

Popular abstract of the research proposal

All the elementary particles predicted by the Standard Model (SM) of electro-weak interactions have been already observed in collider experiments, with the latest discovery being the one of the Higgs boson in 2012 at the Large Hadron Collider. Searches for real production of beyond the SM particles in such experiments have given null results so far. However, substantial deviations from SM predictions are seen in B-meson decays and other observables at particle colliders. Moreover, various independent astrophysical observations confirm an existence of dark matter (DM), which is a non-luminous form of matter distributed in the Universe. The SM does not offer any realistic candidate for the DM, therefore it is natural to expect that a stable particle should be added to the SM. Last but not least, the SM has difficulties explaining why the Universe is made mostly of matter with a negligible contribution of anti-matter. All these arguments show that extensions of the SM are mandatory. This simple statement is a cornerstone of our proposal, which aims at investigation of more basic theories of fundamental interactions. We believe that a solution of the DM problem should also shed light on other aspects of beyond the SM physics.

We are going to propose and investigate new ideas concerning the DM and also to search for models that could explain the anomalies observed in B-meson decays. Simple models that have been proposed so far to resolve puzzles in B-meson decays usually did not address the question of DM existence. However, more complete setups should aim at resolving both problems simultaneously, in a possibly minimal construction.

The main goal of the present research proposal is to look for generalizations of the SM which could resolve the above-mentioned issues.

Both the dark matter and collider aspects of this project are very relevant and timely. There are many theoretical groups located in leading institutions investigating similar problems. Constructing a model that solves any of the problems mentioned above would be an important contribution to the contemporary high-energy physics.