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Grenoble Axion Haloscopes: From BabyGrAHal to GrAHal for axion dark matter search in the 1-150 micro-eV mass range

Particle physics is not only confined to the high energy frontier. There are unexplored territories at ultra-low energies, i.e. sub-eV, which are also promising for major discoveries. The emblematic particle for this physics is the axion, a pseudo-scalar particle predicted to solve the fundamental problem of the apparent non-violation of the CP symmetry by the strong interaction. This constitutes one of the remaining sand grains in the gear of the standard model of particle physics. Standard axion at the electroweak scale has been excluded after extensive searches, leaving fully open the case of almost invisible axion, i.e. with mass and coupling extremely weak. This particle could also be the main dark matter component of our universe and is one of the rare non-supersymmetric leading candidates. A collaboration between three main laboratories of CNRS, Université Grenoble-Alpes and CAPP in South Korea (now DMAG/IBS) is bringing together key expertises to build and operate several haloscopes for Axion searches with unprecedented sensitivity. Based on existing infrastructures at Grenoble like the 43T/9T modular hybrid magnet of LNCMI recently put in operation at 42 T as a first step, the technological know-hows of Institut Néel to develop novel quantum detectors and amplifiers together with ultralow temperature cryogenics (< 50 mK) and of CAPP for RF cavities, GrAHal will reach beyond state-of-the art sensitivities focusing first to uncharted regions in the 1-150 micro-eV axion mass range. A collaboration with CERN regarding RF cavity technologies is also currently being explored.

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