

WEBVTT

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00:00:11.400 --> 00:00:19.470

Morgan Elowe MacLeod: Wonderful from the top and delighted to welcome to cantiello this week for colloquium and.

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00:00:21.120 --> 00:00:24.210

Morgan Elowe MacLeod: You know, as usual, I think that.

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00:00:26.070 --> 00:00:37.560

Morgan Elowe MacLeod: We can all take a moment to reflect with gratitude that Mateo has taken the time to be here, and also that you all have taken this time, amidst a challenging winter.

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00:00:39.180 --> 00:00:45.810

Morgan Elowe MacLeod: I don't know if any of you know there's like a old Carol called in the bleak midwinter but that's like been on my mind lately.

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00:00:48.210 --> 00:01:01.110

Morgan Elowe MacLeod: Okay, but back to introducing the day on Monday is research scientist at the CCA the flat iron Institute for computational astrophysics in New York City before that.

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00:01:02.400 --> 00:01:11.910

Morgan Elowe MacLeod: He is he was a postdoc at the cavalier Institute for theoretical physics and one of the roles that he played there was really a crucial role in.

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00:01:12.300 --> 00:01:27.270

Morgan Elowe MacLeod: In developing and expanding the Mesa stellar evolution software, which has become just an incredible sort of widely used widely referenced open source software tool for for understanding how stars evolve.

8

00:01:28.380 --> 00:01:28.890

Morgan Elowe MacLeod: and

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00:01:31.110 --> 00:01:39.750

Morgan Elowe MacLeod: With that in mind that a, I guess, I wanted to say just very briefly one thing that I personally really admire about the way that Mateo works is that.

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00:01:41.100 --> 00:01:44.040

Morgan Elowe MacLeod: In the effort to understand how stars are evolving.

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00:01:47.370 --> 00:01:48.750

Morgan Elowe MacLeod: i've seen Mattel really take.

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00:01:49.800 --> 00:02:04.980

Morgan Elowe MacLeod: A role of like bringing together our field and bringing together expertise on all of the little ingredients that go into this complicated solution of understanding how stars evolved, so that we can improve those parts and eventually.

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00:02:05.400 --> 00:02:12.750

Morgan Elowe MacLeod: improve our prescriptions in in sort of a composite simplified model like a one the stellar evolution code.

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00:02:14.520 --> 00:02:20.700

Morgan Elowe MacLeod: So Mateo is an expert on on all things of how stars evolve eventually.

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00:02:22.350 --> 00:02:33.570

Morgan Elowe MacLeod: die as massive stars and give us the sorts of remnants that lead to compact object mergers and today is going to talk about the lives of stars in.

16

00:02:34.830 --> 00:02:40.020

Morgan Elowe MacLeod: A more gashes environment than normal in in discs around a gn.

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00:02:41.490 --> 00:02:42.450

Morgan Elowe MacLeod: So thank you so much.

18

00:02:44.790 --> 00:02:52.470

Matteo Cantiello: Thank you, Morgan okay i'm going to start and share my screen let's see if we can get started with this.

19

00:02:53.610 --> 00:03:04.920

Matteo Cantiello: All right, Okay, so my job today and he's to tell you a little bit about some work i've been doing recently on style evolution in Asia, and so I went out.

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00:03:05.700 --> 00:03:16.230

Matteo Cantiello: start straight away, saying i'm very excited about this work, if anything, because it brings in this fashion that we're gonna be talking about about stealth physics.

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00:03:16.800 --> 00:03:24.780

Matteo Cantiello: Are the crossroads of a number of disciplines that I usually do not intersect with, and so you know, working with.

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00:03:25.290 --> 00:03:43.590

Matteo Cantiello: stars in Asia, and this brings in dynamic sprinting to galactic evolution fitbit Christian processes and even additional with sources and a high energy astrophysics, and so I will try to convince them that this is a very interesting topic and something we're thinking about.

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00:03:44.760 --> 00:03:56.160

Matteo Cantiello: So, first I want to knowledge, a growing team of colleagues that held me true last year to develop some of the ideas that i'm going to discuss about.

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00:03:56.760 --> 00:04:03.390

Matteo Cantiello: In particular, little Alexandre determine who is a pre Doc was pretty dark at CCA and it's a PhD at university of Maryland.

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00:04:03.750 --> 00:04:21.360

Matteo Cantiello: items are men who is a postdoc at CCA then my more senior colleagues Dublin uc Santa Cruz and rosov appear not to see and stony brook and this team is growing i'm talking to more people and interact with other colleagues and developing new ideas so it's very.

26

00:04:22.980 --> 00:04:36.840

Matteo Cantiello: Interesting that you know by branching and looking at another region so critical region with start Mike for my also start interacting with colleagues that I didn't interact with for us, I find this very, very good for me.

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00:04:38.190 --> 00:04:50.190

Matteo Cantiello: So yeah what is this talk about um well the main idea is that stars can be born or even captured by agm this and because of that evolution can be changed substantially.

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00:04:50.550 --> 00:04:58.320

Matteo Cantiello: And what we did we looked at how to modify the numerical problems TV boundary condition to account for the President of the.

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00:04:59.040 --> 00:05:13.080

Matteo Cantiello: guests guesses medium identity around the star, especially in the regions close to supermassive black holes, we found out that the most important processes our bond a Christian intro mixing the Star and masters and.

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00:05:13.680 --> 00:05:21.300

Matteo Cantiello: muscles that appears on the star become very loneliness because we will see the stars tend to accrete them become massive and very massive object.

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00:05:21.930 --> 00:05:35.310

Matteo Cantiello: But he has an impact for the production off compact remnants and music explosions, and only would leave that the pressure them to start my fleet to evolution of a gn composition, to the deployment and talk for.

32

00:05:36.270 --> 00:05:45.630

Matteo Cantiello: ukulele process elements like like heavier than alien into the into the desk and also these might have a feedback on the agm structure and evolution.

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00:05:46.920 --> 00:05:59.400

Matteo Cantiello: So I mentioned an agm so I could galactic nuclear What are those these are like very bright to cosmic sources, they are powered by we believe they're powered by the accretion onto supermassive black hole.

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00:06:00.690 --> 00:06:06.000

Matteo Cantiello: Usually, you know the structure is complicated, but really discuss very simplistically here in.

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00:06:06.510 --> 00:06:13.650

Matteo Cantiello: As a geometrically thin a Christian desk surrounded by a broad line region of a mission and a buffer Taurus and.

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00:06:13.980 --> 00:06:20.340

Matteo Cantiello: You know, there are models step try to incorporate different pieces of physics to calculate what the.

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00:06:20.730 --> 00:06:28.740

Matteo Cantiello: Gas conditions in this this are going from in the region, outward this model of fairly complicated I think they're still in the infancy, but.

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00:06:29.280 --> 00:06:39.780

Matteo Cantiello: This is possible and people have ideas of what this condition might be, and this will motivate the condition that will use to calculate our stellar evolution model of each and stars.

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00:06:40.650 --> 00:06:57.990

Matteo Cantiello: Important to notice that those desk are not infinitely live they actually have finite lives and the lifetime, are you know daughter off 10 628 years and also interesting and important for this talk a piece of observation that shows that the.

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00:06:59.160 --> 00:07:09.150

Matteo Cantiello: In a region sub does this seem to be announcing their composition, so the Middle East, he seems to be high on all redshift and all increase with the massive at the back of the central black hole.

41

00:07:12.510 --> 00:07:27.030

Matteo Cantiello: So why do we want to study start a chance, well, the idea is that, first of all agents are actually relatively common about one to 10% of all galaxies and go through, or if our our industry in that phase or observational in that phase of pollution.

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00:07:28.110 --> 00:07:34.620

Matteo Cantiello: And the immediate surroundings of the supermassive black hole are actually populated or densely populated.

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00:07:35.520 --> 00:07:53.130

Matteo Cantiello: Usually, we talked about neutron star cluster is our cluster of stars, there are leaving in the neighborhood of the supermassive black hole to look at this galactic Center around sagittarius a star there are about 10 to the seven stars just within 1% of the supermassive black hole.

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00:07:54.450 --> 00:08:05.310

Matteo Cantiello: and, obviously, you know people that mentioned or people have studied the passivity death star's can form an ATM discs so there's also the possibility of having it start forming that involved in this in this environment.

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00:08:05.970 --> 00:08:14.640

Matteo Cantiello: So, as I mentioned our to their one avenue to formation and of stars and agendas, but also start can be captured from the nearby new new facility clusters.

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00:08:15.240 --> 00:08:25.290

Matteo Cantiello: This process of stellar capture relies on astronomical drag and the expectation of waves in the disk so this cartoon is showing a little bit idea here we have capturing.

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00:08:25.770 --> 00:08:41.520

Matteo Cantiello: Typical loma stuff from a nuclear star cluster they get embedded into the agm disk and has will see one of the possible outcomes, is that the density or decreasing rate is high enough the stars can trying to massive into their massive star.

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00:08:44.220 --> 00:08:52.260

Matteo Cantiello: Okay, so you know that stellar physics i'm still evolution in general it's a fairly successful story of astrophysics from the numerical standpoints.

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00:08:53.370 --> 00:09:06.330

Matteo Cantiello: You, if you look at a chart diagram or cmt you can actually you can actually map qualitatively pretty well the positional stars, you understand what phase of evolution to going true.

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00:09:07.410 --> 00:09:13.770

Matteo Cantiello: And I will I will even say that before loma start this understanding is qualitatively and quantitatively pretty good.

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00:09:14.070 --> 00:09:21.150

Matteo Cantiello: In the arrow stellar I positions to our physical health So when I make the case that there is still a lot of uncertainties and this is a part of the.

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00:09:21.480 --> 00:09:25.650

Matteo Cantiello: Work I usually do, especially in high in massive starts with still understanding.

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00:09:26.400 --> 00:09:37.470

Matteo Cantiello: How basic physical process might effective solution, but overall, you know this this theories consider while established however canonical stellar evolution is usually.

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00:09:37.800 --> 00:09:46.530

Matteo Cantiello: Usually, as soon as the presence of star in a called relatively empty interstellar medium, so the service boundary condition of them have distribution problem.

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00:09:46.890 --> 00:09:57.660

Matteo Cantiello: account for load external temperature temperatures and banishing pressures, but the density is in a GM this can be much, much higher than your typical run of the mill is Sam.

56

00:09:58.020 --> 00:10:07.890

Matteo Cantiello: Up to 10 to 10 times actually and the typical soundscape can be order 10 kilometers per second so you have Krishna rate on this task might be very, very large.

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00:10:10.170 --> 00:10:20.130

Matteo Cantiello: So, if one a model do stars, we need to go back to the blackboard and include new ingredients and we'll see that important gradients required new atmospheric boundary condition.

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00:10:20.490 --> 00:10:33.510

Matteo Cantiello: And, accounting for Christian on the Star and masters and muscles will become important because, as you can imagine, as a star create and become very massive will to become married very luminous and the stuff that we're going to discuss all approach jamming the luminosity.

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00:10:35.190 --> 00:10:49.560

Matteo Cantiello: So boundary condition okay so as you imagine the star embedded making this acquitting material from the desk from this outer bond a radius, this is the radius from which material will start falling into the star.

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00:10:50.760 --> 00:10:55.560

Matteo Cantiello: There is going to be in a Christian stream produce and a shock over the star.

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00:10:55.920 --> 00:11:03.450

Matteo Cantiello: Obviously wanna you want us involved starts with a long time skill and so you don't want to have to resolve the shock radius.

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00:11:03.780 --> 00:11:11.250

Matteo Cantiello: Above the shop very good, so what we're going to what we doing we're assuming that the boundary the other boundary of the Mesa model.

63

00:11:11.880 --> 00:11:28.350

Matteo Cantiello: Is at the shock radius and we will use analytical solution to tell Mesa what the condition on the shock boundary are by knowing what the unethical solution for the mature up falling onto the star are.

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00:11:29.610 --> 00:11:39.360

Matteo Cantiello: So to do this we pretty much the right instruction of attrition stream making some assumption and approximation so let's assume it's very good symmetry steady state.

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00:11:39.930 --> 00:11:46.350

Matteo Cantiello: We assume that the Stream is not pressure support it in that entity strong for the mainly by ear relative infusion.

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00:11:46.950 --> 00:12:02.100

Matteo Cantiello: And Sam and then illuminati is constantly live stream also the muscle the Stream is small compared to most of the Star and i'm assuming that passing the Stream is constantly equal to the addington scattered level, we would check that is assumption are usually.

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00:12:03.780 --> 00:12:15.420

Matteo Cantiello: fulfilled and we discussed in the paper you know possible departure of this assumption, but the overall messages I think that these are pretty safe, and so they allow us to calculate.

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00:12:16.080 --> 00:12:26.310

Matteo Cantiello: Models of stars in this condition and so just to familiarize a little bit with this new boundary new boundary understand evolution model, so you from radio.

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00:12:26.730 --> 00:12:35.400

Matteo Cantiello: i'm showing here one of this calculation that also show you later, for now, just know the status function of time, the muscle started blue line increases.

70

00:12:35.700 --> 00:12:47.640

Matteo Cantiello: Very rapidly to about 200 solar masses this start started as a once one mess, so this was a son and building an agm disk it grow to 200 so unnecessary in about 7 million years.

71

00:12:48.540 --> 00:13:02.370

Matteo Cantiello: So the largest radius of the problem is the bond I radius, which is always like tend to 1000 or 10,000 times bigger than the stellar radius the shop radius which correspond with the radius of the metal made a model is this.

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00:13:03.510 --> 00:13:09.810

Matteo Cantiello: thing curve and then the reason for this very courageous that you can imagine, you can build by calculating what the.

73

00:13:10.200 --> 00:13:22.650

Matteo Cantiello: opacity, with no into passive optical optical depth into the Christian stream and you can see that this usually correspond to the shop radius as long as the Christian it's not too large, the pressure is not too large, but then.

74

00:13:23.310 --> 00:13:36.720

Matteo Cantiello: As the star, we are very, very large freights you know if you start seeing into the stream at larger radio and it says citizens the reader the star, that you will see if you're sitting at the bond a radio seeing you looking down.

75

00:13:39.180 --> 00:13:52.230

Matteo Cantiello: Okay, so that star that is reaching about 200 solar masses obviously eats the haddington limit and so what's going to happen there, well, we can have a Christian under the star the bond a Christian, that is going to be.

76

00:13:53.340 --> 00:14:01.740

Matteo Cantiello: be opposed by the 10s of the star to want to lose mass, and this is because the star is to close with adding to the meanest.

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00:14:02.310 --> 00:14:08.190

Matteo Cantiello: In this case, what we do is assume that attrition is reduce obviously there's a complicated multi dimensional problem.

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00:14:09.000 --> 00:14:23.610

Matteo Cantiello: But what we do, we reduce the Christian great as the star gets closer into the data into luminosity we try different ways to do this and we found out that the solution are not too sensitive to the way we reduce your Christian.

79

00:14:25.020 --> 00:14:39.000

Matteo Cantiello: At the same time we actually losing mass and the muscles rate is some talk some typical announced it super adding to a wind, which is scaling with the extra luminosity trying to into a wind.

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00:14:41.220 --> 00:14:48.900

Matteo Cantiello: So these are the three main ingredients atmospheric boundary condition, a Christian muscles, the other ingredient is very important for the star is mixing.

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00:14:49.530 --> 00:14:56.940

Matteo Cantiello: So i'm going to make the case now that, as we start brewing mass they're going to evolve chemical machinist least today state well mixed.

82

00:14:57.420 --> 00:15:03.210

Matteo Cantiello: The reason is that, first of all, as star get massive and very, very massive supermassive.

83

00:15:03.690 --> 00:15:18.150

Matteo Cantiello: There in the region become more and more combative so 100 solar mass star as 90% of mass Hoover by corcoran bakshi so the stars already fairly well mixed by the usual combative mixing.

84

00:15:18.540 --> 00:15:25.440

Matteo Cantiello: But also the other region, the relative region is getting closer and closer to margin stability so gamma equal four thirds.

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00:15:26.610 --> 00:15:32.580

Matteo Cantiello: So any type of instability can easily grow in this magician dominated region.

86

00:15:32.940 --> 00:15:40.050

Matteo Cantiello: The same time you have a Christian and muscles, who are into playing so you're going to have some kind of circulation and probably are driven.

87

00:15:40.290 --> 00:15:54.870

Matteo Cantiello: By this process So all in all, we expect this stuff, together with the fact that, as we will see later to start probably also rotate rapidly to stay well mixed so we implemented like an extra diffuser became the star that allow the star to.

88

00:15:56.010 --> 00:15:57.450

Matteo Cantiello: To bring to the surface.

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00:15:58.650 --> 00:16:04.290

Matteo Cantiello: Nuclear Material as it evolved and you can see here in the slot is keeping on plot time is functional.

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00:16:05.070 --> 00:16:13.950

Matteo Cantiello: muscle mass coordinate and you can see that material here around 67 solar masses 67 million year sorry is actually.

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00:16:14.490 --> 00:16:30.480

Matteo Cantiello: drag out from the poor by these extra the facility and start making its way into the anvil to the surface, and this is the edm rich material, as you can see, you can see the diffusion coefficient we get larger and larger as it starts getting closer and closer to be out into new knowledge.

92

00:16:31.830 --> 00:16:41.220

Matteo Cantiello: Okay, so with this ingredients were able to build Mesa solution calculation, so we implemented this new type of physics into Mesa and then what we did with.

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00:16:41.760 --> 00:16:51.510

Matteo Cantiello: took samosas at once, or math models and we embedded into an agm with different density and sound speak so that we can regulate your Christian great on start.

94

00:16:51.870 --> 00:17:00.840

Matteo Cantiello: With some cost single position of good material and for now, we will make it effective rotational do i'll show you later that Adam for man is working on that piece of physics so as of now.

95

00:17:02.070 --> 00:17:02.580

Matteo Cantiello: So this is a.

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00:17:03.960 --> 00:17:06.390

Matteo Cantiello: Show going given solution and wanted to start.

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00:17:07.650 --> 00:17:19.500

Matteo Cantiello: This again keep it on diagram again, this is a log of time from the beginning to the end of the evolution of the calculation, the star actually answered oxygen that calculation and some oxygen burning.

98

00:17:20.430 --> 00:17:27.360

Matteo Cantiello: You can see that the star started creating mass at a very high rate you get the equilibrium mass of the box you undersold masses.

99

00:17:27.780 --> 00:17:43.230

Matteo Cantiello: And then It evolves and and actually is able to shed away mass tend to it's super addington wins and ends up actually as a tensile a mass compact a wolf or a star that's going to end up producing like the black hole.

100

00:17:45.390 --> 00:17:54.240

Matteo Cantiello: So that's pretty interesting and important part here is that this increase in masses that cover runaway process which you, to the fact that bond a Christian.

101

00:17:54.660 --> 00:18:02.820

Matteo Cantiello: depend on the square of the muscle starts the more massive Star and the more you want to create also the other important point is that the attrition.

102

00:18:03.690 --> 00:18:15.420

Matteo Cantiello: rate depends also on the ratio of the agent density to the Cuba to sound speak so once you fix row and CSS you know you can determine what your Christian rate is going to be.

103

00:18:16.560 --> 00:18:20.850

Matteo Cantiello: The most budget is pretty interesting for the star because it starts at creating and losing mass the same time.

104

00:18:21.270 --> 00:18:29.010

Matteo Cantiello: Although it evolves only to understand massive it loses about 400 solar masses Lillian REACH, see no process material into the age again.

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00:18:29.430 --> 00:18:39.630

Matteo Cantiello: and leaves behind a cancel a mess black hole we didn't account for the heels new to the possible supernova explosion, however, already the yields produced by the.

106

00:18:40.320 --> 00:18:46.590

Matteo Cantiello: nucleus processing during the main sequence, and later phases solution leads to large amount of volume and see no.

107

00:18:47.550 --> 00:18:57.330

Matteo Cantiello: process elements like we have several saw saw mess of oxygen carbon released into the agm, and this can be important for the pollution and an evolution in composition.

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00:18:57.810 --> 00:19:08.790

Matteo Cantiello: So this is a snapshot of different evolution of different stars are different different densities, so this is a long time as.

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00:19:09.390 --> 00:19:16.440

Matteo Cantiello: A massive the doors functional block time, as you can see, there are kind of like tree group of stars, the group of star low densities.

110

00:19:17.040 --> 00:19:26.040

Matteo Cantiello: That are barely affected so so my star becomes maybe a few slow, Ms dos but you still end up with a low mass object is I like the circles.

111

00:19:26.760 --> 00:19:40.230

Matteo Cantiello: The stars symbol show started as an evolution, similar to the one we just looked at where it grew to a few to a few hundred so masters, maybe, and then lost most of its mass it managed evolving till the end of.

112

00:19:41.580 --> 00:19:48.870

Matteo Cantiello: Its evolution and dies a comeback remnant and then i'm very high densities, you can see that as our guest stars, that seems to.

113

00:19:49.650 --> 00:20:06.870

Matteo Cantiello: REACH very high masses like thousand so a message, and then they keep going keep going for like under the millions of years, so this is a like 1000 semester that leave as \$1,000 Ms dos for maybe a giga year if you land it print material, as long as once.

114

00:20:08.640 --> 00:20:21.690

Matteo Cantiello: So what is happening there is that the stories well mix and he's accreting other rate that is higher than the rate that is burning aggregate score so he's constantly fat for fuel from the disk.

115

00:20:22.050 --> 00:20:38.490

Matteo Cantiello: So pretty much can stay on this main sequence, as long as it once so it's kind of a idiosyncrasy of this type of evolution, you have the agent is supplying you your new few of the sidewalk and you can stay there, as long as you want to spike your luminosity being extremely high.

116

00:20:39.690 --> 00:20:49.620

Matteo Cantiello: Now the other two types, the other history type of our evolution can be a understood pretty easily by the hierarchy of time skill involved in this problem, and so we have.

117

00:20:50.370 --> 00:20:59.490

Matteo Cantiello: Get Christian time skill and the nuclear time skill, so if the first look Christian efficient time because it's much it's larger than nuclear time skills, so the stars time to evolve.

118

00:21:00.750 --> 00:21:07.860

Matteo Cantiello: Before it's a substantial amount of mass in intermediate Christian you have depression times at least between the nuclear and the gn.

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00:21:09.330 --> 00:21:20.670

Matteo Cantiello: timescale, meaning that the Christian time skill is comparable to a little bit of time to sort of start creating enough mass but it's also time to evolve past the hydrogen burning during the main sequence.

120

00:21:21.030 --> 00:21:31.440

Matteo Cantiello: For runaway accretion the last case of immortal star depletion rate is much, much time so as much Marshall order than the time scale and so to start stays very massive.

121

00:21:35.100 --> 00:21:50.340

Matteo Cantiello: So we have this different regime of evolution and you can turn a once on mass star into this like thousands on mass be north or you make can make her black hole or you can just like increase its master little bit, but still produce a lone star.

122

00:21:51.630 --> 00:22:00.300

Matteo Cantiello: So i'm just want to mention a few a few next steps we working on, so the modification to bond a Christian so Alex dyckman has been working on.

123

00:22:00.780 --> 00:22:05.970

Matteo Cantiello: Reducing the bond that Christian rate by accounting for a few physical processes in Asia, and this, there are.

124

00:22:06.480 --> 00:22:13.950

Matteo Cantiello: pretty important that rely on the fact that you have this kind of bill supermassive black hole So if you have a.

125

00:22:14.430 --> 00:22:23.580

Matteo Cantiello: Your bond a radius becoming larger than the pressure than the than the scale height in the desk obviously at some point to some clarification if that's going to increase your attrition rate.

126

00:22:24.090 --> 00:22:32.820

Matteo Cantiello: same same story, if you have a desk you have a complex and slow, so you have sheer so he says, you are your bond that radius become larger you start creating material.

127

00:22:33.060 --> 00:22:39.630

Matteo Cantiello: With increasing relative velocity and so at some point the material one to fall into the black hole anymore, by the way, this is the same reason why.

128

00:22:40.050 --> 00:22:43.620

Matteo Cantiello: As the previous start on likely going to increase their annulment and content.

129

00:22:44.520 --> 00:22:51.960

Matteo Cantiello: And also because of times, and this is the most important fact, as you get closer and closer to black hole the heel sphere of the star so it's a.

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00:22:52.500 --> 00:23:05.640

Matteo Cantiello: gravitational sphere of influence becomes relatively small and at some point, it becomes smaller than the bond a radius so at some point, there is material between the hillary's and vonda rates that actually cannot fall onto the onto the star but it's actually.

131

00:23:06.210 --> 00:23:07.320

Matteo Cantiello: captured by the black hole.

132

00:23:09.240 --> 00:23:18.300

Matteo Cantiello: So these are most important point is that allows to make read more realistic map of the outcomes of this agent star evolution into.

133

00:23:18.930 --> 00:23:23.760

Matteo Cantiello: This model so if you know your some speed and and locker and density, you can.

134

00:23:24.030 --> 00:23:35.340

Matteo Cantiello: Tell which region i'm gonna create a runaway Christian regime or intermediate and so you can you will know which regions form massive into the massive stars and also compact remnants.

135

00:23:35.610 --> 00:23:52.050

Matteo Cantiello: And you know for desperate constant sounds good, for example, and increasing density moving toward the black hole he will find that you have this massive stars and they're relatively compact remnants and possibly explosion segregated two rings of of the desk.

136

00:23:53.700 --> 00:24:04.200

Matteo Cantiello: Also, Adam is working on this idea of that the stars actually might be rapidly spinning and so checking them angle them into balance content and how they will take one day and their lives.

137

00:24:04.500 --> 00:24:13.230

Matteo Cantiello: He finds that the stars that have produced come back to Romans are rapidly spinning, and they might be a project or so, but at least explosion like longer reversed.

138

00:24:14.670 --> 00:24:16.350

Matteo Cantiello: I am I doing with time.

139

00:24:18.690 --> 00:24:19.500

Matteo Cantiello: Morgan has.

140

00:24:19.740 --> 00:24:20.460

Ana Bonaca: Five minutes.

141

00:24:21.150 --> 00:24:21.840

Matteo Cantiello: Okay, so.

142

00:24:21.930 --> 00:24:23.790

Ana Bonaca: Our next five minutes i'm gonna just.

143

00:24:24.570 --> 00:24:29.700

Matteo Cantiello: talk a little bit about, so this is all interesting theoretical ideas, but it is.

144

00:24:30.390 --> 00:24:41.670

Matteo Cantiello: Just fantasy and obviously we need to look at the observation so using this quote from famous rock band, which by the way, has a one of the Members is actually a PhD in astrophysics.

145

00:24:42.150 --> 00:24:55.050

Matteo Cantiello: um so one place where we believe that it could be a useful to look at for looking for signature or or facts coming from this type of solution is the very galactic Center of the Milky Way.

146

00:24:55.740 --> 00:25:07.560

Matteo Cantiello: they're The reason is that the Milky Way might have experienced an agm like phase about six to 7 million million years ago the Fermi babo might be showing the fact of that face and.

147

00:25:08.670 --> 00:25:16.620

Matteo Cantiello: Today we have observational style publishing this time around, and there are directly available, so we can actually explored in one part of the galaxy.

148

00:25:17.250 --> 00:25:23.700

Matteo Cantiello: Something we cannot do with auto with a chance, and so this galactic Center is a pretty wild place and.

149

00:25:24.270 --> 00:25:34.890

Matteo Cantiello: In fact, within 1% or above 200 young master stop and which Presidents is not predicted and the density of this message the stars increases moving.

150

00:25:35.610 --> 00:25:44.580

Matteo Cantiello: within one part sick and they're actually no no messy starts outside of point 5.6 and the present a mass function you stop having.

151

00:25:45.360 --> 00:25:51.000

Matteo Cantiello: Also, some of the stars show show like helium enrichment and you can see here from this.

152

00:25:51.330 --> 00:26:04.680

Matteo Cantiello: Is from the review of the gop Center from right or cancel 2010 can see the population of blue young star confined to the very near very 0.5 or six inch radius of the of the galactic Center.

153

00:26:05.490 --> 00:26:16.200

Matteo Cantiello: The more interesting aspect of this is that, if you look at the dynamics of stars in the galactic Center that your expectation from buckling wolf is the formation of the of the cost, so the density of.

154

00:26:16.530 --> 00:26:30.570

Matteo Cantiello: loma star should be increasing as we move toward the galactic Center this is shouldn't be the case where massive stars, because their lifetime it's too short for that relaxations effect to become important and yeah would you serve is that.

155

00:26:31.260 --> 00:26:39.270

Matteo Cantiello: loma star seems to be actually depleted moving into the Center of the Gal the galaxy well massive star seems to be.

156

00:26:40.650 --> 00:26:52.320

Matteo Cantiello: Forming sort of this sort of stellar cast and maybe the idea here, and you know there's not the only possibility, but what we will be able to just using theories that actually sounds stars, the stars in the galactic Center.

157

00:26:52.830 --> 00:27:03.750

Matteo Cantiello: were turned into more massive stars and so that's why you see a depletion of loma Star and the galactic Center and increase of more massive object moving toward the end of.

158

00:27:04.800 --> 00:27:18.960

Matteo Cantiello: Another piece of the puzzle might be given by the presence of low mass X Ray binaries as identified by Chandra observation, the blue dots in this region, which are confined to the one part, six region around the supermassive black hole.

159

00:27:20.910 --> 00:27:31.110

Matteo Cantiello: Okay, when I just get to the end of the stock by talking about possibly implication and prediction so as I mentioned, publish a message very messy starts in each and this might be common.

160

00:27:31.740 --> 00:27:40.620

Matteo Cantiello: This might have an impact on the composition evolution of each n desk and also feedback from winterbottom NGO obese and a big topic that is.

161

00:27:41.100 --> 00:27:45.900

Matteo Cantiello: discussed to stay to explain some of the observational like a virgo is the potential.

162

00:27:46.350 --> 00:27:55.350

Matteo Cantiello: I article merger accomplished object sing got in each and disk and here we present a possible way to seed large number of such.

163

00:27:55.830 --> 00:28:07.620

Matteo Cantiello: compact objects in the in the mid plane of the agm desk and this might have an impact off, as I mentioned for galactic Center self publishing at abundances um.

164

00:28:08.220 --> 00:28:19.560

Matteo Cantiello: I might not have time to talk to this, but I can answer question about the possibility of relativist explosion in in hcm discs and I want to stop here, and thanks everyone for listening.

165

00:28:23.040 --> 00:28:23.760
Morgan Elowe MacLeod: and giving us out.

166
00:28:29.880 --> 00:28:30.630
Morgan Elowe MacLeod: So.

167
00:28:31.980 --> 00:28:39.000
Morgan Elowe MacLeod: We have a couple questions coming in, if you have questions, what I would ask you to do is private message me in the chat.

168
00:28:40.080 --> 00:28:52.920
Morgan Elowe MacLeod: Not your whole question, just like a couple words is fine, about what you have a question about, and you can do that at any time as we're talking and I will call on you to unmute yourself and ask a question.

169
00:28:54.330 --> 00:29:05.820
Morgan Elowe MacLeod: So, as we get started, I mean, I think this is a really amazing problem in part because, even if agm discs are geometrically thin.

170
00:29:08.580 --> 00:29:22.260
Morgan Elowe MacLeod: We know that they have some aspect ratio and we know that all supermassive black holes have tons of stars around them, as you, as you said, but they are in your cartoon and so there's a huge fraction of stars that must be undergoing this sort of evolution.

171
00:29:23.280 --> 00:29:32.820
Morgan Elowe MacLeod: Not fraction of stars in the universe as a whole but fraction of stars in this sort of bizarre and fascinating environment in the first place so.

172
00:29:32.880 --> 00:29:44.790
Morgan Elowe MacLeod: yeah that's something that I really love about this problem is that we know that it's happening, and this is a great step towards trying to think about what is happening um.

173
00:29:45.300 --> 00:29:55.470
Matteo Cantiello: yeah totally and I think that the you know the fascinating aspect is really trying to connect it to the observation and any streaky because you know those things are extremely luminous.

174
00:29:56.460 --> 00:30:09.150

Matteo Cantiello: And you know, most of the solution might be happening embedded within the disk. However, you know I think the fact that this does might become this monster, maybe help us there because.

175

00:30:10.020 --> 00:30:21.210

Matteo Cantiello: You want one, in fact, that I think could be interesting to you. You know, look for is this idea that maybe you know the stars producing relativistic explosion explosions embed into disk.

176

00:30:21.660 --> 00:30:25.050

Matteo Cantiello: But depending where down this might be actually recognizable.

177

00:30:25.410 --> 00:30:38.790

Matteo Cantiello: Maybe you know they've been mistake it as ATM variability and maybe nobody ever look at this problem with the right lens, so I think this is the type of angle, we want to use that you know resolved by home to school and choose to work on this paper, where she tried to.

178

00:30:40.020 --> 00:30:51.870

Matteo Cantiello: map given a typical agent agendas models, which you know I want to mention, you know they are all the uncertainties sub case, but you know, assuming that that's a proper model, you know.

179

00:30:52.290 --> 00:31:00.060

Matteo Cantiello: If you embed one on one on one on one grb in a in a GM desk depending on the density obviously your problem is different than your.

180

00:31:00.720 --> 00:31:15.000

Matteo Cantiello: afterglow or prompt mission might be muffled and you might see this peering as some of the different types of trends and depending where the transits occur and I found that it's a very fascinating possibility and something we should look at.

181

00:31:15.540 --> 00:31:27.750

Morgan Elowe MacLeod: And also really interesting to think about these, as you know, we sometimes call these nuclear transients and so these transients would be spatially coincident with the Center of the galaxy as far as we could tell.

182

00:31:28.290 --> 00:31:37.620

Morgan Elowe MacLeod: And, but they wouldn't necessarily have this high energy sort of pure environments signature that we're so used to.

183

00:31:38.820 --> 00:31:43.710

Matteo Cantiello: yeah it depends, where they are some actually will look like very similar to normal Derby.

184

00:31:44.520 --> 00:31:47.100

Matteo Cantiello: And and some actually will have.

185

00:31:47.130 --> 00:31:59.820

Matteo Cantiello: part of their maybe to prompt Commissioner afterglow being diffuse the way and so maybe you might just see the afterglow later on, because the early part of the transition was diffused by the fact that you are in a.

186

00:32:00.180 --> 00:32:05.700

Matteo Cantiello: You know, in a in a dense environment, so what really matters is the hierarchy of the relevant radio of the problem.

187

00:32:06.180 --> 00:32:17.490

Matteo Cantiello: So you know, in the fireball internal external shock model you got you got the the prompt the mission that come from the fact that the engineers driving Shell of material with different.

188

00:32:18.570 --> 00:32:21.780

Matteo Cantiello: Different times, but also the different lines factor and so eventually they.

189

00:32:22.080 --> 00:32:30.300

Matteo Cantiello: eat each other and you've got the gamma rays and usually that stuff it seems straightaway because you're kind of transparent, you know your medium upside is transparent.

190

00:32:30.630 --> 00:32:39.180

Matteo Cantiello: than later on those shot the Shell eat enough interstellar medium to or sequence sell a medium in this case to slow down significantly.

191

00:32:40.050 --> 00:32:49.200

Matteo Cantiello: You have their external shock that start producing your afterglow so usually the sequence of events and those three day Iraqi police staggered this way.

192

00:32:49.560 --> 00:32:56.280

Matteo Cantiello: But in this case it's funny you know you can have enough so much mass around you that the first thing that happens is an external shock.

193

00:32:56.730 --> 00:33:11.100

Matteo Cantiello: The first child goes out, and you know it's fine so much mass around itself that if you're ready for them and external sharp before we make an internal one so that kind of change it a little bit the laws of foster glaus happy we're used to.

194

00:33:12.270 --> 00:33:23.250

Matteo Cantiello: And so resolve a map this type of outcome, together with the w love Zaki and myself, and you know II II i'm not an expert on on after blows you know.

195

00:33:24.060 --> 00:33:33.000

Matteo Cantiello: That definitely people on this call, there are better suited to talk about this than I am, but I think it'd be interesting to maybe look at some of these things and trying to find.

196

00:33:34.050 --> 00:33:38.250

Matteo Cantiello: Possible signature off of this of this type of explosions.

197

00:33:39.210 --> 00:33:45.210

Morgan Elowe MacLeod: that's awesome well let's first talk about how stars get there, so my day you had a question would you like to go ahead.

198

00:33:47.850 --> 00:33:49.230

Magdalena Sophie Siwek: yeah hi again with you.

199

00:33:49.950 --> 00:33:50.340

and

200

00:33:52.320 --> 00:33:58.860

Magdalena Sophie Siwek: yeah and a question about i'm capturing stars and to agent discs you mentioned that in the beginning, and I am just not.

201

00:33:59.370 --> 00:34:11.370

Magdalena Sophie Siwek: really have an intuition, for how easy it is to do that, and especially how easy it is to get the star into the plane of the Aegean disc seems like the time skills might be long.

202

00:34:12.570 --> 00:34:13.380

Matteo Cantiello: yeah it depends.

203

00:34:13.440 --> 00:34:14.730

Matteo Cantiello: How far you are from the.

204

00:34:14.730 --> 00:34:21.930

Matteo Cantiello: Center of the of the galaxy so this time scale decreases substantially asked as you get closer and closer.

205

00:34:22.380 --> 00:34:36.870

Matteo Cantiello: And my understanding is that when you are we send a carsick you know the time scale for capture become you know, a million year or so, so you know, and there are a number of papers working on this, I mean the original work on this was from octomom.

206

00:34:37.560 --> 00:34:45.870

Matteo Cantiello: 1923 that's two people were fair to mostly but also recently I think Morgan has worked on this problem foggy and.

207

00:34:47.490 --> 00:34:52.710

Matteo Cantiello: collaborators work on this and it seems to that the resolve seems to be pretty.

208

00:34:54.210 --> 00:35:05.640

Matteo Cantiello: pretty well understood that you know drag and bending waves and the spiral wave that exciting the desk you know allow you to capture and blind your orbit into the desk.

209

00:35:06.750 --> 00:35:15.270

Matteo Cantiello: Especially if you're you know very close to the central region you're far out, you know that might not happen with seemed a lifetime of the GM remember those things you know, as I said.

210

00:35:15.510 --> 00:35:30.180

Matteo Cantiello: can leave up to maybe hundred million years, some people argue for longer, but let's say conservatively a few a few million years 200 so you want to have so maybe all of your various regions can do this, you know other regions, never managed to track things stuff down.

211

00:35:31.920 --> 00:35:36.660

Matteo Cantiello: and Morgan, you know, please chime in since you're you're you're the expert here on this type of problem.

212

00:35:36.960 --> 00:35:49.350

Morgan Elowe MacLeod: Something also that I kind of like about this problem is that that process almost certainly takes place but there's also a guaranteed population of stars that just happened to have orbits that are already within the.

213

00:35:49.710 --> 00:36:03.150

Morgan Elowe MacLeod: inclination such that they're within the scale height of the disc already so, even if that didn't take place this population that but there's talking about would exist just we're trying to think about like what the relative quantity so.

214

00:36:03.930 --> 00:36:11.460

Matteo Cantiello: yeah it's a great point I mean, and this new new cluster cluster you know the law law my star family for a long time, so you know they're sitting there specifically.

215

00:36:12.330 --> 00:36:26.730

Matteo Cantiello: Around the Center and down an agent turns on whatever direction you're going to intersect is relation has Morgan said, you know there's going to be some some solid angle they're going to be directly embedded into the agm this.

216

00:36:29.610 --> 00:36:30.420

Magdalena Sophie Siwek: All right, thank you.

217

00:36:31.350 --> 00:36:32.820

Morgan Elowe MacLeod: So we have another question.

218

00:36:34.890 --> 00:36:37.920

Morgan Elowe MacLeod: That I think is a little bit related from floor, would you like to go ahead.

219

00:36:40.470 --> 00:36:43.320

Floor Broekgaarden: I actually have a different question that might even be more related.

220

00:36:43.980 --> 00:36:44.550

Morgan Elowe MacLeod: even better.

221

00:36:46.350 --> 00:36:53.610

Floor Broekgaarden: So, actually, I know, for instance, like mark that works, a lot on like binaries of supermassive black holes and also um.

222

00:36:54.510 --> 00:37:04.050

Floor Broekgaarden: I think there's a lot of like recent observations that are kind of like showing that Oh, if you actually have to like say a binary mtn pair like to have these black holes that it actually might help.

223

00:37:04.380 --> 00:37:22.230

Floor Broekgaarden: Get you things closer to the life cycle Center or like the Center of the galaxy so, for instance, like with DVDs from the top from yesterday, so I was wondering if you expect any like any binaries it in agents to have any impact on on these results that you showed.

224

00:37:23.070 --> 00:37:23.700

Matteo Cantiello: yeah so.

225

00:37:24.210 --> 00:37:33.870

Matteo Cantiello: that's a good question, for I haven't thought about this, much to be honest, and you know i've been started thinking about he ends only maybe a year or two ago.

226

00:37:34.950 --> 00:37:48.390

Matteo Cantiello: Some taking it, step by step, and, as you well know, similarly to stellar physics, you know you start with single stars and you go to binary so I guess the gear is the same, but it seems like you know it might be important in into.

227

00:37:49.350 --> 00:38:04.110

Matteo Cantiello: Potentially you know, like changing the dynamics of the of the problem and I don't know Morgan city or someone was working on the capture problem, or is this is just going to have an impact on the dynamics of stocks that might be capture not.

228

00:38:06.570 --> 00:38:07.230

Morgan Elowe MacLeod: I don't know.

229

00:38:07.920 --> 00:38:14.010

Matteo Cantiello: yeah it's a good one, I haven't I haven't really talked enough about this to have a.

230

00:38:16.020 --> 00:38:17.310

Matteo Cantiello: An opinion actually yeah.

231

00:38:20.520 --> 00:38:23.820

Morgan Elowe MacLeod: Maybe along those lines Luca dude do you want to chime in.

232

00:38:26.250 --> 00:38:42.420

Lieke van Son: yeah actually also binary question thanks for a great south, by the way, it's I really love this subject, but more on the stellar binary side, so I was wondering since it's such a densely populated area in the galactic Center and.

233

00:38:43.440 --> 00:39:01.290

Lieke van Son: What fraction of these stars, would you expect to form binaries or higher order multiples and how would that also influenced the creation models that you are with that limit or you know, change the amount of mass that you expect to be created or in what we actually.

234

00:39:03.210 --> 00:39:07.500

Matteo Cantiello: yeah not another excellent question because, so I.

235

00:39:09.030 --> 00:39:13.200

Matteo Cantiello: So we we started with a very simple approach, where we you know we.

236

00:39:13.260 --> 00:39:21.480

Matteo Cantiello: We took like the simple exercise we put like one semester or into agent condition and start creating.

237

00:39:23.100 --> 00:39:34.560

Matteo Cantiello: Now, if you had a binary system, I think what will happen is that both stars will create some level imagine the other wide binary and.

238

00:39:34.920 --> 00:39:42.240

Matteo Cantiello: mature will fall on to the stars and a creek both stars at some point, I guess, one will become.

239

00:39:42.780 --> 00:39:50.490

Matteo Cantiello: More massive and we'll take it away run away respect to the other, and then probably will merge with the other one that's my my.

240

00:39:51.480 --> 00:39:57.270

Matteo Cantiello: My because the issues that as the other ones started creating you're going to have.

241

00:39:58.020 --> 00:40:06.510

Matteo Cantiello: This stream material falling into the primary and escape the one that starts becoming the primary now the bond a real sense of.

242

00:40:07.050 --> 00:40:13.500

Matteo Cantiello: Why fire out so you know you might have a situation where the other star if it's close enough.

243

00:40:14.460 --> 00:40:29.220

Matteo Cantiello: it's within the bond a radius of the other one and now it's kind of like you know orbiting within a mature region, which increasingly high density, so it might actually spiral in you might end up with a with merging the two stars.

244

00:40:30.810 --> 00:40:43.350

Matteo Cantiello: Now if they're far with firing off that distribution never occurs like you never entered the boundaries of the other one maybe they can both create some level and above and still evolve like separately.

245

00:40:44.760 --> 00:40:52.620

Matteo Cantiello: But then I don't know what will happen that will never probably interact um but yeah I.

246

00:40:54.360 --> 00:41:09.660

Matteo Cantiello: I don't know if this will, so I don't think this will change much about the general the general picture, but it might lead to some interesting effects, I mean if you manage having to stop you know evolving and making.

247

00:41:12.660 --> 00:41:25.920

Matteo Cantiello: me think yeah I don't know I mean, I think that the most important aspect of this becomes a comes in, with the dynamics, later on, and so as as people, people are thinking about when you produce compact remnants into this this then.

248

00:41:26.310 --> 00:41:39.930

Matteo Cantiello: Then the important our department is a physics is like things like migration and and usually the more massive thing stem to migrate faster and then like encounters smaller things that's, the most important effect.

249

00:41:40.920 --> 00:41:47.040

Matteo Cantiello: So you know you that's how you pair sinks, later on, and now you do this article mergers.

250

00:41:47.670 --> 00:41:58.620

Matteo Cantiello: And so you know you don't really need to form compact remnants close to each other in the first place to you know be competitive for like producing.

251

00:41:59.400 --> 00:42:09.840

Matteo Cantiello: gravitational waves sources desk it's just where you're going but it might be that in some cases, you might directly form to comprehend months orbiting each other in the first place.

252

00:42:11.100 --> 00:42:21.090

Matteo Cantiello: Sorry it's not very is again i'm brainstorming as i'm speaking it's not something I talked extensively about but yeah we can we can discuss more offline about this, because I think it's a good idea.

253

00:42:21.690 --> 00:42:34.350

Lieke van Son: yeah yeah no thanks it's yeah I was actually also wondering, because you know there's this whole discussion going on whether or not stars will widen or shrink if you have a circuit binary equation, but you're right let's maybe do this offline but thank you.

254

00:42:35.580 --> 00:42:53.490

Morgan Elowe MacLeod: Number this is wonderful and i'm it's exciting to have work that is at all different stages and is exciting when you know, a discussion can actually feed into what what research happens next, so I think that's great not not a shortcoming so.

255

00:42:54.960 --> 00:43:06.810

Morgan Elowe MacLeod: I was wondering if we can talk a little bit more about essentially the boundary conditions of the disc properties, at a given location.

256

00:43:07.170 --> 00:43:21.630

Morgan Elowe MacLeod: And how they influence what happens so it seems to me that, like the far in this conditions which are optically thick and very dense might be very different from like an optically thin.

257

00:43:22.860 --> 00:43:28.440

Morgan Elowe MacLeod: Lower relative density like surface density compared to the star.

258

00:43:30.420 --> 00:43:30.900

Morgan Elowe MacLeod: and

259

00:43:32.010 --> 00:43:42.270

Morgan Elowe MacLeod: So with that kind of in mind, I think, Martin Elvis has a related question so maybe you can go ahead and then, and then we can let the tail.

260

00:43:43.860 --> 00:43:59.580

Martin Elvis: Oh hi yeah I was trying to relate your diagrams to the scales that we know right happen in agm like whether you ve continuum comes from where the broad line region is formed and that's over quite a range where the Torah says, and I couldn't really get a feel for that.

261

00:44:00.390 --> 00:44:06.090

Martin Elvis: yeah I do we scale things to a sports field radio in this picture oh.

262

00:44:06.150 --> 00:44:15.180

Matteo Cantiello: yeah marketing thanks, so the reason why I didn't put any any physical scaling dairy step the outcome relies.

263

00:44:16.560 --> 00:44:26.730

Matteo Cantiello: On the this model that one us and we haven't yet done, and this is something that we're working on as we speak, so the, as I mentioned, you know, like Alex on the dyckman is working on.

264

00:44:27.360 --> 00:44:37.050

Matteo Cantiello: getting better grasp of the density limit to and some speed limit where we expect certain type of solution to occur.

265

00:44:37.470 --> 00:44:55.800

Matteo Cantiello: And so that maps to a if you map adapt once with With that in mind with this model, then you know you can tell okay within this this model for example within the circle and and and and Goodman model we get a massive stars in the range of like 0.1 to ones parsing.

266

00:44:57.000 --> 00:45:10.650

Matteo Cantiello: So, and before we can put numbers like that we need to do the final pass off projecting our prediction on to this model that's something we haven't done yet because well the first paper we put out.

267

00:45:11.070 --> 00:45:19.320

Matteo Cantiello: We only account for bond that Christian, that is a you know just that we pretty much put a star in the box, but, as I mentioned, you know.

268

00:45:19.650 --> 00:45:22.950

Matteo Cantiello: This is not, I boxes an agm disks and there are other effects, for example.

269

00:45:23.250 --> 00:45:34.650

Matteo Cantiello: One thing that we're going to count the first paper is that you get closer and closer to the black hole the density goes up true so, in theory, you know efficient goes up but actually you're on the radius is not the relevant.

270

00:45:35.280 --> 00:45:42.570

Matteo Cantiello: radius anymore you'll heal radius becomes rather than quantity, and actually that shrinks as we get closer, so you got this country intuitive.

271

00:45:42.900 --> 00:45:52.800

Matteo Cantiello: A fact that, as you move closer at some point you're not making massive stars anymore you actually create very low, so you so the prediction is that we're going to have this kind of a like a.

272

00:45:53.400 --> 00:45:58.830

Matteo Cantiello: Ring so and the boundary of this range will depend on the on the on the disk model.

273

00:45:59.250 --> 00:46:07.200

Matteo Cantiello: And on this prediction that are in in Alex paper now The other thing that it's important to remember and it's something that.

274

00:46:07.620 --> 00:46:14.910

Matteo Cantiello: I mentioned briefly is that those models of agent this are built without your facts of this stuff.

275

00:46:15.390 --> 00:46:23.610

Matteo Cantiello: Now, if you have your stars in embedded into this disc now the expectation is there's gonna be some extra heating and you know some extra.

276

00:46:24.360 --> 00:46:29.820

Matteo Cantiello: Energy sorta so your cube last term into the into this model needs to be accounted for so.

277

00:46:30.210 --> 00:46:41.430

Matteo Cantiello: We will have to do that as well, I think, eventually, so this model will have to be built, some self consistently with the fact that those stocks exist, so there are a few steps.

278

00:46:42.150 --> 00:46:50.790

Matteo Cantiello: Between us, and being able to firmly say okay you expect this evolution to occur between, say Point five at one parsing.

279

00:46:51.690 --> 00:47:10.560

Matteo Cantiello: For supermassive black hole of this size but that's why we want to go, so your question is absolutely on point Martin and unfortunately I cannot tell you, yet what's the what's the I can only give this cartoons where we can give a hierarchy, but we cannot put yet numbers.

280

00:47:10.890 --> 00:47:11.850

Martin Elvis: And I guess.

281

00:47:13.080 --> 00:47:22.620

Martin Elvis: The density of stars and the disk is going to be it's going to feed back into the desk model if there's an input from and so on, so it's good for.

282

00:47:23.130 --> 00:47:24.030

Matteo Cantiello: Multi domain right.

283

00:47:24.810 --> 00:47:37.860

Matteo Cantiello: Right so that's again, you know, so the density of stars it's also a question it's important so on one hand we can sort of predict what the capture rate is so you know if we know the typical density of Michelin star cluster you can tell.

284

00:47:38.250 --> 00:47:46.830

Matteo Cantiello: Depending where you are in the desk how many start to can capture as we discussed earlier, you know, the closer you get the more star you get to go outside you get lower number of stars.

285

00:47:47.460 --> 00:47:54.840

Matteo Cantiello: But the other elephant in the room, is the fact that disk henceforth starts themselves and now predicting how many of the stars can be form.

286

00:47:55.380 --> 00:48:01.800

Matteo Cantiello: Again, it depends on this model so there's a little bit of is completed a feedback loop that one has to take into consideration.

287

00:48:02.730 --> 00:48:10.950

Matteo Cantiello: So I think it's going to take some time, but we have the tools, I think, to build that knowledge, and I think this again, as I mentioned earlier, this is a.

288

00:48:11.670 --> 00:48:26.190

Matteo Cantiello: problem that require different angle and different expertise is, and so you know it's a cross disciplinary problem, but I, you know i'm accreting smart people, and there are no much more than I do so i'm confident.

289

00:48:27.750 --> 00:48:28.680

Martin Elvis: Great talk, by the way.

290

00:48:30.120 --> 00:48:30.450

Martin Elvis: Thank you.

291

00:48:30.990 --> 00:48:33.120

Morgan Elowe MacLeod: Okay, so if we continue with Christian.

292

00:48:34.890 --> 00:48:36.840

Morgan Elowe MacLeod: Maybe rematch would you like to go ahead.

293

00:48:38.910 --> 00:48:48.030

Ramesh Narayan: yeah I was wondering once the star has been captured by the disk I imagine that it will also try to migrate radio Lee.

294

00:48:49.260 --> 00:48:59.400

Ramesh Narayan: And you know you must have estimated the time scale for that so How does that time scale compared with other times kills in your problem now hundred million years is a long time.

295

00:49:00.600 --> 00:49:03.210

Matteo Cantiello: yeah now that's an excellent question so.

296

00:49:04.590 --> 00:49:13.590

Matteo Cantiello: I must confess I haven't completed that that that timescale, because in this first paper we we really sad okay let's not deal with the dynamics the act.

297

00:49:14.970 --> 00:49:20.520

Matteo Cantiello: It is true that the more the more method to start become old sort of more likely it's going to migrate.

298

00:49:21.630 --> 00:49:30.420

Matteo Cantiello: And so that process will be important migration into this is actually complicated and there are you know there's growing.

299

00:49:30.750 --> 00:49:44.130

Matteo Cantiello: there's all work happening on trying to understand how this process work, and I mean migration can actually go both ways, you can have in your migration and awkward migration depending on different physical processes that you account for.

300

00:49:45.480 --> 00:49:52.980

Matteo Cantiello: But I think that's why again next steps will have to pair this down solution with the dynamics which.

301

00:49:53.280 --> 00:50:03.390

Matteo Cantiello: it's right now, you know our attrition rate is fixed, but if you have a model for the for the dynamics, for example, I want to times before your migration, you know which direction you're going.

302

00:50:03.750 --> 00:50:17.730

Matteo Cantiello: Then you can, and you have a model for your for an agent model, you can also change the Christian great dynamically, as you move through the disc and that will tell you, for example, you know what what the outcome for that start we're not there yet.

303

00:50:23.610 --> 00:50:25.080

Morgan Elowe MacLeod: Because they would you like to go ahead.

304

00:50:27.000 --> 00:50:34.830

Razieh Emami Meibody: hi very fascinating talk so I have a question regarding to possible hydrodynamic or effects have you have you.

305

00:50:35.160 --> 00:50:42.990

Razieh Emami Meibody: have in your acquisition is more specifically upper left a cast cooling, or like new reporter stars article actually part of the desk.

306

00:50:43.260 --> 00:50:57.810

Razieh Emami Meibody: And also something that might be related about the thickness of your acquisition, this is this going to be a static or two of these kind of like you know complex process entirely can eat, just like it like he cannot be there, and you know so.

307

00:50:58.860 --> 00:50:59.520

Thank you yeah.

308

00:51:01.020 --> 00:51:10.560

Matteo Cantiello: Okay, so um concerning the second part of questions so like the the disc model so currently what we do is we.

309

00:51:11.910 --> 00:51:25.740

Matteo Cantiello: We assume, so the first step, we did, is that we assume that the Christian pretty much it's constant so we put the star in a box, so to speak, and that box correspond to local condition and HM disk the second order.

310

00:51:26.430 --> 00:51:35.400

Matteo Cantiello: Approximation was, including the fact of ratification, so, given the scale I lost a lot of the desk we say Okay, we had our.

311

00:51:36.390 --> 00:51:52.170

Matteo Cantiello: disk model and as your boundaries increase because your muscles start increase you're capturing region of the this that increasingly have lower density and because i'm verification effect, and so you include that effect, now we haven't.

312

00:51:52.800 --> 00:52:00.660

Matteo Cantiello: projected again this on a realistic this model where you know your your scale like might fluctuate as you correctly said.

313

00:52:01.530 --> 00:52:07.380

Matteo Cantiello: And that's something that will have to do, once we going back to martin's question, we want to get.

314

00:52:08.340 --> 00:52:27.090

Matteo Cantiello: Realistic predictions for the location on the disk with certain type of agent started pollution correct um so yeah so that's that's to you know the it, I think you know this problem, it seems it's to someone so many moving parts, the approach has been, starting with the simplest possible.

315

00:52:28.710 --> 00:52:37.020

Matteo Cantiello: experiment and that adding level of complexities and you know we're ready find that that's ready, you know a lot.

316

00:52:38.130 --> 00:52:39.510

Matteo Cantiello: A lot to to chew.

317

00:52:41.130 --> 00:52:57.390

Razieh Emami Meibody: you're a nice guy both a guest cooling actually have you may be already said, what do you also can stay tight tight, you know, like not puts the stars there, but just like newly born stars actually natural evolution of the system, do you also consider that somehow yeah.

318

00:52:58.410 --> 00:53:08.340

Matteo Cantiello: Right so eventually once we have a like fit back into the depth into the disc model will have to account for both effect of.

319

00:53:08.670 --> 00:53:19.890

Matteo Cantiello: heating and cooling due to the star formation and evolution and and the possibility of having explosions things like that currently we that that.

320

00:53:20.460 --> 00:53:35.790

Matteo Cantiello: Feedback is not included in the sense that the star doesn't know about the html html in the sense that doesn't know about the agent beside the initial density and and and some speed that we tell the start to create act.

321

00:53:36.600 --> 00:53:49.560

Matteo Cantiello: But, as you said, you know, eventually, a perfect model of this will be a model of web and the star knows about the agm this model and the agenda this model knows about the star, at the same time, and there is crosstalk.

322

00:53:50.760 --> 00:53:55.530

Matteo Cantiello: So, then, I envision that with something maybe we can do in the future, but not immediately.

323

00:53:56.190 --> 00:54:08.880

Razieh Emami Meibody: Okay, so I am definitely not actually things that I like to when you're talking that starts with my not bought that kesha disk and voiceover so I was wondering about the acquisition rates that's use that could also depend on metal etc.

324

00:54:09.060 --> 00:54:23.880

Razieh Emami Meibody: Because you just proceeded Ms square root oversee actually cube but just but can you imagine that that just like different process different actually a stage of tactician could also depend on your said honestly city or maybe i'm wrong actually.

325

00:54:24.120 --> 00:54:28.560

Matteo Cantiello: No, no, actually it's a good point I think he I haven't touched much on the Middle East.

326

00:54:28.560 --> 00:54:38.760

Matteo Cantiello: effect but that's an important one, so get Christian on to the stock it's a it's going to depend on the Middle East, it, if anything, because.

327

00:54:39.180 --> 00:54:45.990

Matteo Cantiello: As I mentioned, with the stars tweet rapidly initially they're they're low mass and they couldn't become master and, as I mentioned.

328

00:54:46.620 --> 00:55:00.390

Matteo Cantiello: They start there's a Christian this process either halted or stoltz I want to start to get into me nasty is the point where the radiation acceleration from the from the illuminati of the star becomes comparable to gravity.

329

00:55:01.110 --> 00:55:05.190

Matteo Cantiello: And so the other layers become like like not unbound.

330

00:55:05.730 --> 00:55:18.330

Matteo Cantiello: i'm in that case the the rate that the point where this happens depends on the Middle East, because the adding to luminosity depends on your password to Star and capacity depends strictly on the mental esteem.

331

00:55:18.600 --> 00:55:25.170

Matteo Cantiello: So you know, the more metal rich, you are when you go out and the other regions of the star, the higher the capacity is.

332

00:55:25.410 --> 00:55:29.820

Matteo Cantiello: And so, in a sense that decreases the maximum massive the star, you can form.

333

00:55:30.090 --> 00:55:41.940

Matteo Cantiello: So you the prediction, I think, is and we haven't started this in detail, but the quality of prediction is that if you if you increase them, at least, you have the gas and you're creating so you've increased the Middle East coast agm.

334

00:55:42.360 --> 00:55:48.330

Matteo Cantiello: Again, this is something that the GM will know if he knows how many masters start producing so there's something that.

335

00:55:48.600 --> 00:56:00.090

Matteo Cantiello: The styles of dictate but let's say if you increase the Middle East of the agent this the material at 14 as iron at least you so maximum mass of the star that you can reach it decreases because you're heading to luminosity decreases.

336

00:56:00.360 --> 00:56:06.750

Matteo Cantiello: So I think that that's another prediction of this type of evolution.

337

00:56:07.590 --> 00:56:12.270

Matteo Cantiello: You still got to make master starts and you still going to make come up remnant, so I think that.

338

00:56:12.630 --> 00:56:25.980

Matteo Cantiello: That quality definitely doesn't change but it might change, for example, the heating, because now all your stars, the most massive star you produce are not thousands on us anymore, maybe they are a few hundred or 100.

339

00:56:27.960 --> 00:56:28.740

Morgan Elowe MacLeod: going to.

340

00:56:30.780 --> 00:56:40.110

Morgan Elowe MacLeod: As a kind of last word, whether you think that something that we've learned is that this problem.

341

00:56:42.750 --> 00:56:57.480

Morgan Elowe MacLeod: is going to rely a lot on the subtleties kind of of what the disc properties are at a certain radius or maybe even it's the case that there is a whole spectrum of different outcomes contained within a single accretion disc.

342

00:56:58.440 --> 00:57:05.550

Morgan Elowe MacLeod: yeah so given that range of possibilities, what do you think are the observations that will be most.

343

00:57:06.750 --> 00:57:16.890

Morgan Elowe MacLeod: determinant or most distinguishing to convince us that we're understanding the sort of physics that's going on in this sort of relatively enshrouded environment.

344

00:57:19.050 --> 00:57:25.950

Matteo Cantiello: yeah outside of the galactic Center which I think you know it's a it it's probably our best bet.

345

00:57:26.430 --> 00:57:33.780

Matteo Cantiello: Initially, for trying to look at the remnant of you know, like maybe an ATM disk phase and looking at the.

346

00:57:35.250 --> 00:57:49.500

Matteo Cantiello: The radial stratification of stellar population and their abundances, because one thing that it's important is that, and I imagine you have a GM disk which is on for a while and the galactic Center some of the stars that we talked about.

347

00:57:50.010 --> 00:57:57.750

Matteo Cantiello: Do their shenanigans and enrich the disk and if the disc is well next the material that is processing in the regions might.

348

00:57:58.170 --> 00:58:07.650

Matteo Cantiello: end up in other regions where the Christian is slower, so now, you can have a once on mass star, that is in the other part of the desk is it creating maybe a.

349

00:58:07.950 --> 00:58:15.150

Matteo Cantiello: Not a solid mass of the process material in the desk and then they just disappear, you know that you're in this slow regime of a Christian.

350

00:58:15.720 --> 00:58:26.040

Matteo Cantiello: And so those stars might still be around you know, two semester, at least for one long time, and maybe it, but he brings a it as the surface, the memory.

351

00:58:26.490 --> 00:58:41.820

Matteo Cantiello: of some composition of the desk, so I think that spectroscopy of the galactic Center and better understanding of the dynamics of off of celebration it's a it's an important aspect of this problem in terms of.

352

00:58:42.360 --> 00:58:54.300

Matteo Cantiello: grounding this with observation and the other direction, I think, is you know lygo is a is an interesting like it's very indirect I think you know it's not going to tell us much about my you know we might.

353

00:58:54.720 --> 00:59:06.510

Matteo Cantiello: There are many ways to do things in nature and desk you don't you don't necessarily require to step in evolution, but maybe the rates will tell us something about this and then i'm in a in.

354

00:59:07.800 --> 00:59:19.200

Matteo Cantiello: The other direction, I think it's currently seems promising is he's idea of relativistic explosions in in the desks, and I think if you can start if you see one of this.

355

00:59:20.730 --> 00:59:23.550

Matteo Cantiello: muffled your bs that resolve predicted.

356

00:59:24.990 --> 00:59:33.210

Matteo Cantiello: I think you know that will tell you that some of the stars that actually you know doing this in this agent this maybe won't tell you exactly.

357

00:59:33.660 --> 00:59:45.150

Matteo Cantiello: i'm wearing the desk but maybe by correlating this with the mass of the of the galaxy, and so the muscle supermassive black hole Maybe you can learn something about the hcm solution.

358

00:59:46.350 --> 00:59:49.860

Morgan Elowe MacLeod: that's really wonderful well everyone join me in thanking me to again.

359

00:59:50.850 --> 00:59:54.780

Morgan Elowe MacLeod: Thank you all for being here, thank you, my tail this has been a really wonderful discussion.

360

00:59:54.900 --> 01:00:10.680

Matteo Cantiello: we're really grateful now, thank you guys and it will give me a time and I have to say it was very exciting discussion, I never had this many good questions on the talk so I really like this former, despite the fact that cut down my presentation by argument.

361

01:00:11.850 --> 01:00:12.360

Morgan Elowe MacLeod: that's right.

362

01:00:12.780 --> 01:00:16.920

Morgan Elowe MacLeod: We give you at least five minute I think we, I think it worked because we were able to discuss.

363

01:00:16.950 --> 01:00:20.670

Matteo Cantiello: All the things that I wanted to buy a question so that that's perfect.

364

01:00:21.840 --> 01:00:22.920

Ana Bonaca: I would love to hear that.