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Dark matter search opportunities with NaI scintillating crystals using SiPMs at cryogenic temperatures

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Although there exist multiple and strong evidences of the presence of dark matter in our universe, its nature is still unknown. Only one experiment, DAMA/LIBRA, has provided a hint on the detection of the galactic dark matter by observing an annual modulation in the detection rate. Although this signal is very difficult to reconcile with the negative results from other experiments, it is also impossible to provide a model-independent confirmation or refutation using different target nuclei. This is the goal of several experiments using NaI as target material, either in data taking phase, as ANAIS-112 at the Canfranc Underground Laboratory, or under R&D.

Among the latter, this talk will focus on the ANAIS+ project. The goal is moving forward in sensitivity with respect to ANAIS-112 by reducing the energy threshold significantly while improving the radiopurity of the crystals and the background rejection strategy. This increase in sensitivity of the technique will make ANAIS+ competitive in the searches for light mass WIMPs with spin-dependent interactions, but also for the study of neutrino-nucleus coherent scattering, for instance. In addition, it would enable testing the DAMA/LIBRA signal overcoming the uncertainties introduced by the poor knowledge of the scintillation quenching factors for sodium and iodine recoils.

The ANAIS+ experimental approach relies on the replacement of the PMTs by SiPMs and the operation at low temperature. This approach takes advantage of the high quantum efficiency of SiPMs, the highly suppressed dark noise and the increased light yield of pure NaI at low temperatures, which will enable a significantly reduced energy threshold. Furthermore, avoiding spurious light produced in the PMTs will help to increase the efficiency of the event selection procedures and the possibility of operation inside a LAr bath will enable vetoing dangerous background contributions in the region of interest. ANAIS+ is a collaborative effort between LNGS, CIEMAT and University of Zaragoza. The status of the ANAIS+ project, first tests ongoing and prospects will be presented in this talk.

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