AGPhil 2: Foundations of Physics II

Time: Monday 17:00–19:00 Location: HS XVII

AGPhil 2.1 Mon 17:00 HS XVII

Are four levels of multiverses enough? — •Phillip Helbig[1] and Maura Cassidy Burke[2] — [1]Maintal, Germany — [2]Freudenthal Institute, Utrecht University, Netherlands

Tegmark classified multiverses into four levels: I: regions in our Universe but outside our particle horizon and hence not (yet) observable by us; II: independent Level I universes in the context of eternal inflation and/or with different laws of physics; III: many universes corresponding to the many worlds in the many-worlds interpretation of quantum mechanics; IV: Tegmark's mathematical multiverse in which every mathematical object actually exists. We suggest that Tegmark's Level II multiverse actually refers to two distinct concepts and propose a change in the terminology in order to take that into account.

Levels II and III are the types of multiverse usually discussed, and the definitions of the levels other than II are clear. Level II is most often thought of as consisting of various universes within the concepts of eternal inflation, the string-theory landscape, or brane-world cosmology, but at the same time as universes with different values of physical constants or even different laws of physics. On the other hand, such theories clearly depend on some fundamental laws of physics which must be common to all universes in such a multiverse, thus a distinction is needed. We thus see a need for a level higher than what is usually thought of as the Level II multiverse, which of all of the levels also most closely corresponds to historical multiverse concepts.

AGPhil 2.2 Mon 17:30 HS XVII

Spacetime Functionalism and T-Duality — •Christian Airikka — IFIKK, University of Oslo

Spacetime has been reported missing, last observed close to the Planck scale. Philosophers are investigating the case. One suspect, String Theory, is accused of eliminating spacetime through dualities. Dual theories posit different ontologies but imply the same physics. According to the common core interpretation, anything the duals disagree on is surplus structure. As the duals disagree on facts about their fundamental spaces, it follows that spacetime must be emergent.

A popular account of spacetime emergence is Spacetime Functionalism (SF). SF follows the Ramsey-Carnap-Lewis method of functional reduction. According to SF, spacetime is to be identified with whatever fundamental entities that realise the functional spacetime roles.

I demonstrate the innocence of String Theory. In applying SF to dual theories, one replaces troublesome terms with bound variables, stripping them of interpretation. I show, using a toy model, that the relevant spacetime functions will be realised by identical structures in each dual. It then follows as a matter of logical deduction, according to SF, that they are identified - both with aspects of spacetime, and each other. According to SF, the duals are not in disagreement. Spacetime never was lost! I conjecture that, since dual theories are isomorphic, such identifications follow in more complicated cases as well.

Conclusions: SF, as an account of emergent spacetime in String Theory, is self-undermining. On the other hand, SF might offer a flat-footed realist account of the ontology of String Theory.

AGPhil 2.3 Mon 18:00 HS XVII

The Probabilistic Turn across Physics: From Classical to Quantum Physics and from Psychophysics to AI — •Ken Archer — Linkoping University, Linkoping, Sweden

The meaning and interpretation of probability within quantum physics is illuminated in this paper by identifying parallels in the probabilistic turn across multiple areas of physics. The probabilistic turn from classical physics to statistical mechanics has important parallels with the probabilistic turn from classical physics to quantum physics. Critically, this paper shows these same parallels within another probabilistic turn in a field whose association with physics is controversial - the probabilistic turn from psychophysics to artificial neural networks (ANNs) that are the basis for AI.

In all three fields, probability enables physical models to account for stability. Just as statistical mechanics accounts for the stability of fields and quantum mechanics accounts for the stability of matter, ANNs enable cognitive models to account for the stability of cognitive capacities across heterogenous and even damaged neural networks. Furthermore, this role of probability across physics points to another common feature - the absence of pre-given distributions (Gaussian, binomial, Bayesian, etc) such that softmax in ANNs plays an analogous role as Born's Rule in quantum mechanics. In both cases, the particular mathematization of the phenomena is the theory - there's no deeper human intuition about the phenomena to leverage in a pre-given distribution, as probabilities emerge naturally from the mathematical formalism.

AGPhil 2.4 Mon 18:30 HS XVII

On the theory-ladenness of theorising — •Radin Dardashti — University of Wuppertal, Germany

The theory-ladenness of observations or data is a much-discussed topic in the philosophy of science. It is common to regard theory-ladenness as something problematic that needs to be overcome in order to be able to confront theories on a more neutral basis. But theories themselves are obviously not developed in a vacuum. So one might also ask whether there is a kind of theory-ladenness involved in theory development itself, and whether this might pose a threat to the reliability of theory development. In this paper I discuss different kinds of theory-ladenness in theory development in fundamental physics and the conditions under which they may or may not be problematic.