WEBVTT

1
00:00:08.250 --> 00:00:11.340
Ana Bonaca: Yes. Please go ahead. But I, I will introduce you first.

2
00:00:12.420 --> 00:00:21.540
Ana Bonaca: So our speaker today is on the Lisa Lepage who is calling in from MPa where she leads like group for galaxies cosmology theory group.

3
00:00:22.260 --> 00:00:33.930
Ana Bonaca: And and Lisa has always been at the forefront of numerical research. So as a grad student and then post eth and post like at UC Santa Cruz should get involved with

4
00:00:35.070 --> 00:00:43.140
Ana Bonaca: The first really realistic simulation of the Milky Way. And sorry, the properties of the solar Halo. Then, as she moved to the CFA

5
00:00:43.620 --> 00:00:57.510
Ana Bonaca: Are at the IPC. She also became one of the key people in the illustrious t and g collaboration and which we all know as the state of the art and cosmological simulations and

6
00:00:58.080 --> 00:01:05.070
Ana Bonaca: And she continues to push this this forward and I heard from from many people independently that

7
00:01:05.910 --> 00:01:19.710
Ana Bonaca: The meeting a workshop. She organized on machine learning and astronomy. I think a year or so ago was like a very influential. I'm so it's like it's really a great pleasure to have such a forward thinking person here and this

8
00:01:20.820 --> 00:01:30.900
Ana Bonaca: In this format where I'm sure that we'll have a lot of discussion material and the topic today will be on supermassive black hole feedback. And with that, and I

9
00:01:31.350 --> 00:01:38.490
Ana Bonaca: Guess, just to build example of it and Lisa said, this will be some brand new results not published yet so very excited to hear it.

10
00:01:40.410 --> 00:01:49.080

Annalisa Pillepich: Thank you. Thank you very much and you hear my voice. And do you see the screen. Yeah. Thank you. Yes, thank you very much for having me.

11
00:01:49.080 --> 00:01:50.580
Annalisa Pillepich: Review today.

12
00:01:50.820 --> 00:01:58.620
Annalisa Pillepich: So we're gonna yes discuss about feedback from supermassive black holes and many diverse way the supermassive black holes manifest

13
00:01:59.160 --> 00:02:13.500
Annalisa Pillepich: Themselves and I will start from a numerical theoretical perspective and towards the end, we go back to data traditional data when we were talking about, you could already see a movie. This is from one of our simulations we call it

14
00:02:15.210 --> 00:02:23.820
Annalisa Pillepich: The movie represents the mass weighted 3D velocity of the gas over a few can movie maker per second aside.

15
00:02:24.960 --> 00:02:29.160
Annalisa Pillepich: And what I wanted you to notice if unless you already saw it before is

16
00:02:29.760 --> 00:02:44.490
Annalisa Pillepich: A galaxy on the right corner of the of the panel where you can see that is undergoing in one of his first episode here are Supermassive black of feedback with feedback pushing the gas out of the galaxy thousand kilometers a second.

17
00:02:45.000 --> 00:02:50.610
Annalisa Pillepich: I'm showing you this movie to remind us of two things. One, that whatever happens to galaxies and

18
00:02:50.910 --> 00:03:03.840
Annalisa Pillepich: To their stellar content is mediated by flows of gas in and out of galaxies as the stellar content as you are seeing here in the movie. Now I think your transition. You see transitioning to stellar mass density in projection

19
00:03:04.890 --> 00:03:15.540

Annalisa Pillepich: But the other thing is that from an American perspective powerful energy injections as the from the center of guides is the one that could be made by supermassive black holes.

20
00:03:15.810 --> 00:03:26.970
Annalisa Pillepich: Are fundamental or a key ingredient to hold star formation in massive galaxies as the one at the center of this cluster. This is a bigger like cluster in this 2050 simulation.

21
00:03:27.600 --> 00:03:34.380
Annalisa Pillepich: I mean hammer on this last point, because you really represent the boundary condition. If you like the handsets of all my talk.

22
00:03:35.640 --> 00:03:41.850
Annalisa Pillepich: From the perspective of cosmological simulations of many galaxies or thousands or hundreds of thousands of galaxy.

23
00:03:42.180 --> 00:03:53.040
Annalisa Pillepich: No mechanism, other than feedback from supermassive black holes has been shown to be capable of quenching entire population of galaxies at the level, which are consistent with observations.

24
00:03:53.940 --> 00:04:04.260
Annalisa Pillepich: So, Becca feedback is invoked for guides evolution and there's been traditionally tested against galaxy properties, but in the stock. I will mostly focus on the

25
00:04:04.920 --> 00:04:14.310
Annalisa Pillepich: Effects of feedback from Supermassive black was actually in part on the thermodynamic an organization and metal enrichment properties of the gas within and around galaxies.

26
00:04:14.790 --> 00:04:26.580
Annalisa Pillepich: And will also show you that the objective and preventative nature which emerged from the way we implement supermassive black hole feedback into energy is consistent with two key observations one tentatively, and one more strongly.

27
00:04:26.940 --> 00:04:40.290
Annalisa Pillepich: We call it one is the x ray luminosity dichotomy of so forming a quiescent galaxies and the agenda is a novel this result we saw in SPSS data, which we call it the directionality of quenching

28
00:04:41.280 --> 00:04:48.300

Annalisa Pillepich: So let's get started you know elasticity and G. But let me recap. Very briefly, in the last n G we have

29
00:04:48.810 --> 00:05:02.490
Annalisa Pillepich: Run at least three flagship cosmological volumes and in this simulations we are for our sovereign for gravity and my mental hundred dynamics and expanding universe of 50 100 or 300 can move in the

30
00:05:03.480 --> 00:05:12.180
Annalisa Pillepich: Desert, the successor of the last race. And I think I never said it in as I'm incredibly grateful for the opportunities, the lashes gave me at the time when I was at Harvard.

31
00:05:12.990 --> 00:05:19.440
Annalisa Pillepich: So in fact, last is any less energy came out from the efforts of however people to get refocused sprinkle in Germany.

32
00:05:20.340 --> 00:05:31.380
Annalisa Pillepich: And with one unique set of ingredients we follow the evolution of that matter cosmic gas supermassive black hole stars and magnetic fields and we do so on large cosmological volumes, so that we have

33
00:05:31.680 --> 00:05:44.010
Annalisa Pillepich: an unbiased galaxies that this is 1000 10s of thousands of guides across five. What is a language humans that are mass across environments for example also galaxies, the central and the satellites of object like

34
00:05:46.500 --> 00:05:55.170
Annalisa Pillepich: Total with 10s of thousands of doors galaxies, including some little weirdos. We call them jellyfish. We go underground pressure stripping.

35
00:05:55.470 --> 00:06:08.280
Annalisa Pillepich: And also in the smaller volume 250 at highest resolution, we still have a sizable population of Massey gutters at a redshift, which we can use to contrast to novel observational service at this intermediate redshift.

36
00:06:08.910 --> 00:06:20.370
Annalisa Pillepich: Or this is achieved with very good resolution for this type of simulation, we are talking about 100% on average in the gas within the galaxy bodies.

37

00:06:20.910 --> 00:06:25.590
Annalisa Pillepich: At least into into 50 and just combination of physical ingredient and resolution.

38
00:06:25.920 --> 00:06:36.330
Annalisa Pillepich: Allows us to study galaxies as the ones depicted here. I hope you see them on the left. It's a galaxy in God and you see to face on and the john gas column density

39
00:06:36.840 --> 00:06:45.750
Annalisa Pillepich: And analog plot analog mapping stellar like composite. This is a mass incarceration one another one on the right. In stuff for missionary surface density

40
00:06:47.400 --> 00:06:57.990
Annalisa Pillepich: Now importantly for the stock detention model successfully return two distinct classes or galaxies. You can see them here in death star formation rate versus galaxies that are Muslim. The left

41
00:06:58.200 --> 00:07:13.170
Annalisa Pillepich: Or galaxy color system or Muslim the right but you can see that we both have galaxy and the stuff for the main sequence for the blue cloud and galaxies that rain down from the start. For me, men sequence and then quenched. And they populate the red sequence compared in blue versus

42
00:07:14.280 --> 00:07:20.130
Annalisa Pillepich: Black contours. You can see how the teens. You guys see population compared to his luggage. The Sky Survey.

43
00:07:21.840 --> 00:07:27.000
Annalisa Pillepich: In fact, a population of quench galaxies emerges also intimidated and high received

44
00:07:27.570 --> 00:07:33.450
Annalisa Pillepich: In this plot is the contraction. So the fraction of galaxies as a function of galaxies that are mass, which are quenched.

45
00:07:33.990 --> 00:07:41.340
Annalisa Pillepich: On certain definitions. So they are below this form in sequence, different panels are different Russia, but let's focus on the middle one.

46
00:07:41.700 --> 00:07:51.510

Annalisa Pillepich: So in blue and orange their results from 10 to 120 300 great data points are data from observational data from Cosmos with Mr candles.

47
00:07:52.350 --> 00:08:04.830
Annalisa Pillepich: You can see more Massey galaxies and more frequently quenched. And there is a transitional master gene, which will tend to the tenant and to the level where we go from mostly start forming galaxies to mostly quench galaxies.

48
00:08:05.220 --> 00:08:15.150
Annalisa Pillepich: In red is the results from illustrious we've produced fewer quench galaxies and this we know is related to them feedback from supermassive black hole in a different implementation.

49
00:08:15.960 --> 00:08:22.980
Annalisa Pillepich: Importantly also start forming and wasting galaxy separate too many observable and I will just show one visually.

50
00:08:23.550 --> 00:08:30.420
Annalisa Pillepich: On the red on the left our galaxy which I read based on the Germans are color and on the right are blue galaxies.

51
00:08:30.780 --> 00:08:46.200
Annalisa Pillepich: And you can see that naturally also in this kind of measurement intensity this connection between star formation status activity and more star morphology come up naturally with elliptical EJ galaxy on the left and more discuss regarding the right

52
00:08:47.940 --> 00:08:56.820
Annalisa Pillepich: Now we're still understand many aspects of this dichotomy between start forming and question guys about one thing we're really sure about is that Indian G at least

53
00:08:57.150 --> 00:09:04.110
Annalisa Pillepich: Massive central galaxy stop their star formation or reduce the star formation thanks to feedback from supermassive black hole.

54
00:09:05.010 --> 00:09:17.100
Annalisa Pillepich: This was demonstrated very clearly not blocked by Reiner Weinberger, where do you find galaxy simulated into the same volume with different model. So it's a color versus galaxies Teller mass

55
00:09:17.340 --> 00:09:27.180

Annalisa Pillepich: In blue a galaxy in a simulation will note supermassive black hole feedback in read our galaxy Supermassive black or feedback. And what I want you to notice is that the population.

56
00:09:27.540 --> 00:09:33.420
Annalisa Pillepich: Of reading wise and high mass galaxies only develops when the supermassive black driven

57
00:09:33.720 --> 00:09:42.210
Annalisa Pillepich: When the when the sort of metaphorical feedback is activated and, in particular, in our case is in the form of of Supermassive black could do them wins is a kinetic feedback.

58
00:09:42.600 --> 00:09:51.780
Annalisa Pillepich: And he's also by the way happens not necessarily at high attrition rate of the supermassive records for those of you are not familiar with is what we really do is

59
00:09:52.740 --> 00:10:04.350
Annalisa Pillepich: We don't know how supermassive black hole for we place them in God's with a given six months on halos more massive than a certain mass than the supermassive black holes can grow in mass by accreting surrounding gas and the gas.

60
00:10:04.590 --> 00:10:13.770
Annalisa Pillepich: That is available comes from distribution of the equation in the simulation and then the because can do feedback in our models anti christian rates.

61
00:10:14.190 --> 00:10:21.510
Annalisa Pillepich: Compared to Edmonton we dump thermal energy so internal energy to the gas around in the black hole and low attrition rate.

62
00:10:21.810 --> 00:10:29.880
Annalisa Pillepich: The gas around in the black holes is kicked and the different time steps in different directions. So it's on average as a tropic. All right.

63
00:10:30.840 --> 00:10:33.900
Annalisa Pillepich: And it's intermittent differently from the other mode.

64
00:10:34.830 --> 00:10:49.110

Annalisa Pillepich: So this is what happened that day injection scale. So really, at the level of the gas cells, you could see them in this world, like the solution or presenting a gashes disk. And this is what happens that an emergent phenomenon larger scales.

65
00:10:50.430 --> 00:10:55.920
Annalisa Pillepich: On the left from the left to the right is gas velocity gas temperature guys column density and mentally sitting

66
00:10:56.490 --> 00:11:03.360
Annalisa Pillepich: And at the center of this blog. There is a galaxy. You can see this. You can see this stuff for him in his court, we have something

67
00:11:03.810 --> 00:11:11.520
Annalisa Pillepich: Like 10 cents bars or partial call resolution in the simulation is a 10 to 15 simulation is not an isolated, you know, set up.

68
00:11:12.180 --> 00:11:20.730
Annalisa Pillepich: What I wanted to see is that this guy says undergo Supermassive black or feedback or actually for for the first time. It's a ratio of one point something almost two

69
00:11:21.810 --> 00:11:33.780
Annalisa Pillepich: supermassive black holes drives this outros at 1000 kilometers a second day hits the gas and they produce cocoon like over pressurized metal and rich bubbles around the galaxy.

70
00:11:34.230 --> 00:11:51.240
Annalisa Pillepich: So intensely the supermassive black or feedback ejects and hits the gas around within and around galaxies and by doing so by hitting the gas. It also offsets the cooling time of the CGM by preventing future star formation.

71
00:11:51.810 --> 00:11:58.980
Annalisa Pillepich: Maybe you can see this in this movie. This is another galaxy from changing 100 there are different panels, pick one that you like.

72
00:11:59.370 --> 00:12:08.220
Annalisa Pillepich: But if you like cooling times bigger than one of the cooling time so you can see that they're relatively short in the start from a region of this galaxy and then Supermassive black of feedback starts to go off.

73

00:12:08.550 --> 00:12:16.380
Annalisa Pillepich: And ending the CGM and at the largest distances, you can start to see the current time to come, longer, longer preventing future star formation.

74
00:12:19.830 --> 00:12:30.420
Annalisa Pillepich: Now, I think, a powerful way to say what what the supermassive black of it does at least in T AMP G talking about entropy is be obscene. I went, be the back it's here.

75
00:12:30.930 --> 00:12:38.010
Annalisa Pillepich: So entropy of the gas goes up with temperature and and goes up inversely with that such a big asset to third

76
00:12:38.370 --> 00:12:48.570
Annalisa Pillepich: So here is central reversal guy customers where we stack many galaxy and the entropy is more as measure for the gas within the storyboard. You guys within our he of the galaxies.

77
00:12:48.930 --> 00:12:57.690
Annalisa Pillepich: And quench galaxies are are in the guise of coke or the best stuff from a charade, so that you can see here quench galaxies. They have very high entropy. So

78
00:12:58.440 --> 00:13:02.640
Annalisa Pillepich: This feedback produced naturally different entropy gashes atmospheres.

79
00:13:03.120 --> 00:13:08.820
Annalisa Pillepich: And the remainder of the talk, I will talk about atmospheres of gas. So by this would mean very generally

80
00:13:09.120 --> 00:13:16.350
Annalisa Pillepich: The volume filling gas within and around galaxy. So we think it could be the hot interstellar medium. It'll to exist as not

81
00:13:16.590 --> 00:13:26.160
Annalisa Pillepich: As hot and then going by the ways we're really talking distinguish will be of atmosphere of silicon black medium or inter caste to meet you, much larger and larger mass skills.

82
00:13:27.600 --> 00:13:36.120
Annalisa Pillepich: So these are observable probably they produce different observable. But before going to that I want also to hammer on another point.

83
00:13:36.660 --> 00:13:49.470
Annalisa Pillepich: Although the feedback injection is as a tropic at the cell level the phenomena can be quite diverse and in fact what comes out in our simulation and we could only say after making the simulation is that

84
00:13:50.310 --> 00:13:58.980
Annalisa Pillepich: Most other feedback and supermarket bag of feedback I should produce caches outflow that emerged bipolar by chronically from the galaxies. You can see this year.

85
00:13:59.520 --> 00:14:11.430
Annalisa Pillepich: Were in colors are the gas have lower rates of the gas coming out from galaxy is as a function on the on the bottom of rages and on the y axis of orientation respect to the desk or the minor access

86
00:14:11.760 --> 00:14:21.540
Annalisa Pillepich: The majority of the gas comes out along the minor axis. Alright, so is this old plausible. Well, again, as mentioned earlier. Traditionally,

87
00:14:22.170 --> 00:14:32.340
Annalisa Pillepich: People have tested got information simulation algebra master back of feedback against seller properties of the galaxy and our guys is that appropriate thing is that possible, I can show you more later.

88
00:14:32.790 --> 00:14:42.300
Annalisa Pillepich: But I think we can go more direct and test Supermassive black of feedback by looking at properties of the CGM and off the gas within and around galaxies.

89
00:14:44.280 --> 00:14:55.290
Annalisa Pillepich: Okay, I showed you earlier galaxy on the left and the right, divided by by red and blue color. This is the same in our, in our, in our, in our plot by Dylan.

90
00:14:56.190 --> 00:15:00.870
Annalisa Pillepich: The galaxies are divided in red on the left and blue on the right now.

91
00:15:01.320 --> 00:15:13.770

Annalisa Pillepich: The steps are hundreds of kilo per sec Wyatt and the colors. Then, note that column density of oxygen six in the CGM. So this is a fifth time ionized oxygen. Just depends on a host of thing depends

92
00:15:14.130 --> 00:15:24.390
Annalisa Pillepich: How much gas, you have a actually how much metals, you have actually how much oxygen and how much of it is it oh nice so dependent on temperature and what radiation impinges etc.

93
00:15:24.960 --> 00:15:36.990
Annalisa Pillepich: You can see the desert, very different. So for example, we are finding that so for me to question God to systematically different oxygen six columns and this is George at fix guarantee stellar much

94
00:15:37.830 --> 00:15:49.980
Annalisa Pillepich: The level of oxygen sick density or actually consistent with available observation, say from costs. Hello, but here we are really showing that continue to prediction and showing that the quintessential manifestation, I would say.

95
00:15:50.430 --> 00:15:59.100
Annalisa Pillepich: Of the connection between galaxy properties and the properties of the silicon galactic medium and this case mediated by supermassive black hole feedback.

96
00:16:00.900 --> 00:16:04.440
Annalisa Pillepich: I'm going to skip this and they're going to go to less maybe

97
00:16:05.550 --> 00:16:14.520
Annalisa Pillepich: Difficult things at the fourth at the forefront of both observations and simulation and go back to something you may need more more familiar with x ray mission.

98
00:16:14.970 --> 00:16:23.670
Annalisa Pillepich: So here are neutral, who's also here as opposed to working with me as make Chandra mockups aeration of imagery of galaxies from the simulations.

99
00:16:24.000 --> 00:16:30.480
Annalisa Pillepich: As a practice. You can literally get a spectrum in the x ray assuming say 100 kilos economic exposure.

100
00:16:31.350 --> 00:16:41.310

Annalisa Pillepich: Including Galactica absorption involvement with the new node response function of the standard telescope and you get spectra, like the one on the left or or x ray maps as the one on the right.

101
00:16:42.480 --> 00:16:43.500
Annalisa Pillepich: What are smiling.

102
00:16:44.520 --> 00:16:48.480
Annalisa Pillepich: Oh yes, I think I have an address eight minutes or so.

103
00:16:49.620 --> 00:16:50.760
Ana Bonaca: What we're finding

104
00:16:50.940 --> 00:16:57.180
Annalisa Pillepich: Is that start forming and question galaxies are also different on the x ray atmospheres.

105
00:16:58.110 --> 00:17:08.010
Annalisa Pillepich: So this is Cuban magnitude on the x axis best shoes. The x ray luminosity in soft banned from the gas from within galaxy. So within our E

106
00:17:08.520 --> 00:17:15.300
Annalisa Pillepich: And the controllers are given you that the new galaxies in PNG and read galaxies. They are on the fence killing relations.

107
00:17:16.080 --> 00:17:23.910
Annalisa Pillepich: In comparison to observations, they are on a good ballpark. So these are for example observation with Chandra with similar exposure.

108
00:17:24.240 --> 00:17:36.360
Annalisa Pillepich: From Atlas 3D and massive and others, and that the galaxies in the local universe. It's actually a bit hard to find x ray observation of star forming galaxies, and this is because there is a bit of a difficulty there because

109
00:17:37.230 --> 00:17:48.360
Annalisa Pillepich: Also X rays that binary is not hot volume feeling gas can emit X ray. And so we have to remove remove these from observation, but it's actually very hard because we don't know exactly the modeling.

110

00:17:48.870 --> 00:17:58.830
Annalisa Pillepich: But this is what we found, India and the literature again showing some level of consistency. But all I want you to remember is that they are on different killing relation and that

111
00:17:59.280 --> 00:18:08.130
Annalisa Pillepich: Transitional master, Jim, which is the standard template five solar masses start forming galaxy can actually be brighter in X rayed and choir sing galaxies.

112
00:18:08.640 --> 00:18:21.840
Annalisa Pillepich: Why does this happen in the end, you would know. This happens because of blekko feedback so quiescent galaxies are a signpost that supermassive black holes as as worked and it's worked a lot, otherwise they wouldn't be quenched.

113
00:18:22.620 --> 00:18:29.880
Annalisa Pillepich: And here you should see the same not where the guys are color coded by the energy injectors through supermassive black hole feedback in this kinetic mode.

114
00:18:30.540 --> 00:18:44.040
Annalisa Pillepich: When larger energy injected in this kinetic mode implies lower x ray luminosity. So why does this happen, so x ray luminosity dependent on metal elicited temperature and density. It always goes up with the industry goes up.

115
00:18:45.180 --> 00:18:54.780
Annalisa Pillepich: Remember black holes. Make a jack guns and makes it hotter. But here what wins is the density. So question galaxies.

116
00:18:55.230 --> 00:19:07.680
Annalisa Pillepich: Hotter gashes atmosphere so they should have higher luminosity, is it makes re however they have much less density, much less gas, which is hot and therefore they have lower x ray luminosity.

117
00:19:08.760 --> 00:19:09.270
Annalisa Pillepich: All right.

118
00:19:11.460 --> 00:19:21.000
Annalisa Pillepich: This is an example, a disconnection between galaxies gases atmosphere mediated by supermassive black holes and now I want to show you something else.

119
00:19:21.390 --> 00:19:31.350

Annalisa Pillepich: Which is pointing to a similar direction, but we're now focusing again on galaxies. So this is what led by inertia, Matty Navarro

120
00:19:31.890 --> 00:19:46.440
Annalisa Pillepich: And here we query SPSS data. And now, going back to quenching of satellites we have found that the fraction of quench satellites depends on their location their orientation with respect to the central galaxy.

121
00:19:47.250 --> 00:19:54.300
Annalisa Pillepich: So imagine, you'll have your central guys, you must you guys in the sky you from the photometer you can get the position Angola and

122
00:19:54.660 --> 00:20:06.150
Annalisa Pillepich: You can get my major and minor and access and you can also get the position angle of satellites all around it and most central defender population of satellites are immersed in that matter halo and in a hot gashes Halo.

123
00:20:07.140 --> 00:20:13.710
Annalisa Pillepich: Okay, now I don't know whether I can do this, but I would like to do a survey among this audience. And I want to ask you.

124
00:20:14.370 --> 00:20:26.850
Annalisa Pillepich: Which satellites, do you think are relatively less quenched according to you, and I don't know whether you guys can do it. But if you can put a one or a two in the chat. Then we can see later how many thoughts of this

125
00:20:27.660 --> 00:20:37.500
Annalisa Pillepich: One. If you think that they're relatively fewer quenched or read galaxies along the minor axes of the central galaxy.

126
00:20:38.310 --> 00:20:48.270
Annalisa Pillepich: Or put it to, I don't know if they're doing it because I cannot see the chat if you think that they're going to be fewer quench style guide to on the major axis of your central gags.

127
00:20:49.770 --> 00:20:56.130
Annalisa Pillepich: I'm not really sure whether you want to play to this, but I just give you a moment. It's actually incredibly hard.

128
00:21:02.940 --> 00:21:11.190

Annalisa Pillepich: Alright, the answer. Oops, a daisy. It's the first one we are actually seen the following up

129
00:21:12.540 --> 00:21:23.370
Annalisa Pillepich: in SPSS, the satellites quench fractions are lower along the minor axes of their central. So this is a result that can only be obtained by stacking. We are stalking.

130
00:21:24.030 --> 00:21:36.630
Annalisa Pillepich: Doesn't have a satellite gaiety or under Central's or aligned. Alright, and the end aqueous infraction here is shown as a function of orientation with respect to the minor axes of the central

131
00:21:37.260 --> 00:21:47.190
Annalisa Pillepich: So Mary mind that you don't need to have a disk galaxy as a central to define a major, minor x is, in fact, the majority of the Central's are not discs in SPSS. And this masses.

132
00:21:47.970 --> 00:21:56.070
Annalisa Pillepich: But you can see that there is a significant about quite small trend for which the friend contraction or lower

133
00:21:56.760 --> 00:22:07.980
Annalisa Pillepich: Along the minor axes, or in other ways. You can see that the eyes of quiet and fractions. I have a very different shapes. If you see all your galaxy, say, a john alright

134
00:22:08.460 --> 00:22:27.570
Annalisa Pillepich: And we're talking here about satellites, all the way from a few tends to a few hundreds of killer plastic away from the central galaxy and we're talking about Central's of an average 10 to the 11 solar masses or halos of tend to the 13 and a bit solar masses not massive, massive objects.

135
00:22:29.430 --> 00:22:43.260
Annalisa Pillepich: The coolest thing is that in SPSS. This is an isotope in modulation is stronger is more evident four sentences that are closer to the center of the of the galaxy of the set of the halos where they are hosted

136
00:22:44.580 --> 00:22:57.540
Annalisa Pillepich: A stronger for lower mass satellites is stronger for halos with more massive Central's and the stronger for healers which host relatively more massive supermassive black holes at their center.

137

00:22:58.860 --> 00:23:09.720
Annalisa Pillepich: Okay. Also, this is also present in TNT certainly didn't look for this in the end it was really a surprise.

138
00:23:10.980 --> 00:23:22.350
Annalisa Pillepich: So here, an ingredient is ginger tea and in black is SPSS. And then again, we're talking about a percentage level effect, but is significant and we did all the statistical tests.

139
00:23:23.850 --> 00:23:26.670
Annalisa Pillepich: Now what causes this

140
00:23:27.690 --> 00:23:37.110
Annalisa Pillepich: So you can have this could come up because I'm manifestations have a large construction phenomena, for which galaxy coming COME TO COME IN SANTA guys you can meaning two

141
00:23:37.590 --> 00:23:45.840
Annalisa Pillepich: Groups and clusters and maybe something happens before even they started to interact with the surgery on Monday and the central galaxy.

142
00:23:46.050 --> 00:23:58.290
Annalisa Pillepich: Or it's a wholesaler phenomena, we'd actually is the second situation, we don't really think it's a horse tail phenomenon. So this happens because the satellites are orbiting in this city in the CGM around the decentralized

143
00:23:59.250 --> 00:24:16.290
Annalisa Pillepich: And we find this because in tangy this modulation is essentially absent in illustrates in the original illustrious same volume same healers, but different Supermassive black of Feedback models in illustrious competitive energy

144
00:24:17.040 --> 00:24:27.450
Annalisa Pillepich: And then what relation intended stronger around quiescence Central's which again remember are the ones that underwent more and more Supermassive black feedback.

145
00:24:28.080 --> 00:24:37.920
Annalisa Pillepich: More also the modulation is driven by satellite. The quenched as they were in the redshift zero horse where we are finding them today.

146
00:24:38.520 --> 00:24:52.710

Annalisa Pillepich: And so this excludes and not in the one and not on the satellites that under guys they became satellite but quench before becoming satellites or a welder or satellite to either object. So we can exclude the landscape structure phenomenon.

147
00:24:53.430 --> 00:25:02.280
Annalisa Pillepich: So what's happening. So again, the directionality of content is a manifestation of supermassive black hole feedback from the central of

148
00:25:02.910 --> 00:25:05.490
Annalisa Pillepich: Groups and clubs and clusters of galaxies.

149
00:25:06.480 --> 00:25:19.230
Annalisa Pillepich: And remember Supermassive black, have you back into n g objects and hits the gas. By doing so, it cars lower density region in the silicon galactic medium around Central's and, particularly, so a London minor axes.

150
00:25:19.740 --> 00:25:25.380
Annalisa Pillepich: On the central plot you see a map of stack central 11 sort of mass galaxies intentionally

151
00:25:26.010 --> 00:25:38.910
Annalisa Pillepich: And we put them all kind of genre. Right. And you can see the map is a delta density plot of the gas and above and below the let's call it the disk, the guy to better doesn't have to be at this

152
00:25:39.390 --> 00:25:47.190
Annalisa Pillepich: I'm the densities lower and you can see the same kind of modulation because I'm modulation with orientation.

153
00:25:48.570 --> 00:25:49.140
Annalisa Pillepich: So,

154
00:25:51.000 --> 00:26:05.310
Annalisa Pillepich: The supermassive echo feedback of the central modifies a CGM but by lowering its density a lower Ambien density means lower and precious tripping for the satellites that encounters it, but this means less

155
00:26:05.850 --> 00:26:11.850
Annalisa Pillepich: Gas removal and therefore lower quaint fractions for this secondary satellite galaxies.

156
00:26:12.870 --> 00:26:24.990
Annalisa Pillepich: Alright. So to summarize, we have predicted a dichotomy between start forming and choir sing galaxy in the x ray luminosity versus cave and magnitude relations.

157
00:26:25.410 --> 00:26:34.290
Annalisa Pillepich: For we'd start forming galaxy attend to the 10.5 or actually x ray brighter than question galaxies for the heart volume feeling gas.

158
00:26:35.730 --> 00:26:44.280
Annalisa Pillepich: And we think that this supports the objective nature, at least at the question mechanism in tangy, which is due to Scrum Master Becca feedback.

159
00:26:44.730 --> 00:26:51.360
Annalisa Pillepich: And we've also found support for this also from SPSS data on satellite quench fractions.

160
00:26:51.960 --> 00:27:03.360
Annalisa Pillepich: We found this quenching anisotropy signal which is due to the interaction between satellites and complex medium modulated by the supermassive black hole activity at the center.

161
00:27:03.810 --> 00:27:15.000
Annalisa Pillepich: Of these Halo two in their central galaxies, and I think we and we think we provides operational support for this very far reaching effects of Supermassive black coffee, but they're really done just

162
00:27:15.270 --> 00:27:25.740
Annalisa Pillepich: Attack the central get the galaxy. The massive guides and where the supermassive black hole reside. But given the CGM around it and indirectly the galaxy. They live in such a CGM

163
00:27:26.670 --> 00:27:40.830
Annalisa Pillepich: So this needs to be addressed. Even more quantitatively and we're all looking for, like, to be Rosita for additionally x ray measurements in in the future. And then, and that was what I wanted to tell you

164
00:27:48.000 --> 00:27:48.600
Morgan Elowe MacLeod: Thank you.

165

00:27:49.830 --> 00:27:51.000
Ana Bonaca: Very exciting.

166
00:27:51.240 --> 00:27:57.480
Morgan Elowe MacLeod: It is. And so now what we're going to do is we are going to send you

167
00:27:59.850 --> 00:28:04.740
Morgan Elowe MacLeod: All except and Lisa and on an eye into

168
00:28:06.240 --> 00:28:12.360
Morgan Elowe MacLeod: Or maybe we'll all get sent if we just send randomly into breakout rooms and you

169
00:28:13.020 --> 00:28:20.250
Morgan Elowe MacLeod: Can talk for a couple minutes. Think about what was interesting. What you want to talk about more. There's so much to talk about. I think that

170
00:28:20.550 --> 00:28:34.440
Morgan Elowe MacLeod: This work is like setting the stage for how in computational astrophysics. We can create models that are statistical populations in and of themselves that then can be compared to the observations. It's

171
00:28:35.160 --> 00:28:43.470
Morgan Elowe MacLeod: Like really setting the stage for how we can think about creating models which directly predict the observable.

172
00:28:44.940 --> 00:28:59.790
Morgan Elowe MacLeod: And so there's things about the methodology. There's things about the science, there's, there's so much to talk about. So in your groups take five minutes post the gist of your questions. You don't have to post the whole thing because will call on you to ask it verbally.

173
00:29:00.960 --> 00:29:04.530
Morgan Elowe MacLeod: To either the slack or the chat window and we'll be back soon.

174
00:29:07.980 --> 00:29:09.240
Annalisa Pillepich: Cool. So stay with us.

175
00:29:10.440 --> 00:29:12.660

Morgan Elowe MacLeod: We'll see what happens, we may just randomly sort

176
00:29:26.070 --> 00:29:26.880
Morgan Elowe MacLeod: How's it looking

177
00:29:36.480 --> 00:29:43.140
Morgan Elowe MacLeod: I find something like existentially hilarious about the breakout rooms like you get sent to these little boys.

178
00:29:43.530 --> 00:29:46.920
Morgan Elowe MacLeod: And then you can move between them. And they're like, they're not real.

179
00:29:47.940 --> 00:29:49.530
Morgan Elowe MacLeod: There's something very funny about it.

180
00:29:49.590 --> 00:29:52.230
Annalisa Pillepich: Is it is someone who decides for you. Were you

181
00:29:52.380 --> 00:29:54.570
Morgan Elowe MacLeod: Yeah, yeah, yeah, yeah. You just get sent

182
00:30:00.270 --> 00:30:03.120
Christine Jones: We could talk to people. So are we in a room already

183
00:30:03.450 --> 00:30:04.140
Know,

184
00:30:05.160 --> 00:30:06.330
Christine Jones: Okay, just checking.

185
00:30:07.080 --> 00:30:10.500
Ana Bonaca: Yeah, fire, right. It's my first time doing this and

186
00:30:14.310 --> 00:30:21.210
Morgan Elowe MacLeod: So you'll get the listing and then you click open breakout rooms.

187
00:30:21.900 --> 00:30:26.490
Ana Bonaca: Okay, I get that. And then I gather right here prompts in progress.

188
00:30:31.260 --> 00:30:35.370
Morgan Elowe MacLeod: Oh, I think maybe I need to assign participants in groups of four.

189
00:30:38.040 --> 00:30:39.960
josh: It can also be done randomly is no issue.

190
00:30:40.050 --> 00:30:40.980
Ana Bonaca: Yeah, exactly.

191
00:30:44.640 --> 00:30:46.950
Ana Bonaca: But I can no longer do that.

192
00:30:57.540 --> 00:31:18.390
Morgan Elowe MacLeod: I think that what has happened is that there are four rooms which have been created. So why don't people just sort themselves into those rooms and we'll get this smoothed out in future iterations, so it on the breakout rooms tab. Pick any one of them and and go ahead

193
00:31:19.470 --> 00:31:22.470
Natasha Abrams: I think that he can't actually join us here because

194
00:31:30.660 --> 00:31:33.930
Sirio Belli: I don't see any breakout room tab where should it be

195
00:31:40.050 --> 00:31:41.640
Vadim Semenov: Maybe we can stay here as a

196
00:31:43.230 --> 00:31:44.130
Thief report.

197
00:31:55.200 --> 00:31:55.530
Okay.

198
00:31:56.850 --> 00:31:58.380
Ana Bonaca: Are we in a smaller group now.

199
00:35:34.710 --> 00:35:36.030
Morgan Elowe MacLeod: Do we want to stop the recording.