AGPhil 2: Space and Time

Time: Tuesday 11:00–12:30 Location: JAN/0027

AGPhil 2.1 Tue 11:00 JAN/0027

Einstein's forgotten interpretation of GR: against geometrization and for the unification of gravity and inertia — •Dennis Lehmkuhl — Lichtenberg Group for History and Philosophy of Physics, University of Bonn

Almost every textbook on general relativity tells us that the main lesson of the theory is that gravity is not a force but that it can be reduced to space-time geometry, that gravity is the curvature of space-time. Unbeknownst to most, Einstein himself actively opposed this interpretation of his theory. He thought that instead general relativity should be seen as a unification of gravity and inertia, analogous to the unification of electricity and magnetism in special relativistic electrodynamics. In this talk I am going to outline how this interpretation of general relativity originated in Einstein's work on a relativistic theory of gravity before he first embarked on a metric theory in 1913, and how his interpretation of the equivalence principle made him hold on to this interpretation even after more and more physicists and philosophers opted for a geometric interpretation of the theory. Finally, I will compare the geometric and the unificationist interpretation and discuss whether either or both of them can be upheld in the modern context.

AGPhil 2.2 Tue 11:30 JAN/0027

A dynamical perspective on the arrow of time — •Kian Salimkhani — University of Cologne

It is standardly believed that the generally time-reversal symmetric fundamental laws of physics themselves cannot explain the apparent asymmetry of time. In particular, it is believed that CP violation is of no help. In this paper, I want to push back against a quick dismissal of CP violation as a potential source for the arrow of time and argue that it should be taken more seriously for conceptualising time in physics. I first recall that CP violation is a key feature of our best physical theory which also has large-scale explanatory import regarding the matter-antimatter asymmetry of the universe. I then investigate how CP violation may help to explain the directionality of time. I argue that accounts a la Maudlin that posit an intrinsic fundamental direction of time are not convincing and instead propose to utilise recent results from work on the dynamical approach to relativity theory.

AGPhil 2.3 Tue 12:00 JAN/0027

Causal Theories of Spacetime — •Baptiste Le Bihan — University of Geneva

In the twentieth century, the causal theory of time was replaced by the causal theory of spacetime. Based on pioneering work by Hawking (1976), Malament (1977) and others, it was argued that special and general relativity were, at core, causal theories and the view that the metric structure of spacetime could be accounted for in terms of a causal topology started to gain momentum (Huggett and Wüthrich, forthcoming, ch2). But the theory was also subject to sustained attack in philosophical circles, especially by Smart (1969), Earman (1972) and Nerlich (1982).

While interest in the causal theory ebbed within philosophy, the core motivations behind the theory never really went away in physics. The work by Malament and Hawking on causal structure in relativity gave birth to an important research programme in physics, culminating in what is now known as causal set theory.

To resolve the tension, we develop a new version of the causal theory of spacetime. Whereas traditional versions of the theory sought to identify spatiotemporal relations with causal relations, the version we develop takes causal relations to be more fundamental than spatiotemporal relations. We argue that this non-identity theory, suitably developed, avoids the challenges facing the traditional identity theory and offers a natural interpretation of causal set theory.