

Dark matter (DM) is five times more abundant in the universe than normal matter (stars, atoms, us). Determining its nature is one of the most pressing problems in physics nowadays. In the last 30 years, the search for non-gravitational interactions of DM with normal -visible-matter has been increasingly active, yet no clear evidence has been found. This motivates the study of particle DM candidates whose interactions with the visible matter, even if still present, are very suppressed. Such candidates would be produced in the early universe out of thermal equilibrium with the visible matter. In spite of their tiny interactions, there is a recent activity in the community showing the potential probes of such candidates in present and future experimental facilities, concerning mainly Direct Detection searches and Collider searches, but also astrophysical searches related to gravitational lensing.

In this TFM and depending on the student's interest, she/he will learn about different DM production mechanisms in the early universe, and maybe go beyond and focusing on out-of-equilibrium candidates. She/he could learn which kind of models enjoy of a potentially rich phenomenology, and finally compute the signals of one of these models at the corresponding experimental facility.