

Naturalness and Supersymmetry: a Historical-Philosophical Perspective

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No evidence of “new physics” in general and supersymmetry in particular was found so far by LHC experiments, and this situation has led some voices in the physics community to call for the abandonment of the “naturalness” criterion, while other scientists have felt the need to break a lance in its defense by claiming that, at least in some sense, it has already led to successes and therefore should not be dismissed too quickly, but rather only reflected or reshaped to fit new needs. In our paper we will argue that present pro-or-contra naturalness debates miss the fundamental point that naturalness, despite contrary claims, is essentially a very hazily defined, in a sense even mythical notion which, in the course of more than four decades, has been steadily, and often not coherently, shaped by its interplay with different branches of model-building in high-energy physics and cosmology on the one side, and new incoming experimental results on the other. A particularly important factor in this constellation, albeit by far not the only one, was the rise of supersymmetry from the 1980s onward. In our paper we will endeavor to clear up some of the physical and philosophical haze by taking a closer look back at the encounter and interplay between naturalness and supersymmetry, starting from the 1970s, when the search for “natural” particle models and “natural” solutions to the hierarchy problem of Grand Unified Theories began, to the rise to prominence of the “unnatural” Higgs mass divergences, up to and beyond the time when a facet of naturalness was co-opted as a criterion for supersymmetric model-building. In doing this, we aim to bring to light how naturalness belongs to a long tradition of present and past physical and philosophical criteria for effectively guiding theoretical reflection and experimental practice in fundamental research.

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