AGPhil 15: Quantum Gravity 3

Time: Thursday 15:00–16:30 Location: PTB SR AvHB

AGPhil 15.1 Thu 15:00 PTB SR AvHB

Rethinking Geometry in Physics — •Amine Rusi El Hassani — University of Lausanne, Lausanne, Switzerland

The role of geometry in physics underwent a significant shift from Newton to Einstein. While Newton considered geometry as an a priori and fixed framework to describe the physical world, Einstein challenged this view and emphasized the importance of linking geometry to physical experiments and operational definitions. This led to the development of Einstein's "practical geometry" which played a crucial role in the development of his theory of general relativity. As we move towards the quantum world, the questions of how to think about geometry and its ontological status become even more crucial. Can we go beyond Einstein's practical geometry? What is the relationship between geometry and quantum theory of matter? These are the questions that I am currently exploring. By examining alternative theories of geometry, such as spectral geometry, we can gain new insights into the ontological status of geometry and its relationship with physical concepts. In this talk, I aim to provide a critical evaluation of Einstein's practical geometry and explore new avenues for thinking about geometry in the quantum world.

AGPhil 15.2 Thu 15:30 PTB SR AvHB

How "existence" can emerge from nothing at all: Ancient and modern perspectives on Information in Quantum Gravity — •Ewoud Halewijn — TU Delft, Netherlands

The concept of "existence" is indispensable for our functioning as human beings. To survive, we better regard information as if it were "about what is existing", such as food or dangerous animals. Believing that information is "about reality", is beneficial in real life, so we might strive for a quantum gravity theory that describes "what really exists".

In this talk, I advocate we should temporize our efforts to do so, for two reasons. Firstly, information is not just "about reality". It is also "part of reality". Ancient Mesopotamian and early Vedic scholars were aware thereof, but hereafter classical Greek philosophers, Catholic scholars and mostly Descartes have removed part of the meaning of the concept of information. Secondly, the more thoroughly we study quantum phenomena, the harder it gets to make a clear distinction between what semioticians call signs (e.g. variables in theories) and their meaning (the "things" they describe). Unfortunately, once signs and meanings coincide, what well-functioning human beings consider to be information and reality, both cease to exist.

If we nevertheless want to "describe reality", we should initially develop models that are unrelated to what most people believe is "existing". And later on expand them, to let "existence" emerge out of nothing at all.

AGPhil 15.3 Thu 16:00 PTB SR AvHB

An effective approach to quantum gravity : the pragmatic solution we never dreamt of, but already have — •Etienne Ligout — Institut d'Histoire et de Philosophie des Sciences, Paris, France

Upon quantization, general relativity proves to be unrenormalizable: the perturbative expansion breaks down at the Planck scale. Most of the efforts to devise a coherent quantum theory of gravitation have thus historically been focused on finding an ultraviolet completion of general relativity up to the Planck scale. In this talk, I shall argue that this endeavour - while relevant to tackle some limitations of the classical framework (such as singularities) - is not warranted from an empirical standpoint, simply because we are far from being able to probe the Planck scale. In fact, at all the scales currently accessible, the quantum corrections to the gravitational dynamics remain small, and - crucially - can be computed. This is achieved by adopting an effective approach, where only the dominant contributions in the action (at the energy scale considered) are retained. When carried out, this program yields a comprehensive quantum gravity theory at low energies, giving for instance the quantum corrections to the newtonian potential or to the bending of light around a star (see e.g. Donoghue 1994). Building on these results, I defend a pragmatic approach to the problem of quantum gravity : rather than wonder what happens to gravity at the Planck scale in spite of any empirical support, we should adopt an effective point of view and restrict our focus to energy regimes where the quantum gravitational effects are well controlled and understood.