AGPhil 12: Foundations of Classical and Quantum Mechanics

Time: Friday 14:00–16:00 Location: HS XVII

AGPhil 12.1 Fri 14:00 HS XVII

On the applicability of Kolmogorov's theory of probability to the description of quantum phenomena — •Maik Reddiger — Anhalt University of Applied Sciences, Köthen (Anhalt), Germany

Through his axiomatization of quantum mechanics (QM), von Neumann laid the foundations of a "quantum probability theory." In the literature this is commonly regarded as a non-commutative generalization of the "classical probability theory" established by Kolmogorov. Outside of quantum physics, however, Kolmogorov's axioms enjoy universal applicability. One may therefore ask whether quantum physics indeed requires such a generalization of our conception of probability or if von Neumann's axiomatization of QM was contingent on the absence of a general theory of probability in the 1920s.

Taking the latter view, I motivate an approach to the foundations of non-relativistic quantum theory that is based on Kolmogorov's axioms. It relies on the Born rule for particle position probability and employs Madelung's reformulation of the Schrödinger equation for the introduction of physically natural random variables. While an acceptable mathematical theory of Madelung's equations remains to be developed, one may nonetheless formulate a mathematically rigorous "hybrid theory", which is empirically almost equivalent to the quantum-mechanical Schrödinger theory. A major advantage of this approach is its conceptual coherence, in particular with regards to the question of measurement.

This talk is based on `arXiv:2405.05710 [quant-ph]` and Reddiger, *Found. Phys.* **47**, 1317 (2017).

AGPhil 12.2 Fri 14:30 HS XVII

Absolute time and absolute space — •Grit Kalies[1] and Duong D. Do[2] — [1]HTW University of Applied Sciences, Dresden, Germany — [2]The University of Queensland, Brisbane, Australia

The kinematic concept of velocity led to the geometric mechanics of Newton, Lagrange and Hamilton [1] and to further geometric theories such as special and general relativity, according to which time and space are relative. A different picture emerges when velocity is described as a dynamic (energetic) state variable of a material object (system, body, elementary particle, etc.) and the dynamic role of velocity in a collision is taken into account: 'Velocity is a physical level, like temperature, potential function,...' [2]. The velocity as an intensive state variable of an object leads back to absolute time, absolute simultaneity and absolute space and to the insight that nature is more than geometry. [1] G. Kalies, D. D. Do, AIP Adv. 14, 115225, 1-16 (2024); [2] E. Mach, The science of mechanics (The Open court publishing co, Chicago, 1907), p. 325.

AGPhil 12.3 Fri 15:00 HS XVII

Rethinking Consciousness Through Quantum Perspectives: A Challenge to Individualism and Objectivity — •Konstantinos Voukydis — Department of History and Philosophy of Science, National and Kapodistrian University of Athens, Athens, Greece

In the Philosophy of Consciousness, a central issue revolves around how mental states represent objects of the world, particularly concerning whether mental content is individuated by factors that are external or internal to the subject.

From a conceptual and meta-theoretical standpoint, the physical-logical framework introduced by quantum mechanics disrupts the ontological and semantic interpretative schemes of classical logic, redifining the traditional notions of individuality, separability, contextuality, and reality. By foregrounding the observer's role and the inherent interconnectedness of elements in quantum systems, the quantum paradigm provides a novel lens for re-evaluating relationships between wholes and parts, objectivity and subjectivity, and the very nature of phenomenal consciousness.

This interdisciplinary approach seeks to bridge two foundational problems in its epistemic extent: the quantum measurement problem in physics and the hard problem of consciousness in philosophy. By doing so, we propose a framework for understanding phenomenal consciousness not as an autonomous, objective property but as emerging from a dynamic network of interactions involving the internal subjectiveness and the external objectiveness.

AGPhil 12.4 Fri 15:30 HS XVII

Dialektische Aufhebung des Widerspruchs zwischen klassischer Physik und Quantenmechanik — •Roland Schmidt — Schwalbenweg 21, 34225 Baunatal

In der Newtonschen Theorie ist Wirklichkeit der determinierte Ablauf eines universellen Geschehens. In der relativistischen Nachbesserung geht der universelle Charakter des Wirklichen verloren. Demnach lassen sich ausschließlich subjektiv erlebte Wirklichkeiten gegeneinander abgleichen. Wenig überraschend wird diese Subjektivierung durch die klassische Elektrodynamik erzwungen, der bei der metaphysischen Betrachtung subjektiver Wahrnehmung eine ganz entscheidende Rolle zukommt. Das letztgültige Vordringen elektromagnetischer Potenzialität in die zerebralen Zusammenhänge eines Subjekts erfordert aber auch Ansätze quantenphysikalischer Art. Die Aufspaltung der physikalischen Theorie in einen klassischen und quantenmechanischen Zweig kann durch eine weitere Subjektivierung der elektromagnetischen Theorie behoben werden. Dabei ist die Unterscheidung zwischen zerebral anhängigem und zerebral entkoppeltem Elektromagnetismus von entscheidender Bedeutung. Es wird sich herausstellen, dass klassische Kategorien wie Raum, Gegenwart und das Dasein gegenständlicher Bedeutsamkeiten von einem grundlegenden Symmetriebruch herrühren, der sich aus der zerebralen Existenz erlebender Subjekte ergibt. Empirischer Ausdruck ist beispielsweise die kosmologische Rotverschiebung, die nunmehr aus dem Umstand folgt, dass die elektromagnetische Trägheit grundlegender Teilchen gegen den kosmologischen Ereignishorizont hin allmählich verschwindet.