

Fundamental laws of nature and their roles in metaphysics

When we learn various sciences (e.g., physics, chemistry, biology, psychology and sociology), they are usually presented to us as separate fields of study, each with its own subject matter. However, nowadays it is commonly believed that physics is in some way distinguished among the sciences as it deals with the building blocks of objects of other sciences and the laws governing them. This leads to the philosophical question: how exactly this relation between the sciences should be understood and to what extent the subject matters of other sciences are independent of the subject matter of physics?

In the presentation of those sciences, several metaphysical notions are commonly used (although not always mentioned by that name): laws of nature (e.g., Newton's second law of dynamics, Schrödinger equation), dispositions (e.g., solubility, poisonousness), causation (e.g., smoking is a cause of cancer, striking a match is a cause of fire), mechanisms (e.g., the mechanisms of chemical transmission at synapses), counterfactuals (i.e., statements of the form "if A happened, then B would happen"), natural kinds and natural properties (i.e., those kinds and properties that have not been invented by humans, but reflect the real divisions in nature), etc. This also leads to the philosophical question: are these metaphysical concepts independent of each other or are some of them closely related to others (or even reducible to them)?

The aim of my project is to develop a unified view on the relations between fundamental physics and non-fundamental sciences, as well as on relations between various metaphysical notions used to express scientific theories. A distinguishing feature of my research strategy is that it will address these two questions in relation to each other, and not separately. A specific hypothesis that I would like to consider is that the mentioned metaphysical concepts, as they are used in non-fundamental sciences, can be understood as all deriving from the fundamental laws of nature on the one hand, and from the contingent features of the actual world on the other hand, where the latter are captured by the concepts of kinds and normal conditions associated with them.

For example, consider the disposition of solubility. When one says that a given piece of salt is soluble, this could be understood as meaning that the fundamental laws of nature guarantee that this piece of salt, when immersed into water in normal conditions, will dissolve. My aim in this project is to make this analysis of dispositions more precise (using some tools of contemporary formal logic) and to apply it, *mutatis mutandis*, to other metaphysical concepts (such as non-fundamental laws of nature, causation and mechanisms). A part of this task will be the precisification of the concept of normal conditions. My novel idea here is that this concept should be always associated with a particular kind of objects and understood statistically (i.e., normal conditions for objects of kind K are those conditions that usually hold in the neighbourhood of objects of kind K). This approach will enable me to avoid the criticisms of the concept of normal conditions in the literature, according to which it is either trivial or redundant. Importantly, I want both to formulate an abstract philosophical account of the mentioned issues and to relate it to some of the actual examples from special sciences.

Another problem that I would like to address is how to distinguish among various kinds, into which all objects existing in the world can be divided, those kinds that can be said to be in some sense "natural". In this context, I want to explore the idea that those kinds and properties deserve the name "natural" which obey more "natural" laws, where the naturalness of laws is understood in terms of simplicity, informativeness and small number of exceptions. I will be particularly interested in non-fundamental natural kinds and natural properties, the analysis of which will be dependent on the previous analysis of non-fundamental laws.

If the fundamental laws play so many and so important roles in metaphysics as my working hypotheses suggests, then the question about their nature becomes even more pressing. I plan to address this question in my project as well. My proposal is to revive and refine the view that laws of nature are relations between universals (i.e., properties that can have multiple exemplifications). This is one of the canonical approaches to laws of nature in the philosophical literature, but currently it is rarely actively researched and it has never been seriously confronted with the known examples of the laws of physics. My supposition is that even though the existing versions of this view (by David Armstrong and Michales Tooley) are not able to adequately capture these examples, the core of this view is accurate and can be developed in a more promising way.

In terms of publications, the main expected result of this project is a monograph, which will summarise my proposal for how to think about the relation of the fundamental laws of nature to other scientifically relevant metaphysical concepts. Additionally, I plan to publish papers about the status of the fundamental laws of nature.

The broader significance of this project for society and culture comes from its potential to significantly contribute to the development of contemporary scientific worldview, which should be based not only on the particular results of various sciences, but also on a theoretically advanced analysis of the relations between them and on the knowledge about the basic metaphysical concepts underlying them.