

This project belongs to fields of philosophy of physics and scientifically oriented metaphysics. Its aim is to investigate ontological and methodological status of symmetries in physics.

Physical sciences describe the world by constructing formal models of physical phenomena. These models are significantly different for different types of phenomena. However, there are some elements, which are shared by many of them. Symmetries belong to such elements: many modern physical theories are based on symmetries of some type. They have in some sense privileged position with respect to other elements of these theories: they are often postulated prior to other elements and then these other elements (like equations of motion) are derived from them.

Now, the role of philosopher is twofold. On the one hand we may analyse in details the role of symmetries in construction of scientific theories – this should be done by philosopher of science or methodologist. On the other hand, if we are sympathetic to realistic understanding of science (namely, that from our best scientific theories we may conclude something about the real world), there arises the question about the status of real, physical counterparts of symmetries. This question belongs to metaphysics. My project is focused more on the second problem, but also touches the issue of methodological status of symmetries.

The main question of the project is: do symmetries form a special ontological level of physical reality? In particular, are they somehow superior to laws of nature? The first task will be to make such a thesis about ontological speciality more precise. I will analyse arguments for and against it, which may be found in the literature; e.g. Wigner (1967) and Lange (2007) are proponents of special role of symmetries, whereas (Froegatt and Nielsen 1991) try to derive symmetries of physical theories from some other assumptions.

The main part of the project will be devoted to developing my own conceptual construction and argumentation for the negative answer to the main question, that is, for the thesis that symmetries (in the sense of real counterparts of theoretical constructs) are special cases of other components of physical reality, which should be postulated anyway and in fact historically they are identified before symmetries.

The starting point for my analysis will be Caulton's (2015) distinction between analytic and synthetic symmetries. His framework has some far-reaching consequences, which has not been noticed by this author. Despite the formal similarity, analytic and synthetic symmetries turn out to be completely different types of theoretical constructs. Analytic symmetries encode the information about physically real quantities, whereas synthetic symmetries can be treated as special cases of laws of nature, if we understand laws as expressing relationships between physically real quantities. Therefore symmetries do not form one "natural kind" of theoretical entities, but belong to two other, more general kinds, which are different for analytic and synthetic symmetries.

If we agree with this result, then the natural question arises: If symmetries are not ontologically special, why they are so important methodologically? Providing an answer to this question will be the last part of my project. The hypothesis is that for some reasons it is easier for scientists to postulate adequate symmetries than other elements of a theory that is under construction.

The methods used in the project are these typical for analytic metaphysics and philosophy of science: conceptual analysis, study of relevant physical theories, and construction of ontological models with use of formal tools, like logic and set theory. As regards novelty of the project, so far there is no systematic study concerning ontological status of symmetries and possible metaphysical implications of their distinguished methodological role in physics. The hypothesis that symmetries do not form one "natural kind" of theoretical entities and that they are in fact special cases of two more general kinds (they specify either physical quantities or relations between them) is a very original one, without any precursors in the literature.