UNIVERSITÄT BIELEFELD

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Phenomenological Aspects of Axion-Like Particles in Cosmology and Astrophysics

Cosmology and particle physics are closer today than ever before, with several searches underway at the interface between cosmology, particle physics, and eld theory. The mystery of dark matter (DM) is one of the greatest common unsolved problems between these elds. It is established now based on many astrophysical and cosmological observations that only a small fraction of the total matter content of the universe is made of baryonic matter, while the vast majority is constituted by dark matter. However, the nature of such a component is still unknown. One theoretically well-motivated approach to understanding the nature of dark matter would be through looking for light pseudo-scalar candidates for dark matter such as axions and axion-like particles (ALPs). Axions are hypothetical elementary particles resulting from the Peccei-Quinn (PQ) solution to the strong CP problem in quantum chromodynamics (QCD). Furthermore, many theoretically well-motivated extensions to the standard model of particle physics (SMPP) predicted the existence of more pseudo-scalar particles similar to the QCD axion and called ALPs. Axions and ALPs are characterized by their coupling with two photons. While the coupling parameter for axions is related to the axion mass, there is no direct relation between the coupling parameter and the mass of ALPs. Nevertheless, it is expected that ALPs share the same phenomenology of axions. In the past years, axions and ALPs regained popularity and slowly became one of the most appealing candidates that possibly contribute to the dark matter density of the universe. In my talk, I will show that the phenomenology of axions and ALPs interactions with photons can be used to constrain some of their properties and explain several astrophysical phenomena.

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