

Metaphysical Perspectives on Contemporary Physics

When: Thursday October 17 from 14:00–19:00 and
Friday October 18 from 10:00–15:30

Where: Room B112.D, Library Building

Conference Program

Thursday October 17

14:00–15:00	Hans C. Öttinger – Stochastic bra-ket interpretation of quantum mechanics based on quantum field theory
15:00–16:00	Kian Salimkhani – Talk to be determined
16:00–16:30	Coffee Break
16:30–17:30	Valia Allori – Against the Measurement Problem: On the Incompatibility between Scientific Realism and Quantum Mechanics
17:30–18:30	Quentin Ruyant – Perspectivism, Concrete and Abstract

Friday October 18

10:00–11:00	Matteo Morganti – Non-Standard Cosmology and Metaphysical Infnitism. A Case Study in Naturalistic Metaphysics
11:00–12:00	Jennan Ismael – Determinism and Incompleteness
12:00–13:30	Lunch & Coffee Break
13:30–14:30	Tomasz Bigaji – Symmetries and qualitative indistinguishability
14:30–15:30	Raoni Arroyo – OSR shouldn't use partial structures anymore

Book of Abstracts

Hans C. Öttinger (ETH Zürich) – *Stochastic bra-ket interpretation of quantum mechanics based on quantum field theory*

Abstract: The stochastic nature of quantum mechanics is more naturally reflected in a bilinear two-process representation of density matrices rather than in squared wave functions. This proposition comes with a remarkable change of the entanglement mechanism: entanglement effects do not originate from superpositions of wave functions, but they result from the bilinear structure of density matrices. Quantum interference appears as a multiplicative phenomenon rather than an additive superposition mechanism. We propose two general requirements such that the bilinear representation of density matrices is given in terms of two uniquely defined, identically distributed, Markovian stochastic jump processes. These general ideas are illustrated for the Einstein-Podolsky-Rosen and double-slit experiments. The expression of the stochastic nature of quantum mechanics in terms of random variables rather than their probability distributions facilitates an ontological viewpoint and leads us to a bra-ket interpretation of quantum mechanics. The Fock space of quantum field theory and the associated particle picture provide the metaphysical foundations of the proposed interpretation.

References: 1. H.C. Öttinger, Stochastic bra-ket interpretation of quantum mechanics, J. Phys. Commun. (2024) accepted for publication.

2. A. Oldofredi and H.C. Öttinger, The Dissipative Approach to Quantum Field Theory: Conceptual Foundations and Ontological Implications, Euro. Jnl. Phil. Sci. 11 (2021) 18, 1-36.

3. H.C. Öttinger, Philosophical Approach to Quantum Field Theory (Cambridge University Press, Cambridge, 2017).

Kian Salimkhani (University of Cologne) – *Talk to be determined*

Abstract: TBD

Valia Allori (University of Bergamo) – *Against the Measurement Problem: On the Incompatibility between Scientific Realism and Quantum Mechanics*

Abstract: The measurement problem is traditionally considered the problem to solve in order to restore the compatibility between quantum theory and scientific realism. In this paper instead I argue that it is not straightforward to spell out what the incompatibility problem actually is, and that different types of realists will think of it in different ways. First, I distinguish between a robust version of realism, which looks for a fundamental description of reality, and a relaxed version, which looks for a description of the regularities in the phenomena. I argue that while the relaxed realist will naturally think of the measurement problem as a problem of precision, the robust realist will think of it as a completeness problem. I also maintain that each kind of realism comes with a natural explanatory structure: while the robust realist will find satisfactory constructive theories, in which the phenomena are dynamically explained, the relaxed realist will be happy with principle theories, which provide constraints on them. In this regard, I show that the spontaneous localization theory, thought as a theory about the wavefunction (dubbed bare GRW), is a non-constructive dynamical hybrid. This creates two tensions for the wavefunction realist endorsing bare GRW. First, they seem relaxed realists in denial, as bare GRW's explanation is not constructive. This leaves them with relaxed

realism, which however is arguably too weak to be truly realism by their standards. In addition, there seems to be an explanatory mismatch between the non-constructive quantum explanation, and the constructive derivation of thermodynamics from the microscopic dynamics which appears to be problematic for a realist of any kind.

Quentin Ruyant (University of Lisbon) – *Perspectivism, Concrete and Abstract*

Abstract: In philosophy of physics, perspectivist and relational interpretations of Quantum Mechanics attempt to solve its conceptual problems by understanding quantum mechanical representations as being relative to an observer, reference or viewpoint. In general philosophy of science, various brands of scientific perspectivism have also been proposed in order to account for the situatedness of scientific representation. Both families of approach pretend to find a middle way between realism and relativism: they reject the idea of a cognitively accessible "view from nowhere", but without subscribing to strong incommensurability between various perspectives. On the surface of it, it could seem that they are congruent. However, they are actually quite different, and their articulation does not go without saying: whereas quantum perspectivism entertains a concrete understanding of perspectives associated with particular space-time locations and concrete individuals, scientific perspectivism entertains a more abstract or metaphorical notion associated with conceptual schemes, methodologies or epistemic standards. In order to analyse the similarities, differences and congruence between these two families of approach and their various versions, I first propose an analytic framework for concrete perspectivism based on the notion of indexicality (representations as functions of a context). On this basis, I distinguish three kinds of attitudes towards perspectives/indexicals: eliminativism, reductionism and non-reductionism. Then I examine how this framework can be extended to type-level (abstract) perspectivism. I argue that the same three kinds of attitudes towards abstract perspectives are clearly identifiable in the philosophical literature. Finally, I propose to identify abstract perspectives with families of potential concrete perspectives associated with cross-perspectival rules of translation between them. If we accept this conception, there are good reasons to think that a coherent non-reductionism towards abstract perspectives requires non-reductionism towards concrete ones, but not the other way around.

Matteo Morganti (University of Rome 3) – *Non-Standard Cosmology and Metaphysical Infnitism. A Case Study in Naturalistic Metaphysics*

Abstract: This talk aims to lend support to a particular understanding of naturalized metaphysics, according to which metaphysics and science (especially physics) should be developed in parallel and cooperate towards the formulation of the deepest and most encompassing possible explanations of the relevant parts of reality. This is done by exploring the connections between a) cosmological hypotheses that regard our present universe as just an episode/part in something much bigger (possibly infinite) and b) the form of metaphysical anti-foundationalism known as 'metaphysical infinitism'. In the first part, metaphysical infinitism is (briefly) illustrated and defended from possible objections. In the second part, non-standard cosmological models are presented, focusing in particular on their alleged explanatory advantages. It will be argued that metaphysical infinitism represents a useful general framework for correctly conceiving of the latter models of the universe and assessing their strengths and weaknesses. In turn, the existence (and scientific respectability) of these cosmological perspectives suggests that metaphysical infinitism is not just a philosophical fancy. More generally, a 'mod-

erate' form of naturalism about metaphysics should appear plausible, or at least worth further exploration.

Jennan Ismael (John Hopkins University) – *Determinism and Incompleteness*

Abstract: There is a presumption common in physics and philosophy that in a deterministic context we could in principle remove all contingent sources of ignorance about the world and predict everything that would ever happen. I will argue that that is not so. There are absolute limits on what a system could know about its own universe (which questions of physical fact it could correctly answer). The argument hinges on self-reference and shares a common structure with familiar incompleteness and incomputability results. I will analyze those limits in physical terms and look at how they interact with determinism.

Tomasz Bigaj (University of Warsaw) – *Symmetries and qualitative indistinguishability*

Abstract: The notion of symmetries of physical theories has been extensively scrutinized by philosophers. The straightforward definition of a symmetry as any transformation preserving the laws of a theory suffers from well-known shortcomings. It is standard to add some extra condition to this characterization in order to achieve a better fit with scientific practice. In my talk I will discuss whether this condition can be formulated in terms of qualitative indistinguishability. I will consider several pros and cons of this approach. While qualitative indistinguishability of symmetry-connected models seems to be guaranteed in the case of the permutation-invariance of quantum mechanics and diffeomorphism-invariance of general relativity, there are other cases, such as gauge symmetry of electromagnetism or Galilean boosts in Newtonian mechanics that apparently involve qualitatively distinguishable models. Another problem relates to the issue of identification of symmetry-related (qualitatively indistinguishable) solutions. There are some cases considered in the literature in which such identifications clash with our pretheoretic intuitions regarding indeterminism. Relatedly, I will also argue that the standard concept of symmetry applied to relational structures is in some way dependent on non-qualitative, haecceitistic distinctions (regarding which element of the structure is which). To deal with this problem, qualitativists/anti-haecceitists may be advised to modify and expand the original concept of a symmetry of a relational structure by adding some underlying qualitative characteristics of its elements in terms of an additional “essential” structure.

Raoni Arroyo (Universidade Estadual de Campinas) – *OSR shouldn't use partial structures anymore*

Abstract: Ontic structural realism (OSR) has been employing the tools of partial structures to make sense of the stance, primarily when responding to underdetermination in the quantum-mechanical case. As we argue, however, the concept of quasi-truth involves an epistemological conception embedded in the formulation of partial structures. At issue here are inseparable theses that are not often acknowledged. Formulated in terms of quasi-truth, the OSR approach to underdetermination states that we can accept (but not believe) each of the quantum theories insofar as they are all quasi-true, i.e., empirically adequate. A significant shift away from belief and truth has been implemented. But the distinctions between belief and acceptance as well as between representation and empirical adequacy are characteristic of empiricism not of realism. This is why OSR

shouldn't use partial structures anymore.