AGPhil 7: The role of geometry in gravitational theories

Time: Thursday 10:45–12:45 Location: A 060

Invited Talk AGPhil 7.1 Thu 10:45 A 060

A Defence of the Geometrical Interpretation of General Relativity — •Oliver Pooley — Faculty of Philosophy, University of Oxford, UK

According to a popular view, general relativity, in its standard formulation, is fundamentally a theory of spacetime structure; one that explains gravitational phenomena through spacetime curvature. In my talk I will critically review several challenges to this view, from Einstein's rejection of the geometric interpretation of the theory to recent uses of the notorious Hole Argument. Particular attention will be paid to the questions of whether and why the metric field, g_{ab}, is naturally interpreted as representing spacetime geometry (rather than, say, a "gravitational field"). I also hope to clarify the extent to which various principles supposedly satisfied by general relativity (primarily, general covariance and the equivalence principle) bear on this family of interpretative questions.

AGPhil 7.2 Thu 11:30 A 060

General Covariance, Diffeomorphism Invariance, and Background Independence in 5 Dimensions — •Antonio Vassallo — University of Lausanne, Department of Philosophy, CH-1015 Lausanne, Switzerland

The paper considers the "GR-desideratum", that is, the way general relativity implements general covariance, diffeomorphism invariance, and background independence. Two cases are discussed where 5-dimensional generalizations of general relativity - namely, the original Kaluza-Klein theory and induced matter theory - run into interpretational troubles when the GR-desideratum is forced upon them. It is then shown how the conceptual problems dissolve when such a desideratum is relaxed. In the end, it is suggested that a similar strategy might mitigate some major issues in modern spacetime physics, such as the problem of time in canonical quantum gravity or the embedding of quantum non-locality into relativistic spacetimes.

15 min. break.

AGPhil 7.3 Thu 12:15 A 060

The neighborhood of General Relativity in the space of (spacetime?) theories — •Dennis Lehmkuhl — IZWT, University of Wuppertal, Einstein Papers Project, Caltech

How 'special' is General Relativity (GR) as compared to other theories? The answer to this question depends on what other theories we compare GR to: other field theories or just other spacetime theories? I will argue that Einstein himself saw GR not primarily as a theory of spacetime, but as a field theory unifying gravity and inertia. I will then show that his interpretation of GR as a unification of gravity and inertia is only possible because of the way the different fields couple in GR, and compare GR to a much later theory (Jordan's theory from the 1950s, the first scalar-tensor theory). The comparison will show that it is the coupling structure that ensures the motion of particles on geodesics, and thus the possibility for Einstein to interpret the theory as a unified field theory (of gravity and inertia).