AGPhil 2: Space, Time and Symmetry I

Time: Tuesday 11:00–13:00 Location: H-HS IV

AGPhil 2.1 Tue 11:00 H-HS IV

Energy-momentum conservation and the specificity of general relativity — •Valeriya Chasova — Archives Henri-Poincare (AHP-PReST UMR 7117), University of Strasbourg — Centre de philosophie des sciences et societes (CEFISES), Universite catholique de Louvain

Harvey Brown [2005] argued that general relativity (GR) is specific in that inertial motion enjoys a specific status there, and he derived this status using the fact that Einstein's equations ensure the conservation of the energy-momentum tensor. In a recent paper [2019 in Studies], Weatherall shows however that the same status can also be achieved in other theories including special relativity (SR) and Newtonian gravitation (NG), and for this he relies on the fact that in these theories as much as in GR the energy-momentum conservation can also be derived from properties of the dynamics of the matter. If Weatherall is right, the specificity of GR can no longer hinge on the status of inertial motion, so I consider whether it may hinge instead on the specificity in deriving the energy-momentum conservation. Here Brown's remark that Einstein's equations ensure this conservation in GR is of help, as there is no analogue of this in SR or NG. So GR would come out as specific provided, when considering what makes a theory specific, one relied on deriving the energy-momentum conservation via field equations rather than via the dynamics of the matter. So I discuss whether we are entitled to do so.

AGPhil 2.2 Tue 11:30 H-HS IV

Symmetries and relationism — •Guy Hetzroni — Tel-Aviv University, Tel-Aviv, Israel

Despite the "century of symmetry" in physics, it seems that we have not yet achieved a satisfactory understanding of the reason that symmetry considerations repeatedly turn out helpful in constructing and unifying theories. The presented research provides an examination of the method through which symmetry principles are used in three different cases: the gauge principle in quantum field theories, general covariance in the general theory of relativity, and Mach's principle in classical mechanics. It shall be argued that the applications of symmetry arguments in all of these are all based in similar ways on a common hidden assumption, roughly stating that every possible transformation of the mathematical representation of a given system has a corresponding physical change in the state of the system with respect to another physical system. In addition to this account of the methodology, I shall claim that the most natural way to explain its success is by appealing to a certain form of relationism with respect to fundamental degrees of freedom. I shall argue that this view has the potential of providing a down-to-earth physical understanding of the applicability of symmetry considerations that stands in contrast to common descriptions of symmetries in terms of mathematical necessity, beauty of unexplained miracles.

AGPhil 2.3 Tue 12:00 H-HS IV

Measuring expansion of the universe — •Ari Belenkiy — SFU, Vancouver, Canada

Apart from the ongoing debate on who is the discoverer of the Expanding Universe, there is another debate as to whether the space around us is expanding. The debate originated as early as 1933 by G. C. McVittie and the conclusions are swinging since then. In 1973, Misner, Thorne and Wheeler suggested a standard picture for global expansion is that of a rubber balloon being gradually filled in with air. Asking whether atoms expand, whether the meter stick expand, whether the distance between sun and earth expand, Misner et al answer all three questions in negative: "Only distances between clusters of galaxies and greater distances are subject to the expansion. Only at this gigantic scale of averaging does the notion of homogeneity makes sense." This conclusion however left open the question about expansion on smaller scales where homogeneity is absent and Friedman solutions are not necessarily present. In 1998, Cooperstock, Faraoni and Vollick took a contrarian view, claiming that "effects of dark energy are observable not only globally, but also in local systems. These effects can be measured and are comparable with the present value of the Hubble constant." As a result of this uncertainty, as recently as 2008, John Peacock renewed the discussion asking similar questions: "Is the space in my bedroom expanding, and what would this mean? Do we expect the Earth to recede from the Sun as the space between them expands?" All these surprising and often counter-intuitive results ask for an experiment.

AGPhil 2.4 Tue 12:30 H-HS IV

Symmetry and the equivalence of models — •Joanna Luc — Jagiellonian University, Kraków, Poland

In my talk I will defend the thesis that symmetry-related models of the same physical theory should be regarded as representing one and the same physical state (this thesis will be called SYM-ONE). I will start from listing potential counterexamples to this interpretative principle present in the literature (Belot 2013, Belot 2018, Fletcher 2018, Roberts 2015). Then, the conceptual framework will be proposed that enables one to analyse these examples in a way that avoids abandoning SYM-ONE. The crucial ingredient of this framework is the distinction between theoretical and applied models. The latter include elements that are needed to relate theoretical models to the actual measurements, such as the choice of reference frame and the choice of units. The fact that symmetry-related models are often treated as representing physically distinct states in scientific practice can be explained by the fact that scientists use implicitly applied models, not their theoretical counterparts. Therefore, the arguments from scientific practice against SYM-ONE do not work and arguments of other types are claimed to be less forceful in this context.