# Exploring the light dark sector of the Universe

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Despite an enormous number of discoveries of new elementary particles that took place in recent several decades, which was culminated in 2012, when the Higgs boson was found at the Large Hadron Collider (LHC), we have also learned that the current state of our knowledge about the smallest constituents of matter is still incomplete. This is due to many groundbreaking observations in the fields of particle physics, astrophysics, and cosmology, i.a. growing evidence for the existence of dark matter in the Universe or the discovery of non-zero masses of neutrinos awarded with the Nobel Prize in physics in 2015.

In the last decade, there has been important theoretical progress in our understanding of possible forms of elementary interactions that could address these and other open problems in physics. This development became possible due to studying much overlooked in the past scenarios with new, i.e. yet undiscovered, light and long-lived particles (LLPs) with a mass of the order of the proton mass or smaller.

As a result, a large number of new experiments have been proposed to search for new such particles and even more such proposals are to be critically assessed in the future. In the process, it remains essential to first rigorously analyze the combined impact of the numerous relevant past experiments in a statistically sound way. In the current project, this will be done with the efficient tools and expertise that has already been well-tested in other fields of particle and more general physics.

A particular emphasis will be put on the future of a new direction in such searches at the LHC, which has recently been initiated with the approval of the ForwArd Search ExpeRiment, or FASER, with a significant role of the Principal Investigator of the proposed research project. A thorough investigation of these topics will play a major role in fully exploiting the discovery potential of the LHC. Besides, the possible highly complementary impact of light new physics species on astrophysical phenomena and cosmology will also be studied. These dynamically developing efforts are among the most promising directions that can deliver spectacular evidence for the existence of light new physics in the coming years.

The results of the project will supplement the decision-making process with regards to the future searches for light new physics, as well as it will investigate their possible future impact on elementary particle physics and cosmology.