AGPhil 10: Foundations of Quantum Mechanics II

Time: Thursday 17:00–19:00 Location: HS XVII

AGPhil 10.1 Thu 17:00 HS XVII

Unveiling Biases in Physics: the Case of Higher-Order Equations and the Quest for a Theory of Quantum Gravity — Luca Gasparinetti[1] and •Aaron Collavini[2] — [1]University of Milan, Milan, Italy — [2]University of Italian Switzerland, Lugano, Switzerland

Drawing on the work of Anjum and Rocca (2024), this talk examines philosophical biases in theoretical physics, focusing on the Lagrangian formalism's dominance in formulating, among others, theories of quantum gravity. In particular, Lagrangian theories of order higher than the second in the time derivatives are unstable according to Ostrogradsky's no-go theorem (Swanson 2022). This implies that, in physical practice, higher-order theories are often rejected a priori. However, Collavini and Ansoldi (under review) critique the application and the consistency of the Lagrangian framework to higher-order formulations, and invite to reconsider and extend the conceptual framework on which the standard treatment of second-order theories is based. Their arguments exemplify the weakness of the foundational premises hidden in physical theories, and invite to uncover new pathways for reconciling general relativity and quantum mechanics. Drawing on their analysis, we argue that the unquestioned reliance on the Lagrangian formalism is shaped by specific philosophical biases and value judgments. Collavini and Ansoldi*s work thus serves as a key example of how confronting implicit assumptions can drive progress towards a better understanding of the physical world. This would finally demonstrate how revealing and interrogating hidden philosophical biases can foster a productive interplay between philosophy and science.

AGPhil 10.2 Thu 17:30 HS XVII

The Quantum Landscape: a Status Report — •Marc Holman — Utrecht University

Regardless of one's sentiments about the strength of various arguments to modify (aspects of) the mathematical structure of quantum theory, it must be acknowledged that this structure could simply turn out empirically inadequate at some point. Yet, in sharp contrast to the situation with our *other* highly successful fundamental theory in physics, viz. general relativity - for which the same basic verdict of course applies *and* for which countless alternative theories have been developed over the years - alternatives to quantum theory have been very little explored and at any rate seem out of vogue. After briefly reviewing underlying reasons for this situation (which can be traced, at least in part, to different views on general relativity as a physical theory), I discuss some recent proposals, motivated by quantum field theory and cosmology, to modify the standard quantum formalism, and conclude with a rough sketch of the landscape of alternatives to quantum theory - i.e., the "quantum landscape".

AGPhil 10.3 Thu 18:00 HS XVII

Natural Spacetime: Describing Nature in Natural Concepts — •Markolf Niemz — Heidelberg University, Germany

Today's physics describes nature in "empirical concepts" (based on observation), such as coordinate space/time, wave/particle, force/field. There are coordinate-free formulations of special and general relativity (SR/GR), but there is no absolute time in SR/GR and thus no "holistic view" (universal for all objects and at the *same* instant in time). **I show:** Euclidean relativity (ER) provides a holistic view by describing nature in "natural concepts" (immanent in all objects). "Pure distance" (proper space/time) replaces coordinate space/time. Pure energy replaces wave/particle. Process is a promising concept to replace force/field. Any object's proper space d_1, d_2, d_3 and its proper time τ span a natural, Euclidean spacetime (ES) d_1, d_2, d_3, d_4, where $d_4 = c\tau$. For each object, there is a relative 4D vector "flow of proper time" $\boldsymbol{\tau}$. The new invariant is absolute, cosmic time θ. All energy moves through ES at the speed c. An observer's view is created by orthogonally projecting ES to his proper space and to his proper time. *Information is lost in projections giving rise to mysteries.* ER explains the 10% deviation in the published values of H_0, and it declares dark energy and nonlocality obsolete. **I conclude:** (1) Information hidden in the 4D vector $\boldsymbol{\tau}$ solves 15 mysteries. (2) An acceleration rotates $\boldsymbol{\tau}$ and curves an object's worldline in flat ES. (3) ER complements SR/GR. We must apply ER if there are significantly different 4D vectors $\boldsymbol{\tau}$ and $\boldsymbol{\tau}'$, as in high-redshift supernovae or entanglement. We must apply SR/GR if we use empirical concepts (www.preprints.org/manuscript/202207.0399).

AGPhil 10.4 Thu 18:30 HS XVII

More on a Presupposition of Bell's Theorem — •Carsten Held — Nonnenrain 2, 99096 Erfurt, Germany

In earlier work, the Bell-CHSH inequality was shown to rest on a nontrivial presupposition, i.e., that the values of elementary spin quantities are scalars, not, e.g., vectors. The theorem's argument succeeds for scalars and fails for vectors. However, the reference to vector values can be motivated from the physics of spin. Hence, it seems that the Bell-CHSH inequality fails as a proof of non-locality. But how powerful is this argument really? We discuss two objections: (A) If we introduce four unit vector values, we learn that they cannot be mapped consistently onto QM observables. (B) Given the four vector values, the contradiction vanishes but we can map them 1:1 to scalar values and for them the contradiction reappears. If we analyze these objections, we find that neither is convincing.