AGPhil 8: Quantum Gravity 2

Time: Thursday 14:00–15:30 Location: H7

AGPhil 8.1 Thu 14:00 H7

A Tale of Two Machs: Relationalism in Quantum Gravity — •Mark Shumelda — University of Toronto, Canada

Several approaches to quantum gravity are explicitly motivated by temporal relationalism. This is the notion, historically prefigured by Leibniz and Mach, that time is simply not part of our basic ontological framework.

Relational approaches to physics in general, and quantum gravity in particular, seek to describe the history of the universe not as curve in four-dimensional Minkowski spacetime, but rather in some kind of parametrization-invariant configuration space. Relational approaches such as loop quantum gravity are already well-known to philosophers. In my paper I begin a philosophical analysis of time in the light of two relatively new and very different approaches to quantum gravity: geometrogenesis and shape dynamics. In my analysis I contrast the opposing ways in which geometrogenesis and shape dynamics implement the basic tenets of Machian temporal relationalism.

It turns out that far from removing time altogether from the fundamental theory, both geometrogenesis and shape dynamics posit an ontologically robust sense of temporal passage, though in very different ways. I argue that while each approach has its philosophical merits, neither is able to describe time as a fully emergent concept. Time, it seems, is here to stay in the fundamental theory, even given a Machian, relationalist approach to dynamics.

AGPhil 8.2 Thu 14:30 H7

The fundamental role of the proper time parameter in general relativity and in quantum mechanics — •René Friedrich — Strasbourg

Einstein's relativity provides us with some hints about the nature of time which have not been fully taken into account in quantum gravity yet. The phenomenon of time dilation is replacing Newton's absolute time with a twofold, complementary time concept, consisting of the observer's coordinate time after time dilation and the observed object's proper time before time dilation.

Although many authors are highlighting the importance of proper time within GR, theories of quantum gravity are usually starting off with the assumption of a relative spacetime manifold. However, for fundamental questions about the nature of time we should not refer to coordinate time but to the more fundamental parameter of proper time. Following this approach, the universe of quantum gravity is composed of solipsistic worldlines which are parameterized by their respective proper time, including lightlike worldlines of fields whose length is zero.

The definition of proper time: "The time measured by a clock following a given particle" provides the particle with a well-defined physical property: its aging - in general relativity as well as in quantum mechanics. It will be shown that, in a first step, time is produced locally by the rest energy of mass particles in the form of proper time, and that only in a second step time is measured and synchronized by observers in the form of coordinate time.

AGPhil 8.3 Thu 15:00 H7

Simplicity and naturalness in a fundamental complex dynamics — •Aldo Filomeno — Universidad Católica de Valparaiso

Some traditional criteria for the fundamentality of a theory – naturalness, simplicity, unification, among other conditions – appear to be inconsistent with our current best physics. In light of this, while some expect these criteria to show up in future quantum gravity theories, others argue that such criteria ought to be abandoned. In this paper we stress that there is a third way of thinking about this situation. If such criteria are preserved, another qualitatively different physics at the fundamental level gains plausibility, in that it would restore the naturalness and simplicity: a highly complex dynamics at the fundamental level. This amounts to an account of fundamental laws of nature that has long been studied and defended in various (unorthodox) projects in physics, while it has been neglected in philosophical accounts of laws of nature.