

AGPhil 9: The role of the metric investigated

Time: Friday 9:30–11:00

Location: A 060

Invited Talk

AGPhil 9.1 Fri 9:30 A 060

On the seemingly double appearance of the signature in general relativity — ●HARVEY BROWN — Oxford University, UK

Both Einstein and Schrödinger explicitly based the existence of a metric field in general relativity on the local validity of special relativity. But the Lorentzian nature of the metric in special relativity can be viewed as an emergent property of the dynamics of matter fields, and in particular the electromagnetic field, as Itin and Held carefully demonstrated in 2004. This talk addresses the question as to how this approach to justifying the Lorentzian signature of the space-time metric is supposed to hold in general relativity, if at all.

Invited Talk

AGPhil 9.2 Fri 10:15 A 060

The status of Kottler's premetric program in Newtonian gravity and in electrodynamics: an essay — ●FRIEDRICH W. HEHL¹, YAKOV ITIN², and YURI N. OBUKHOV³ — ¹U. Cologne, U. Missouri, Columbia — ²Hebrew U. Jerusalem — ³RAS Moscow

In the year 1922, Kottler published two articles on 'Newton's law and

metric' and on 'Maxwell's equations and metric.' Because of the omnipresence of the gravitational field, the metric g_{ij} (and its reciprocal), according to general relativity, is intervening in most physical laws. The innocently looking raising of an index, $A^i := g^{ik}A_k$, contaminates the electromagnetic 4-potential with the presence of the gravitational potential g^{ik} . The program of Kottler was to investigate where in physics the occurrence of the metric is essential and where it is misleading. Taking the Maxwell equations as our main guinea pig, we show that they are of a "pre-metric" nature. that is, they are independent of the metric altogether. Furthermore we demonstrate how one can derive a metric, up to a factor, from data of local and linear electrodynamics.

H., Obukhov, *Foundations of Classical Electrodynamics: charge, flux, and metric*, Birkhäuser, Boston (2003); Itin, H., *Is the Lorentz signature of the metric of space-time electromagnetic in origin?*, *Annals of Physics* (NY) 312, 60 (2004); H., Itin, Obukhov, *Recent developments in pre metric classical electrodynamics*, *Zlatibor Proceedings*, see arXiv:physics/0610221 (2006).