Dark matter: models and cosmic abundance

Institute: Laboratoire de Physique de Clermont Auvergne (LPCA)

Field: Theoretical high-energy physics, particle cosmology, particle physics phenomenology

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The existence of Dark Matter is corroborated by a large amount of observational evidence coming from different scales: galaxies, galaxy clusters and, eventually, the Cosmic Microwave Background (CMB). According to the latest CMB data from the Planck satellite, and assuming the standard ΛCDM cosmological model, dark matter constitutes roughly 83% of the matter content of our Universe. Understanding its nature is one of the most pressing questions in contemporary high-energy physics and cosmology.

One of the key elements in answering the question “What is dark matter?” concerns its cosmic origin: how it came to be in our Universe and why there is as much dark matter as we infer from the CMB observations. Many different dark matter models have been proposed during the past decades, which go hand-in-hand with specific dark matter “generation mechanisms”. That is, scenarios concerning the cosmic evolution which, assuming a “dark matter candidate” particle species, can explain the observed dark matter abundance in the Universe.

The goal of this internship is to study such mechanisms within a simple extension of the Standard Model of particle physics containing a particle that could play the role of a dark matter candidate. The intern will familiarize herself/himself with notions concerning physics beyond the Standard Model and the thermal history of the Universe as well as with some numerical tools which are commonly used in the field of particle physics phenomenology. Time permitting, some aspects of dark matter detection may also be discussed.