Lecture 22: 9 April, 2021

PHYSICS 419 - Spring 2021

1 Physicalism and Panpsychism

I hope this note gets precisely at what physicalism claims. A brief alternative to it is added in the last paragraph.

Physicalism purports that mental events (thoughts, desires, emotion, sensation, etc.) are physical events. This would imply that a purely physical description of a mental event should exhaust everything there is to know about the mental event. The problem is that mental events such as desires to eat chocolate or the urge to itch your ear have an inner quality and hence a third person physics description takes you further away from understanding precisely what is being experienced. That is, how would one understand what is being described as being a desire to eat chocolate when the description is in terms of volt-meter readings or connections between neurons, that is nuts and bolts. One would still have to go from the physics to the mental state. The way physics works is as follows. Physics describes the content of some phenomenon in terms of other physical things: forces, fields, and particles. The relationship among such things is summed up in some equation. There is no equation from which desire to eat ice cream can be deduced. It is unclear what that would look like because what one obtains from the physics is, in most cases, a reductive account of the phenomenon in terms of the physical constituents. Physics does not entail mental states–it only entails other physical things. It is on this ground that the physicalist program is questioned, thereby leading to the hard problem of consciousness. Namely, there is an explanatory gap between a physical description of what is going on in your brain and what it is that you are thinking. We talk about thoughts and desires entirely in terms of language that is devoid of physical referrents. Describe Marxism in terms of voltages and neurons firing and you are no closer to understanding Marxism than you were before you read das Kapital.

The examples of Frank Jackson's and Nida-Rumelin are an attempt to show that there is something left out in a physicalist account of the mental. Let me simplify them because they are needlessly complicated. Take for example Nida-Rumelin's Marianne who engages in a housing experiment that deprives her of seeing colors in their natural state but otherwise she receives complete knowledge of the world. Someone asked if she is able to deduce the wavelength of the red paint on the wall. Lets assume she is given all the equipment to do this. So the situation is as follows. Marianne knows the sky is blue, though she has never seen a blue sky and but she has seen the blue of the sky. The question is does she learn anything new when she steps outside the room and sees a blue sky. Is there something beyond the neurons firing in her brain (and the neurobiology that is contingent on that) when she looks at a blue sky that we have to account for? If the answer is no, then physicalism is true. But even the physicalist has to explain what it is like for Marianne to see a blue sky. Such a description will not be in terms of physics, however. What it is like for someone to have an experience is not objective and hence a third-person account leaves something out. Physics is entirely third-person. Hence, it cannot account for experience. The solution is to deny that qualia exist. Then how do you account for the itchiness of itches or what it is like to kiss your grandmother or to have your arm ripped off by a pitbull? In each of these cases, there are physical facts but there is also an experience. One can say that the physics causes the experience but is not entailed by it. If this is so, then physicalism is false because what is being caused is not physical–it is the inner quality of the experience. So then it seems that the physicalist program leaves something out, namely experience which was precisely what it was attempting to describe in the first place. Simply, the problem of what an experience is like for Marianne or anyone else is not summed up by studying her neurobiology. This would be true only if there were a necessary connection between the mental and the physical. Kripke's modal argument shows that this is not the case.

You might find the following quote from T. Nagel's article, *Panpsychyism*[1] to the point: "The theories that physical data provide grounds for may take extraordinary leaps which permit the deduction of radical physical consequences (convertibility of matter and energy and the deflection of light by gravity). But without mentalistic evidence, there is no reason to give mental content to the explanation of physical events. (Someone who infers from a drought that the rain god is angry is not basing his hypothesis on physical evidence alone. He is making a psychological interpretation of the drought, based on his familiarity with human motivation. Any inference of this kind, reasonable or unreasonable, does not belong in physics)." In the same essay, Nagel[1] offers a possible way out of the problem of the irreducibility of the mental. The answer is rather shocking: Panpsychism. That is, the constituents of matter have nonphysical properties. This follows from 4 assumptions: 1) Material Composition: by this Nagel means that all organisms are composed of material stuff, simpliciter. There is nothing more than matter. 2) Nonreductionism: Mental properties such as feeling, emotions, thoughts of Marxism and sensation are not physical properties of an organism. That is, they are not implied by physical properties alone. 3) Realism: Such non-physical properties must have come from something. That is, there is no soul. 4) Nonemergence: No property of a complex organism is truly emergent. Emergence is inherently an epistemological statement reflecting our knowledge of the working of a system. That is, it might appear that our current level of understanding of the physical constituents does not admit the property missing. Nonetheless, it is still possible that at some later date, other constituents will be discovered that will allow a complete explication of the properties of the organism.

Panpsychism follows necessarily from these assumptions simply because if mental events are derived from the organism and the matter which makes up organisms is quite varied and in principle could be any matter (all carbon atoms are equivalent) then all matter must carry the ingredients necessary for consciousness to arise. This might seem absurd and indeed that all matter has non-physical properties should strike you as an unacceptable alternative in the mind-body debate. But try to defeat any of Nagel's assumptions. If you deny (1), then you end up with dualism. If you deny (2), then you do not have the mind-body problem. That is, you deny the mental. It is unclear what is a realistic alternative to the denial of realism (3) would look like. One seems to be inevitably stuck with belief in souls if you deny (3). Now the last one on nonemergence. Denial of (4) results in irreducible contingent laws connecting mental states and complex organizational patterns of an organism. As Nagel[1] puts it, denial of nonemergence would entail that mental states have no necessary causal connection to brain states. This seems implausible. Hence, although papsychyism seems outrageous, it is more plausible than its denial.

So where does this leave us regarding quantum mechanics. Since we do not have a theory of consciousness, it is unclear how such a notion (which we do not understand) can be invoked to explain the collapse of the wavefunction. The results of GHZ tell us that we must accept quantum uncertainty as an ontological property of the world.

Concluding Perspectives on measurement:

The central problem of the Folk approach is that it does not specify at what point the linear wave eq ceases to apply, and thus is incomplete in the sense that it does not fully describe whether interference effects will be found in hypothetical experiments with large-scale quantum coherence.

The Copenhagen approach avoids that problem by saying that the wave function is a non-existent entity to which the linear wave function applies exactly, in between experiences, which are real. The problem here is that "experience" is elevated to a central position in the physical working of the universe- it delimits the applicability of the wave equation. However, "experience" is an extremely fuzzy concept, and appears to play an ephemeral role in a universe whose physical behavior seems to be consistent over broad expanses of time and space.

The Bohm hidden variables account does not work as shown by Bell.

The "macro-realist" approaches predict that the wave function really does collapse (following a non-linear equation), under circumstances which depend on physical parameters. The theories are not yet full developed, and invoke non-QM random fields.

The standard Many Worlds picture contains only the wave function obeying the linear wave equation. It doesn't explain why the universe is found in a condition in which "measurement" occurs, but it is consistent with that description. Unfortunately, it gives the wrong probabilities for experimental outcomes.

Notice that the Many-Worlds approach pictures the experience/reality question in a way opposite to the Copenhagen interpretation. For Copenhagen, experience is taken to be the central theme, even at the cost of making the theory anthropocentric. People sound central to the process. For Many Worlds, the math is taken to be central, with the requirement that experience be correctly predicted. People are so radically peripheral to the process that most aspects of reality remain completely hidden from any individual experience.

Conclusion: The world has not been kind to local realism. The violations of local realism are just what QM predicts. However, special relativity and all the key limitations on time-travel have survived intact, no matter how beaten-up our intuitions may be.

It is evident that the current state of the interpretation of QM (centered around the measurement problem) is unsatisfactory if one wishes to maintain objective reality. Whether or not some version of quantum mechanics recaptures the intuitive appeal of objective reality is unknown.

2 Thermodynamics

In the broadest sense, thermodynamics is concerned with the properties of matter in so far as they are influenced by changes in temperature. This definition can be sharpened. Classical thermodynamics limits itself to a macroscopic study of the properties of matter as a function of temperature: an atomic-level description is not part of classical thermodynamics. Specific macroscopic observables of interest are the pressure, volume, internal energy, and the entropy, for example. For our future study in quantum mechanics and cosmology, we will need the concept of entropy. The simplest way to introduce the concept of the entropy is to reflect for the moment that in the natural world, there seems to be a natural direction in which spontaneous events occur. For example, a car in neutral will run downhill. One in neutral at the bottom of the hill will not spontaneously move up hill. It will remain there for all time. Although there is a finite probability that it might all of a sudden run uphill, such an event is highly unlikely. Also heat flows from a hotter object to a colder object, not the other way. Engines cannot operate in a cycle without giving off exhaust. That is, the efficiency of an engine cannot be unity. All of these processes are governed by a fundamental thermodynamic principle. That principle is the maximization of the entropy by all spontaneous changes in a closed thermodynamic system. The second law of thermodynamics states that all spontaneous changes in a closed system will necessarily increase the entropy. Physically, entropy is a measure of the order in a system. An equivalent restatement of the second law is that physical processes run in a direction that decreases order or in other words increases disorder. When leaves fall off a tree, they do not accumulate in a nice clump below the tree. Rather they are dispersed all over the place. Entropy dictates that this be the case.

From Thermodynamics to Statistical Mechanics

Consider a container of a gas with a fixed volume. What happens if the container is doubled. If the volume of the gas doubles, the degree to which we know the precise location of each gas particle has decreased. That is, our information content of the container has decreased. Boltzmann was the first to conjecture that microscopically the way to understand the entropy of a given thermodynamic state is through the information content. Specifically, Boltzmann conjectured that the statistical route to the entropy is obtained by considering all the possible distinct ways of distributing the particles of a system. Let W be the number of distinct ways of distributing particles in a system. Boltzmann conjectured that the microscopic prescription for computing the entropy is: $S = k_B \ln(W)$, where k_B is Boltzmann's constant=natural gas constant/Avogadro's number. Boltzmann was way ahead of his time when he made this proposal. Faced with failing health and abject rejection from the scientific community, Boltzmann committed suicide. On his tomb lies the inscription: $S = k_B \ln(W)$. This equation is the basis for modern statistical mechanics. We now turn to the underlying principles of probability that make its computation possible.

Before we do this, consider the problem of Maxwell's Demon, a hypothetical entity who performs impossible feats. For example, he stands at the door between two rooms and only lets molecules through one way. Notice that this process would reduce entropy, since there's more ways to place the molecules if they can go on either side than if they're confined to one side.

Then you get high pressure on one side, low pressure on the other. You could then use that pressure difference to drive a piston. Is this possible?

Within classical physics there is no account of why this Maxwell demon procedure is impossible, although it obviously wouldn't be easy. Classically, this is IN PRINCIPLE not different from trapping all the billiard balls on one side of a table. So there's a bit of a paradox about classical thermodynamics.

3 Probability

What does probability mean?

That is, what do we mean when we say, "The probability of rolling a 3 with a 6-sided die is 1/6."

There are at least two standard types of answers, frequentist and subjectivist.

Frequentist interpretation of Probability

There a few formal definitions that are necessary. You should read Sklar pages 92-100. When we roll a dice that has six sides, the probability that any of the sides ends up face up is 1/number sides of the dice. This number is 1/6th. Now what if we roll the dice 12 times, will we measure that each side shows up twice. Probably not. The probability of 1/6 corresponds to a generalization we make from a large number of dice tosses. We take the ratio of the number of times a particular side ends up facing up over the total number of tosses. This frequency is the idealized probability that we associate with rolling an evensided dice. Of course, any finite sample size we choose we might not ever see 1/6th as the frequency associated with observing any side of the dice. The law of large numbers says that if the sample size is large enough, we will in fact see 1/6th. Now conditional probability. What if we roll two dice. What is the probability of observing an 8. An eight can occur five ways. What is the probability of observing a 4 if the sum on the dice is 8. The answer is 1/5, though 2 fours will appear. This is a question of conditional probability. The conditional probability question is what is the probability of an event A occurring given that event B occurred. The answer is take the ratio of the number of ways event A can occur over the number of ways event B can occur. In probability the ratios are always of the form: event of interest/total events. Sometimes probabilities multiply. What is the probability of rolling a 5 and then a 6. If each of these events is independent (which we have no reason to believe they are not) then we simply take the product of the individual probabilities that a 5 and a 6 occurs. Hence, the joint probability is 1/36. These are the facts associated with probability. But we still have to answer the question, what do we really mean by probability. Because we can only really talk about the ideal probabilities of 1/6 for example in the context of a dice when the sample size is large, why is it that we say that when we roll a dice a 6 will occur 1/6th of the time. No experiment we have ever performed will ever give this result, unless we roll dice from now until eternity. The objectivist ignores this and says that "probabilities are those generalized attributions of frequency and proportion that appear in the posits that play a fundamental role in the structure of generalizations". Probability is the dispositional magnitude that a particular outcome is produced. The dispositional magnitude of flipping a head on a two-sided coin is 1/2. What does an objectivist say about a random sequence? Consider the sequence HTHTHTHTHTHT. Is this sequence random? We could easily have generated this sequence by two print commands in a 3-line computer program. A simple rule of thumb is that no 3-line computer program can generate a random sequence. Believe it or not, this criticism is not too far from the truth. A random sequence is viewed as being random if it is generated with a computer program that is sophisticated enough to generate a random sequence. But this is somewhat circular. The sequence with alternating H and T's is not random because it seems to fit a simple rule. Namely H on odd flips and T on even flips. Since this rule works, the sequence is not random. Let's assume no such simple rule can be devised. Then a sequence is random if the limiting relative frequency in subsequences is not too far off from the ideal frequency predicted from the law of large numbers.

Subjectivist (Bayesian) probability:

Probability is defined in terms of the speaker's degree of confidence in his statement. In this case, there are hidden variables. On this account, probability is not so much about the world but about our biases and our knowledge of a particular situation. In A good example of subjectivist probability at work is the Monty Hall question. I will go over this in class. The crucial piece of information is knowing what is in Monty's head.

Sometimes there's a list of possible outcomes, each assumed to be equally likely until we learn otherwise. This is called the principle of indifference.

This definition is certainly flexible enough to cover all the cases we've mentioned. Is it too flexible?

The problem here is that the a priori beliefs have no obvious rational basis, and reasonable people can obtain different results from different initial beliefs. (Sklar, p. 99)

References

[1] T. Nagel, Panpsychism in *Mortal Questions*, Cambridge University Press, 1979.