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Show Due Dates

D13(BH) Weekly Discussion

Erin O'Connor

Apr 14 at 9:09am

3 34

Due this week

First, be sure to do the reading and watch the lectures:
Assigned reading and lectures

Then answer the following questions in this discussion forum (and yes, you may look to see what others write, but try to find what they might have missed and you should go back to the original reading and lectures to get answers for yourself). Then post your own question at the end, and then answer someone else's question. If no question is available, go ahead and check back later until the due date. If nothing comes available you can then pick any question you wish.

We hope to emulate a seminar classroom environment where students can share ideas. Always be respectful with all communications you have with your esteemed fellow colleagues (your fellow students) in this course.

- 1. DISCUSS in some detail something you found unusually interesting or intriguing in the reading or lecture material. Are there new insights that you have gained (something you had not thought of or considered before)? Focus on one of the concepts and explain as best you can in your own words. (4 pts)
- 2. Post a question that you have about something you read. Be sincere. What do you want to know? Write the word QUESTION all in caps, so that your fellow classmates know what your proposed question to the class is. (3 pts)
- 3. ANSWER the question of another student according to what we discussed in the lectures or what you read in the assigned readings (don't just make something up). Try to answer a question that no one else has responded to yet (but not a hard and fast rule). A good way to respond to another student's question would be to say something like, "Good question! The answer can be found on page..." and give the quote from the reading. You are free to reference other sources outside of class material, but always consider the credibility of the source, state what the source is, and give the link. (3 pts)

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Reply

Malcolm Tircuit (https://canvas.sbcc.edu/courses/46681/users/427388)

Apr 24, 2022

DISCUSS:

It was very interesting learning about time travel and all of its implications such as what has to exist for it to happen. It was also very interesting hearing about the paradoxes that come with time traveling to the past. Also, it was very intriguing learning about time travel on a molecular level. The way that a particle could escape a black hole using time travel. The many-worlds theory is crazy. I always thought that was sci-fi but to actually learn the reasoning behind it was fascinating.

QUESTION:

If humans ever evolve to become 4th dimensional will we be able to time travel as we think of it now or will we exist outside of time itself and not be able to interact with it?

Reply

Alak Fryt (*He/Him*) (https://canvas.sbcc.edu/courses/46681/users/354278)

Apr 24, 2022

Malcolm, to be quite frank I'm still confused with the concept of the 4th dimension and how it works and it's hard for me to try and depict any sort of image of what that would be like and the types of properties we'd experience. But from what I've looked up, I think that if we were to become 4th dimensional, then time travel would theoretically be possible, however there wouldn't be any way for us to alter the past.

Reply

Erin O'Connor (https://canvas.sbcc.edu/courses/46681/users/24247)

May 1, 2022

Your answer to Malcom is very well-thought-out. I very much agree with your perspective, that if we could see the fourth dimension and interact with it, then yes we could time travel into the future, but we would never be able to time travel into the

past because then we would violate the law of causality and we need to have causes precede effects - otherwise nothing really makes any sense anymore.

Reply

Erin O'Connor (https://canvas.sbcc.edu/courses/46681/users/24247)

May 1, 2022

you did a great job outlining the many crazy ideas that we are grappling with in this class and in modern physics. They all seem like science fiction, but they are real ideas and scientists are exploring them as true representations of reality. About humans and the fourth dimension, I think the best way to visualize what it would be like for humans to be 4th dimensional is to watch the video I showed earlier in the class about higher dimensions. Go to 3min25sec to see a person as a 4th dimensional being. https://youtu.be/gg85IH3vghA

Reply

Victor Jensen (https://canvas.sbcc.edu/courses/46681/users/416476)

Apr 24, 2022

QUESTION: Since information is never lost, could a highly-advanced civilization with functionally infinite energy negate the need for time-travel by just building the past from scratch? Perhaps making a simulated universe and running it backwards is the motivation for a highly-advanced civilization to start simulating civilizations. As Hawking discussed in an earlier chapter, in a universe being ran backward with decreasing entropy, the inhabitants would still experience time in the direction of increasing entropy. What if our own universe is an example of this? Technically to simulate the universe from our perspective, by our understanding, from beginning to end, one only needs to simulate our own gravitational pocket and project an image of everything outside it inwards. While large, this is a finite amount of information and therefore requires a finite amount of resources to simulate.

By restricting the simulation to a specific timeframe and/or a specific spacial area (with little or easily-reduced interference from outside) this can be decreased by magnitudes further. What if we're all copies of the current human's ancestors, being watched by the most excited archeologists of all time? Or what if they already ran a simulation as far back as they wanted, and now we're part of a giant Sims game looking to answer all of history's "what if?" questions. I wonder what question they'd be testing with us?

Reply

Erin O'Connor (https://canvas.sbcc.edu/courses/46681/users/24247)

May 1, 2022

Wow, this is a very creative and innovative idea. Of course, why not? I guess you could do some calculations as to the amount of energy required and you could use some of the laws of thermodynamics to place boundaries or restrictions on how possible this may or may not be. But either way, this would make a great sci-fi film and so you better get started on your screenplay. Can I play the role of the "mad scientist"?

Reply

Alak Fryt (*He/Him*) (https://canvas.sbcc.edu/courses/46681/users/354278)

Apr 24, 2022

DISCUSS: I think that the fact that the thought of time travel is a thought at all is pretty fascinating. A lot of this type of material is just so very reminiscent of the movie "Interstellar" and I know I keep referring to this movie when going through these discussions but it's just something that I notice time and time again. This time it's about wormholes and the way they work and the type of energy you would need to be able to successfully make it through a wormhole and travel to a far distant place.

QUESTION: Do you think that we'll be able to figure out a possible way to travel at the speed of light?

Reply

Lexie Brent (https://canvas.sbcc.edu/courses/46681/users/122267)

Apr 24, 2022

Hey Alak! I don't think we'll be able to figure out a way to travel at the speed of light. A basic answer but the energy required to reach the speed of light is just too great, even for advanced beings like humans. If we were to do it, it'd have to be fairly soon considering the rate at which we're depleting our resources - climate change aside, we wouldn't be able to scrounge up the massive amounts of energy needed to even get close. And maybe it's just me but it seems like one of those laws of physics that's meant to stop us from doing something we shouldn't, just like with time travel hahaha.

Reply

(http

Brian Wolden (https://canvas.sbcc.edu/courses/46681/users/274832)

Apr 24, 2022

Hi Alak.

Great question! As far as I understand it, speed of light travel isn't possible for anything with mass. According to special relativity, objects with any amount of mass can't ever reach the speed of light because, as they approach the speed of light, more and more energy is required to increase their speed. This increase in the energy required is such that any amount of mass requires an infinite amount of energy. Even to get very tiny particles up to 99.9999991% the speed of light in the LHC requires a huge amount of energy! It seems to me that ways of getting around the speed of light, through manipulation of space time or wormholes, are more likely (though still pretty unlikely).

However, if I understand the theory correctly, if we could get up to a significant percentage of the speed of light, the relativistic effects of moving so fast would mean that we could travel vast distances in a relatively short time from the perspective of those traveling at those speeds, though everyone not traveling at those speeds would age differently and could be long dead by the time we returned or even got to our destination.

Reply

(http

Franco Diaz Campo (https://canvas.sbcc.edu/courses/46681/users/403036)

Apr 26, 2022

Hi Alak,

Today, with all the instruments we have, it is tough to travel at the speed of light. But we don't know in the future; it is possible that we can do that because the technology every day grows, and who would think 200 years ago that today we could fly from countries with an airplane. So it is an interesting question to analyze.

Reply

(http

Erin O'Connor (https://canvas.sbcc.edu/courses/46681/users/24247)

May 1, 2022

It's not a coincidence that so many of the concepts that we talked about in this class relate to the movie Interstellar. That's because they hired a famous astrophysicist, Kip Thorne, to help them design the movie and make it scientific but in a fun and interesting way. They did a great job and many of the things that they show would be really how it was if you could go to space and do some of these things. Now of course, we never actually could go

through a wormhole, that has not been figured out yet, so those parts of the movie push the boundaries. But it's done in a thoughtful way and I really enjoyed the movie myself.

Reply

Malcolm Tircuit (https://canvas.sbcc.edu/courses/46681/users/427388)

Thursday

From what I know, I don't think we will ever figure out a way to travel at the speed of light due to the laws of physics preventing it. One alternative for this is to use a wormhole to travel vast distances. Of course, these are theoretical but if they did exist, it might be our only way of getting to other local groups.

Reply

Lexie Brent (https://canvas.sbcc.edu/courses/46681/users/122267)

Apr 24, 2022

It's interesting to me that Schrodinger's cat thought experiment and that whole part of quantum mechanics have continued to be heavily focused on and debated. Especially since Schrodinger came up with it to show how ridiculous he thought the Copenhagen interpretation was yet it seems to only have increased interest in that school of thought. After all that I've learned about it, I kind of agree with him and I have to say that I don't really understand why it matters on a macroscopic scale. The Copenhagen interpretation Wikipedia page section entitled "Completion by hidden variables?" stood out to me because it somewhat addressed my biggest problem with it: if it's all theoretical and cannot be correlated to anything physically "real" and therefore is ontic unless microscopic, then what is the point in exploring it? (Don't get me wrong, I very much enjoyed learning about it, I'm just a little confused). In citation 53 there is a quote from Einstein that I find reflects my thoughts, "The present quantum theory is unable to provide the description of a real state of physical facts, but only of an (incomplete) knowledge of such." Then in citation 54, Heisenberg is quoted as confirming that exact idea, "Since the statistical nature of quantum theory is so closely [linked] to the uncertainty in all observations or perceptions, one could be tempted to conclude that behind the observed, statistical world a "real" world is hidden, in which the law of causality is applicable. We want to state explicitly that we believe such speculations to be both fruitless and pointless." I can't help but think then, what is the real point of making these observations? Of course, I am in support of trying to further our knowledge of the world and understanding of physics and science but this seems not only unknowable but unimportant without any evidence that it could help us in the grand scheme of things. I could definitely be missing some important piece of information

here or interpreting this field of study incorrectly but it seems clear to me that deterministically or indeterminiscally, what happens will happen and what happened has happened whether we observe it or not.

Question: I'm not fully understanding what Hawking is saying in the second paragraph on page 5 of Chapter 10. Professor O'Connor then mentioned there being something inside the black hole causing the antiparticle to time travel and I just became even more lost. I understand the virtual particle pairs but not how they relate to time travel. If anyone could explain further I'd love some clarification! Thanks :)

Reply

(http

Abigail Jacobs (*She/Her*) (https://canvas.sbcc.edu/courses/46681/users/367167)

Apr 24, 2022

Hi Lexie!

This is also a concept that I do not fully understand all that I understand about time travel in black holes is the fact that if you can travel faster than the speed of light you can time travel inside of a black hole. Honestly, I still don't understand what inside of the black hole causes antiparticles to time travel. I wish I had a much better answer:/

Reply

(http

Sarah Savage (https://canvas.sbcc.edu/courses/46681/users/375381)

Apr 24, 2022

Hi Lexie,
Your question is the perfect example of how complex these different concepts and interpretations are. When I read this chapter, that paragraph made no sense to me. When I listened to the lecture, it suddenly made perfect sense to me! Then re-reading it just now, it somehow doesn't make sense to me again. LOL I suggest re-listening to the lecture.

Reply

(http

Erin O'Connor (https://canvas.sbcc.edu/courses/46681/users/24247)

May 1, 2022

You made an excellent well-thought-out and supported argument for your points. This is what intellectual debate is all about. You can have great scientists on each side of a great debate, and what's important I think, is that each side supports their arguments and presents their findings and in as clear and concise and thought-out way as possible. You

certainly did this and you did your research and you read specific citations and arguments were excellent. You were basically saying that your sense of reality, of what's real, is rooted in what is actually tangibly and there for you to see and interact with. Well done.

Reply

Erin O'Connor (https://canvas.sbcc.edu/courses/46681/users/24247)

May 1, 2022

The part about the virtual particles falling backward through time to the singularity inside of a black hole, that can be a bit tricky but let me try to explain again. The virtual particle pairs are created at the Event Horizon. But the negative energy particle of the pair falls into the black hole and to the singularity. But remember, it's a negative energy particle falling forward in time. But in math class if you put two negative signs on the same number the two negatives will turn back to a positive, so you can kind of flip signs. As long as you do it twice it goes back to being the same thing. So a negative particle falling forward to time, if you flip the two signs, you'll get a positive particle falling backwards through time to the singularity. So you can sort of imagine the particle being created at the Event Horizon and falling to the singularity but falling backward in time so that if he were now to look at things as going forward in time, the particle will start at the singularity at a time before it was created and then it would go to the event horizon, and then it would switch to the other particle which would radiate out as Hawking radiation. In this way you can sort of do a timeline of the particle beginning at the Singularity and traveling out through the Event Horizon and out into space, allowing energy to leave the black hole end for the black hole to evaporate.

Reply

Brian Wolden (https://canvas.sbcc.edu/courses/46681/users/274832)

Apr 24, 2022

DISCUSSION

This week's material gave me a much better understanding of the Many Worlds interpretation (MWI) of quantum mechanics. I had heard of the multiverse before, but it had never been clear to me exactly why this theory had much weight behind it. The MWI is one of the proposed alternatives to the historically more readily accepted Copenhagen interpretation. In the MWI, the wave function does not collapse on "observation" as it does in the Copenhagen interpretation. Instead, all possible states of the probabilistic wave function exist and each state results in a different "world" defined by the probabilistic position of all the possible

variables in that “world”. In the Copenhagen interpretation, there is only one world based on statistical likelihood and the collapse of the wave function after observation, though “observation” or “measurement” seems to mean different things to different physicists. This means that the Copenhagen interpretation is indeterministic by definition whereas the MWI is, in a sense, deterministic, in that everything that could potentially happen does happen in one world or another. The reason that the MWI is, in some ways, preferable to other interpretations of quantum mechanics is that it doesn’t try to explain how the wave function collapses, and instead says that it doesn’t collapse at all or even that the wave function is the incorrect way to think about it. Since it does away with the need for a mechanism by which the wave function collapses, it actually requires a less complicated explanation for quantum mechanics. This makes it preferable scientifically and philosophically because of Occam’s Razor. This theory was dismissed by most of the scientific community for years after it was theorized by Hugh Everett at least in part because it is pretty strange and philosophically uncomfortable, for lack of a better word. It also, at least at this time, lacks any sort of theoretical mechanism by which it could be tested.

Related, there is an interesting BBC documentary that also aired on NOVA called *Parallel World, Parallel Lives* that I highly recommend. Hugh Everett is the father of Mark Everett who formed the band Eels. Hugh died when Mark was 19 and, in an attempt to better understand his father and his work, he attempts to understand the MWI. If I remember correctly (I saw this many years ago), Mark talks to a lot of physicists who knew and worked with his father, and it also deals with how Hugh Everett’s rejection from the physics community had some negative impacts on his mental health. I remember it being really interesting and recommend it to anyone who is interested in the exploration of the MWI by a non-physicist or the Eels.

QUESTION

I am interested in what both the MWI and the Copenhagen interpretation say about the end of the Universe, particularly regarding the open universe model. First, does the MWI allow for worlds in which the fundamental laws of physics are different? If so, does that mean there are worlds within the multiverse that are open, closed, or flat so that the fate of the universe depends on which one you are in? In an open universe in the MWI, does there become a point in expansion, particularly in the case of a big rip, where there is no longer a mechanism for new “worlds” to be created because there are no longer multiple options to branch off from one another? Similarly in the Copenhagen interpretation, is there a point at which there are no longer mechanisms by which measurements can be taken or there is an observer? Certainly that would be the case if a conscious observer is actually required. If so, is the universe at that point simply one giant un-collapsible wave function?

Reply

(http

Erin O'Connor (https://canvas.sbcc.edu/courses/46681/users/24247)

May 1, 2022

These are great discussion points. I'm glad you were at the last Zoom chat with Professor Rob Geller from UCSB. He specifically addressed and compared the many-worlds interpretation with the parallel universes idea, and the great distinction that he made was that the many-worlds interpretation would apply to one Universe with one set of physical constants, but the infinite number of parallel universes idea would imply an infinite number of universes where the laws of physics could be slightly different in each one, and that of course due to the anthropic principle we exist just in the ones that are suitable for life. So again, I see that you as a double philosophy major, are exploring and analyzing these ideas very deeply and it's great to hear your feedback and see what your suggestions are.

Reply

(http

Erin O'Connor (https://canvas.sbcc.edu/courses/46681/users/24247)

May 1, 2022

That sounds like such an interesting BBC documentary about Hugh Everett and Mark Everett. I definitely need to check it out. It seems to add a humanistic element to a technical scientific topic. And of course I love music so it would be great to see how they put that all together.

Reply

(https:/

Abigail Jacobs (*She/Her*) (https://canvas.sbcc.edu/courses/46681/users/367167)

Apr 24, 2022

DISCUSSION:

The Copenhagen interpretation is an interesting collection of views as it is a way to explain quantum mechanics and to back up the fact that quantum mechanics is merely a way to predict or make educated guesses for measurements etc. The Copenhagen interpretation is simply an interpretation of quantum mechanics. I don't still fully understand the principles of the word or the interpretations but I am interested in doing a further reading to fully understand!

QUESTION:

How is time changed in a black hole?

Reply

(http

Luke Rutherford (https://canvas.sbcc.edu/courses/46681/users/373514)

Apr 24, 2022

Hi Abigail,

From what I understand time is changed by gravitational time dilation. If you were in a black hole time would feel the same because it's from one's own perspective, but to an observer, your time would appear to be moving faster due to the large gravitational force.

Reply

(http

Erin O'Connor (https://canvas.sbcc.edu/courses/46681/users/24247)

May 1, 2022

That was a good way to explain the Copenhagen Interpretation. The quantum mechanics itself is describing the universe as probabilistic, but the Copenhagen Interpretation asked the question of whether this is an intrinsic property of matter, the uncertainty, or weather it's foolish to think that way and that like Einstein and Schrodinger believed, the universe was more deterministic. Tricky stuff, but very fun and interesting to explore.

Reply

(http

Naomi Xu (https://canvas.sbcc.edu/courses/46681/users/27955)

Thursday

From my understanding, even Einstein's approved time travel is still relativistic. It views time like space and you would be able to find a "shorter path" in time in a sense in order to time travel, but you physically won't feel as if you are going any faster. Similarly, on the off change you don't get spaghettified going in a black hole, you wouldn't feel any difference in time, it is only to the observer that you speed up.

Reply

(https:/

Sarah Savage (https://canvas.sbcc.edu/courses/46681/users/375381)

Apr 24, 2022

DISCUSS:

This week's videos and readings were just mind boggling. I like how there have been so many different scientists considering the Copenhagen Interpretation, coming up with their own variations, and even those who don't agree with the concept of an indeterminate universe perspective. When I try to envision the Many Worlds Interpretation in action, it seems that each person's choices would lead to an infinite number of worlds, and with so many people living on earth, this sort of feels so large that it would be impossible. If we could travel back in time, this interpretation could make it possible for us to change events in the past because choosing to go back in time could split reality so that the original timeline continues in a universe where you choose not to time travel and a new universe splits off to allow for the traveler to make changes to chronological history in this new universe. Regarding Schrödinger's Cat, I understood the basic concept before this week, but had always been under the impression that this was Schrödinger's standpoint. Finding out that he and Einstein thought this perspective was implausible and that the thought experiment was designed to show the concepts's absurdity was news to me!

QUESTION:
I'm having trouble grasping the concept of positive curvature and negative curvature and their shapes. Positive curvature is described as a sphere and negative curvature as a saddle shape. I don't understand this and what it really means. Can anyone help?

Reply

(http

Sarah Savage (https://canvas.sbcc.edu/courses/46681/users/375381)

Apr 24, 2022

I meant that the Many Worlds Interpretation seems that it would create an amount of universes that just seems too big to be correct. Also, this doesn't seem to work with Occam's Razor. More worlds = more complex, right?

Reply

(http

Erin O'Connor (https://canvas.sbcc.edu/courses/46681/users/24247)

May 1, 2022

Glad to hear that Schrodinger's cat makes more sense to you now. In a way, no one can really make sense of it because it's part of quantum mechanics, but at least you understand the arguments for and against. About curvature of space, mathematically what is meant by positive curvature is that in each of the dimensions the curvature is curved in the same way. Think of a sphere, if I draw a two-dimensional graph on the surface of a sphere, the X and Y axis will be curved in a particular direction, but both of the axis will be curved in the same way (around the center of the sphere). If I think of a saddle shape and

I draw an X and Y axis, one of the axis will be curved one way and the other access will be curved the other way, and so that is what is considered to be negative curvature. As you move up to higher dimensions something like that is used to determine whether we're talking about positive or negative curvature, but I would have to look that up to see exactly how that plays out. But for two dimensions that's the best explanation I can give you.

Reply

Luke Rutherford (https://canvas.sbcc.edu/courses/46681/users/373514)

Apr 24, 2022

DISCUSSION:

I find humans having a concept of time travel incredibly intriguing, especially figuring out what would be needed to make it possible, like the eclipses that bend light and necessary curvature. I was also intrigued by our knowledge of the early universe, knowing close to the entire history of the universe. Findings like these show how far humans have advanced.

QUESTION:

Has there ever been a wormhole observed?

Reply

Erin O'Connor (https://canvas.sbcc.edu/courses/46681/users/24247)

May 1, 2022

Yes, it's unfathomable how precisely we can know the early history of the universe, down to fractions of a second. Wormholes are theoretical, and have never been actually observed. Scientist are still wondering if they can really exist or not. Certain solutions of the general relativity equations allow for them to exist, but they're still may be reasons due to physics why they cannot exist. I guess time, whatever that is, will tell.

Reply

Franco Diaz Campo (https://canvas.sbcc.edu/courses/46681/users/403036)

Apr 25, 2022

DISCUSSION

Hi everyone,

I really like this week's content. It was very fruitful and we saw many topics that are very important in today's physics. We had some a great meeting that I think it was entertaining and funny to watch, and we studied many nice topics on it.

Another thing that I think it was quite important of this week, was the video we saw about the history of the universe; it is one of the most important topics in physics, and knowing a bit more of how our world works, in very important to this class, and I really like to understand all around it.

Lastly, we saw some things about quantum mechanic. Although it is a very tough to understand, it is always important to know its principles for having a better understanding in that topic.

Reply

(http

Erin O'Connor (https://canvas.sbcc.edu/courses/46681/users/24247)

May 1, 2022

Glad to see that you enjoyed this week's topics. It was a chance to summarize some of the things we've learned earlier in the semester and to discuss the Copenhagen Interpretation and the meaning of quantum mechanics.

Reply

(https:/

Naomi Xu (https://canvas.sbcc.edu/courses/46681/users/27955)

Tuesday

DISCUSS

I actually think it's cool in the lecture you mentioned Back to the Future and the scene where Marty plays his guitar solo and the phone call. What's really cool about that scene isn't even the fact that rock in roll is "scripted" in our present and therefore their future. The student called his cousin, Chuck Berry, who in reality wrote the song that Marty preformed, Johnny B Goode, 3 years after the movie took place, which coincides with our idea that "you can go back in time but you can't change the future or that you were meant to change it all along".

Another fictional character story that follows this "law" is flash from the comic books. His mom died when he was a kid, he dedicates himself finding the cause, with him being the fastest

person on the planet, he tries to "time travel" or break the light barrier (travel faster than the speed of light). As he finally gets to the point where he does break the barrier and "catches up" with the person in the past, but it turns out that him breaking that light barrier struck a lighting and that's what killed his mom.

Reply

Erin O'Connor (https://canvas.sbcc.edu/courses/46681/users/24247)

Wednesday

Wow, two great points you make. First, that's funny that it was Chuck Berry. I think I caught that way back when I saw the movie but didn't remember that until you mentioned it right now. That's a great twist. And yes, what a tragic and poignant "moral" being told in the Flash movie. Basically telling us "don't mess with time". You may solve one problem, but create 10 new ones. It's a common dystopian time travel sci fi theme. I hope that if we ever do develop the technology for time travel, people will remember these films and NOT use it. But I don't trust human nature enough for that. But we can hope for the best.

Reply

Naomi Xu (https://canvas.sbcc.edu/courses/46681/users/27955)

Thursday

QUESTION

Are white holes real, or can they be? and how would our search for them (method wise) be different from the way we search for black holes?

Reply