servant: Okay, so

299
00:47:40.980 --> 00:47:42.930
Geraldine Servant: He would like to stress that's

300
00:47:44.160 --> 00:47:53.940
Geraldine Servant: You know, at the beginning of my lecture I gave the relation between the temperature of the universe and the frequency of gravitational waves which were produced at this temperature

301
00:47:55.200 --> 00:48:06.420
Geraldine Servant: So this relation one you'd have to be careful in the case of course my students, it's the way we relate, you know, the temperature of a particular event.

302
00:48:07.380 --> 00:48:16.980
Geraldine Servant: In history of the universe and the frequency we observe is non trivial. So you don't have the simple relation kinds of parties as we discussed

303
00:48:17.670 --> 00:48:33.300
Geraldine Servant: Causing extreme keep anything and red additional waves over the whole history. And so one has to distinguish the time of repetition with the mission and the time the time when the loops were produced. Okay.

304
00:48:35.070 --> 00:48:35.400
grzegorz madejski: Okay.

305
00:48:36.810 --> 00:48:37.200
Geraldine Servant: Sorry.

306
00:48:38.550 --> 00:48:39.600
grzegorz madejski: You have about five minutes.

307
00:48:39.690 --> 00:48:40.620
Geraldine Servant: I hope it's okay.

308
00:48:40.830 --> 00:48:41.940
Geraldine Servant: Yes. Yes. Thank you.

309
00:48:42.810 --> 00:48:44.070
Geraldine Servant: I should be done soon.

310
00:48:45.240 --> 00:48:56.610
Geraldine Servant: Oh, yeah. So I just wanted to stress that there is this extra factor here is a relation between Sterling fans frequency want to discuss and the typical

311
00:48:58.170 --> 00:49:18.000
Geraldine Servant: Lifetime of the time when the reddit loops were produced. So those are the reason why I'm stressing this that usually we usually say resize the window on the big scale. But in this case is that would be a window on MTV scared and Einstein to discuss put the window and

312
00:49:19.350 --> 00:49:26.730
Geraldine Servant: It's it's a different relation here, what should be aware of this. I'm just illustrating here is a type of constraints we could

313
00:49:28.920 --> 00:49:39.000
Geraldine Servant: Obtain bronzer lifetime of this heavy and stable part together and really abundance. This is a famous plot which you may have seen in the case of BBN

314
00:49:39.450 --> 00:49:53.070
Geraldine Servant: Know what are the constraints you obtained from VPN or new TV and stable powders and you have this typical plot where you constrain the lifetime and the would be really cool bone density particle had Medicaid

315
00:49:54.720 --> 00:49:58.980
Geraldine Servant: So the bn cannot probe lifetime much earlier than a circle.

316
00:50:00.090 --> 00:50:10.080
Geraldine Servant: Here you see this is very different experiments, you will be able to to prove particles which have much shorter lifetime. So that's an interesting prospect.

317
00:50:11.520 --> 00:50:22.980
Geraldine Servant: Okay, so I have to skip because I don't have much time. This is just to show the the potential to probe with these experiments to probe heavy particles really very heavy

318
00:50:24.720 --> 00:50:32.790
Geraldine Servant: messes up to 20 Benji and these lifetimes, much, much shorter than corresponding to the BBN it but

319
00:50:34.320 --> 00:50:41.910
Geraldine Servant: You can also pro those stone late stage of inflation. So we mentioned. So you have to stand out inflation.

320
00:50:42.870 --> 00:50:51.390
Geraldine Servant: Followed by region by visiting and radiation here and then you have at a later stage some short inflation. This is actually really motivated

321
00:50:51.810 --> 00:51:00.690
Geraldine Servant: You could have a few effects of inflation at later if you have a super cold face opposition. I mentioned earlier, this is, this is actually possible scenario.

322
00:51:01.170 --> 00:51:17.790
Geraldine Servant: Which he could test as well because this will lead to a feature in your spectrum of gravitational waves on cosmic strings and I'm just illustrating this here. This leads to these different turning pounds which depends now on the number of referrals.

323
00:51:19.560 --> 00:51:22.260
Geraldine Servant: So you see, there are many possible spectra.

324
00:51:23.370 --> 00:51:30.870
Geraldine Servant: Coming from gravitational for reputation or Western cosmic sense, depending on the cosmological system.

325
00:51:32.430 --> 00:51:44.190
Geraldine Servant: Okay, good. So I have only a few minutes left, so let's me conclude. He has a message from spot on reputation and waste from Christmas trees.

326
00:51:45.360 --> 00:51:55.590
Geraldine Servant: To keep you are so fun. You see a very simple spectrum. I was a flat here, what I want to stress is that there is a very rich array of possible spectrum.

327
00:51:56.010 --> 00:52:02.730
Geraldine Servant: Which encode physics happening at a very different energy states. So you have here laboratory of exploration

328
00:52:03.330 --> 00:52:15.240

Geraldine Servant: And there is a nice complementarity between space based ground based interface monitors and radio telescope. So you see with one experiments. You can see one part of the spectrum.

329
00:52:16.080 --> 00:52:24.330
Geraldine Servant: Like this ground basics. So batteries and then you see the other part is Lisa and then you can reconstruct is also different experiments.

330
00:52:25.380 --> 00:52:29.340
Geraldine Servant: And therefore ensure information about very high energy scale says

331
00:52:31.410 --> 00:52:33.600
Geraldine Servant: Okay, so my

332
00:52:35.580 --> 00:52:49.620
Geraldine Servant: Summary if we detect cosmic really ready to our background. I just can bring really unique information on the very early universe on very high energy physics which is complimentary to particular thing.

333
00:52:50.910 --> 00:53:01.530
Geraldine Servant: So in particular, a nice size on track and fast too large to search for it has a huge potential to throw

334
00:53:03.750 --> 00:53:05.040
Geraldine Servant: Us later this month.

335
00:53:06.810 --> 00:53:23.370
Geraldine Servant: And okay also exciting for Bowsers is quite futuristic but exciting proposals on the table to probe even higher energies case like Einstein to discover and explore. So I will

336
00:53:24.720 --> 00:53:25.500
Geraldine Servant: I will end up

337
00:53:26.730 --> 00:53:30.330
Geraldine Servant: Know my last slide is here, very last one.

338
00:53:31.980 --> 00:53:50.160
Geraldine Servant: Just to summarize, so we can learn from church observations of familiar with additional waves about so so the first

condition symmetry breaking events from hidden sectors at lower energies in the apta range for instance in the race to the big scale and

339
00:53:51.720 --> 00:53:51.960
Geraldine Servant: Scope.

340
00:53:53.400 --> 00:54:08.580
Geraldine Servant: We can learn a lot about Christmas trees, we can try to read the modified equation of state of the universe with respect to reduce down that radiation era, whether there was an early matter Iraq to nation some secondary inflation on stage.

341
00:54:09.780 --> 00:54:13.950
Geraldine Servant: So this is what I discussed in this lecture. But as I mentioned in the introduction.

342
00:54:14.340 --> 00:54:16.170
Geraldine Servant: There are other interesting

343
00:54:16.470 --> 00:54:37.350
Geraldine Servant: Sources of cosmological very there's always in particular, eating fish eating the particle production after just after inflation and also some interesting skeleton diamonds to this season still in the making, and a lot of interesting developments.

344
00:54:43.230 --> 00:54:57.630
grzegorz madejski: Okay, thank you very much world in this is really excellent. So at this point I will start I would stop recording and I will ask for the question as a moderator, which I believe is to dog today to take over. So thanks again.