Contribution ID: **6** Type: **not specified**

Dark matter production in non-standard cosmologies

Friday 12 May 2023 09:00 (20 minutes)

The existence of DM in the universe has been one of the open and more relevant questions in physics and astronomy in the last decades. There is a large number of gravitational evidence about its existence, but no conclusive evidence about its nature as a particle. A worldwide program focused on discovering this particle has been carried out through the previous decades following three major strategies: direct detection, indirect detection, and production at colliders.

Despite the great effort, the DM particle nature remains one of the central mysteries in physics. The important thing is that no particle belongs to the Standard Model (SM) of particle physics with the required properties to explain the observed astrophysical phenomena related to DM.

Until relatively recently the DM models proposed hinged on a standard cosmology basis, however, due to the enormous difficulty present in detecting this particle, new models in different scenarios have been introduced.

According to standard cosmology, the universe in its evolution has gone through a series of stages characterized by definite processes and the domination of one of its components over the rest. As an example, in the standard scenario, the period between the end of inflation and the beginning of BBN is hypothesized to be radiation dominated. However, in this particular case, because of the lack of enough observational information regarding this time, there are no reasons to believe that this assumption is true, and is, therefore, possible that the cosmological history featured, for example, an additional early matter-dominated epoch due to slow post-inflationary reheating or massive metastable particles that dominated the total energy density.

Even more exotic scenarios that change the expansion history of the universe compared to the standard radiation-dominated case can also be realized. All of them are called non-standard cosmologies, and they can have important consequences for the physics of the early universe. One of particular relevance to this work is the fact that early periods in these scenarios can alter the cosmological abundances of particle species. Specifically, they can have a significant impact on our expectations for the DM relic abundance, since non-standard eras can change the expansion rate of the universe, lead to entropy injections that may dilute the DM relic abundance, or provide a non-thermal production mechanism for DM [1].

This research project aims to develop the phenomenology of a simplified WIMP DM model in a non-standard cosmology, with a long-lived heavy particle (ϕ) sourcing a matter-dominated era in the period ranging from the end of inflation and the onset of BBN, through the introduction of a generic time-dependent rate for the dissipation of matter into radiation [2]. The main goal of this study is to find the parameter space for a WIMP particle in the proposed frame able to account for 85% of DM in the universe and evade the constraints imposed by experiments.

References

[1] Rouzbeh Allahverdi et al. The First Three Seconds: a Review of Possible Expansion Histories of the Early Universe. 6 2020.

[2] Raymond T. Co, Eric Gonzalez, and Keisuke Harigaya. Increasing temperature toward the completion of reheating. Journal of Cosmology and Astroparticle Physics, 2020(11):038–038, nov 2020.

Authors: ZAPATA, Oscar; FRANCO VELASQUEZ, VALENTINA (Universidad de Antioquia)

Presenter: FRANCO VELASQUEZ, VALENTINA (Universidad de Antioquia)