

# Introduction

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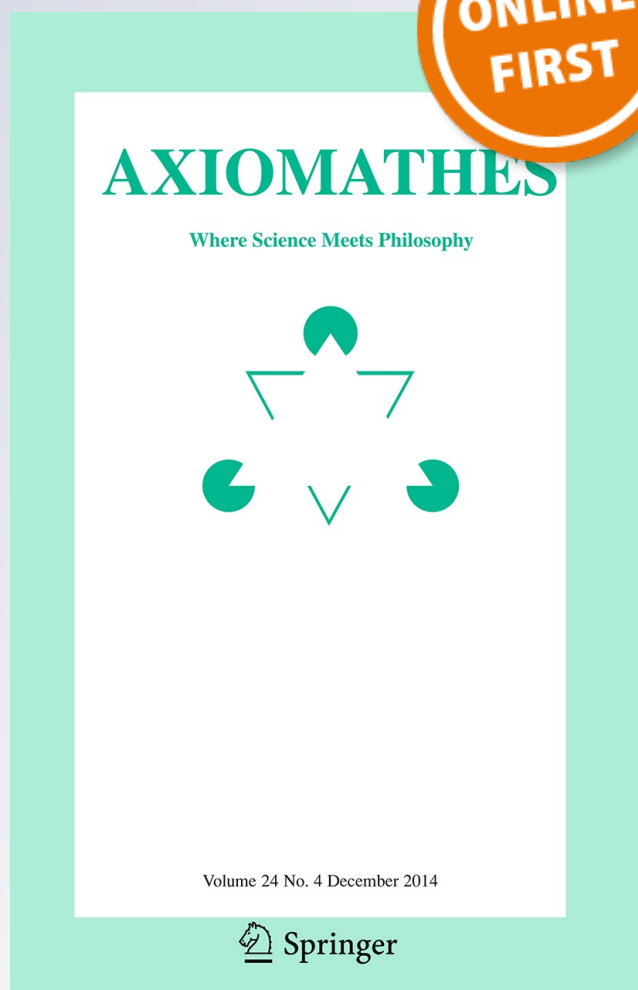
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## Introduction

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The papers of this *Axiomathes* special issue were presented at the “Lisbon International Conference: Philosophy of Science in the 21st Century—Challenges and Tasks”, which took place 4–6 December 2013.

The conference was organized by the Center for Philosophy of Science of Lisbon University (CFCUL), the only research center exclusively dedicated to Philosophy of Science in Portugal, with the propose of surveying the main challenges and tasks for Philosophy of Science in the 21st century.

The selection of papers now presented corresponds to one of the topics pointed out by the Lisbon Conference due to its high relevance in the current philosophy of science: metaphysical problems of science.

We know that metaphysics was a philosophical discipline much before it was a concern for philosophy of science. We also know that metaphysics has a long tradition in Philosophy even before Philosophy of Science became a specific area of research. However, we know that independently of some more speculative trends, metaphysics has become more attentive to scientific developments and more and more scientifically grounded.

On the other hand, we know that since its birth, with A. Comte and afterwards with Carnap or Reichenbach, metaphysics was completely rejected by philosophy of science. Still, we also know that this rejection was never fully accomplished, neither by neo-positivists themselves nor by the great majority of subsequent philosophers of science (from Popper, Kuhn or Lakatos, to Putnam, Kripke, Chalmers, Sellars, Hacking, Ross, or Dupré), in such a way that we are obliged to recognize that metaphysics of science has always been an important branch of philosophy of science.

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But, if this is true, why should today philosophy of science concentrate bigger efforts in the metaphysical problems of science? Why is it necessary to claim for a renewed interest in metaphysics of science?

Let me just provide two examples: (1) contemporary science constantly proposes new entities: quarks, baryons, quasars, black holes. Are they mere conceptual tools necessary for the formulation of theories or true metaphysical entities? And, if this is the case, what kind of ontological commitments do they claim for? (2) Nowadays scientific theories allow successful predictions and much valuable effects. But if we want those theories to explain and to produce a better understanding of what is to be understood, then we must recognize that many crucial metaphysical questions arise. We need to know not only if our theories are true but also what they mean, what they say about the world. The case of Quantum Mechanics is a fantastic illustration. Never a theory had so important outcomes and never a theory raised so big metaphysical questions.

In other words, we witness today a meaningful situation in which many metaphysicians deeply engaged with actual science and an increasing number of philosophers of science dedicated to the metaphysical problems put forward by actual scientific developments.

Metaphysics of science is not a homogeneous body of doctrine or type of inquiry. Today, it may be taken as playing four fundamental roles: (1) a foundationalist role, trying to discover the metaphysics which is supposed to be deeply infused in science, and to uncover the fundamental assumptions underlying science; (2) a critical role, trying to identify the difficulties, to signalize the costs, to discuss the results, the solutions, and the consequences; (3) a cognitive role, trying to analyze the problems, to clarify the ambiguities, to elucidate the complexities put forward by current scientific developments; (4) a prospective role, trying to fulfill the gaps in the understanding of our theories (e.g. quantum theory, evolution) and to shed light into the delicate, tricky questions which the world described by science exhibits (e.g. space/time, causation, emergence).

The papers here presented can be inscribed in these several lines of research. Dingmar van Eck (Reconciling ontic and epistemic constraints on mechanistic explanation, epistemically) tries to provide “an answer to the question on how the ontic and epistemic constraints on mechanistic explanation are related”; Gil C. Santos (Upward and Downward Causation from a Relational–Horizontal Ontological Perspective), criticizes the traditional hierarchical–vertical way of conceiving downward and upward causation and proposes “an alternative *relational ontological view*, assuming a straightforward *horizontal* and *intra-level* way of representing those putative cases of cross-level causation”. In a similar line of research, João Cordovil (Contemporary Quantum Physics Metaphysical Challenge—looking for a Relational Ontology) points to the possibility of a relational metaphysics being able to deal with the ontological problems put forward by the traditional object’s metaphysics underlying Quantum Physics; Sergio Armando Gallegos (Measurement and Metaphysics in Van Fraassen’s Scientific Representation) defends the metaphysical nature of van Fraassen’s concept of measurement and his empiricist structuralism as a whole.

The papers of António Zilhão (Free Will and Rationality) and Maria Joana Rigato (Reductionism, Agency and Free Will) are both positioned inside the free will debate: Zilhão claiming for the unsatisfactory nature of different justifications of the libertarian argument and suggesting a possible way of interpreting the meaning of the libertarian free will intuition; Rigato stressing the effective causal, originator role of the agent thought out as “irreducible substance” and “irreducible identity”, that is, arguing that “agent-causalism doesn’t conflict with contemporary science”.

Finally, the three last papers deal with challenges put forward by recent developments of logics, philosophy of mathematics and computer science. Fernando R. Velázquez-Quesada (Reasoning Processes as Epistemic Dynamics) analyses deductive, default and abductive reasoning as different instances of epistemic dynamics, trying to see how they interact with each other, and proposing how they can be understood as different epistemic actions that modify an agent’s knowledge and/or beliefs in a different way. Nino Guallart (An overview of type theories) compares intuitionistic type theory, as elaborated by Martin-Löf, with Coquand’s construction calculus, revealing their respective logical implications, and showing the relationships between type theories and proof theory shown by Curry-Howard isomorphism. Finally, Reinhard Kahle (What Is a Proof?) proposes to address the famous question of what is a proof by discussing how the experiences from examinations of proofs, by computer based theorem, can help to sharpen that question, and by analyzing the new challenge given by the so-called ‘big proofs’.