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Title: **Constructive Axiomatic Method for Physics: a formal description of LIGO experiment.**

Abstract:

Drawing on the "semantic view of theories" initiated by P. Suppes in 1960 [1], I defend a stronger version of the "non-statement" view, according to which scientific theories are not simply classes of models but symbolic tools that allow one to construct such models from their primitive elements using relevant data collected in the empirical contexts where those theories are applied. In this way, theoretical methods of model-building become significant constituents of scientific theories. Since the same methods also serve as methods of justification of theoretical claims and, in particular, as model-theoretic prototypes of experimental and observational methods in physics, I argue that the proposed constructive method better accords with existing scientific practice than the standard Hilbert-style axiomatic method [2].

A mathematical foundation for the proposed constructive axiomatic method is Homotopy Type Theory (HoTT), a Gentzen-style typed formal calculus (namely, Martin-Löf Type Theory, or MLTT) interpreted in homotopy theory and applied in proof-verification software (including Rocq and Agda). A characteristic feature of HoTT is its distinction between homotopy types of different levels, which allows one to formally distinguish propositional types from higher, non-propositional types, where the terms of non-propositional types serve as truth-makers of corresponding propositions [3], [4].

In this talk, I will show how this formal technique can be used to represent the design of the LIGO 2015 experiment and other similar experiments [5, Section 4.3].

References:

[1] Suppes, P. (1960), A Comparison of the Meaning and Uses of Models in Mathematics and the Empirical Sciences, *Synthese* **12**, p. 287-301.
[2] Rodin, A. (2018), On Constructive Axiomatic Method, *Logique et Analyse* **242**, p. 201-231.
[3] The Univalent Foundations Program (2013), *Homotopy Type Theory: Univalent Foundations of Mathematics*, Institute for Advanced Study, Princeton, USA.
[4] Rodin, A. (2019), Models of HoTT and the Constructive View of Theories, in: Stefania Centrone, Deborah Kant and Deniz Sarikaya (eds.) *Reflections on the Foundations of Mathematics: Univalent Foundations, Set Theory and General Thoughts*, Springer, Synthese Library vol.407., pp. 191-219.
[5] Rodin, A. (2020), Axiomatic Architecture of Scientific Theories, *Habilitation thesis*.