TOWARD A PLURALIST APPROACH TO MATHEMATICAL EXPLANATION OF PHYSICAL PHENOMENA
The existence of mathematical explanations in the empirical (i.e. the natural and social) sciences is now largely recognized in the literature. There is no consensus, however, on how these explanations work and whether they can be captured through a model. Although much research has been devoted to the general topic of scientific explanation in the last five decades, the concrete topic of mathematical explanations in the empirical sciences has received specific attention only very recently. Nevertheless, this is a central topic in the philosophy of science, and the study of a notion of mathematical explanation now figures prominently on the agenda of philosophers of science and mathematics. Much of this interest stems from the key role that the notion plays in the ontological debate between realists and anti-realists, notably in the new indispensability arguments, and in the debates that concern the applicability of mathematics, mathematical modeling and idealization.

The object of this work, composed by three parts, is to analyse the nature and function of mathematical explanation of physical phenomena. The first two parts offer a detailed critical review of the main proposals in the literature, divided into monistic (or winner-take-all) and pluralist approaches. Part I is devoted to the presentation and evaluation of the three main contenders for a monistic account of mathematical explanations of physical phenomena: Steiner’s, van Fraassen’s and Kitcher’s. In Part II the main pluralist proposals, namely those put forward by Christopher Pincock and Robert Batterman, are analysed. In the last part, Part III, I present and defend my original (pluralist and pragmatic) proposal. I characterize mathematical explanations of physical phenomena in terms of two particular devices, intellectual tools and conceptual resources, which I maintain play a primary role in explanatory practices. By evaluating my account on various test cases offered in the literature, I show how such a proposal is extremely plausible and, furthermore, it provides new insights into the study of mathematical explanation.

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