ID de Contribution: **180** Type: **Non spécifié**

Investigating the electromagnetic moments of dark matter with direct detection experiments

mercredi 19 novembre 2025 14:00 (15 minutes)

Observationally, we only know that dark matter (DM) interacts gravitationally. Much experimental and observational effort is spent probing further DM-induced signals, particularly interactions between DM and the visible sector. One of these search efforts includes dedicated underground laboratories, trying to measure DM particles scattering off of targets. In this talk, I will discuss the possibility of spin-1/2 dark matter candidates interacting with the photon, whose strength is parameterized by four unique form factors. For small momentum transfers, these form factors can effectively be modeled by the electromagnetic moments (EM) of DM, so its direct detection phenomenology can be fully quantified via these EM moments. I will discuss the sensitivity of direct detection experiments such as XENON1T and PICO-60 on individual EM operators and their induced interference effects. These experimental findings are then translated into the parameter space of a t-channel toy model of spin-1/2 DM interacting with tau-leptons via scalar bosons. Direct detection experiments can probe a large region in the underlying parameter space, particularly if the toy model contains strong CP violation. Finally, I will discuss the implications for a thermal relic in this toy model.

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Classification de Session: Astrophysics & Multi-messenger