

SUSY 2024

Theory meets Experiment

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DIRECT SEARCHES FOR DARK MATTER: STATUS AND PROSPECTS. Down to the neutrino floor while solving the DAMA/LIBRA puzzle.

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The particles composing the dark matter are thought to be distributed in haloes around the galaxies and then, they can be detected on Earth-based very sensitive instruments if they couple to normal matter other than gravitationally. However, the many unknowns and uncertainties in the properties of the particles and their distribution in the galaxy affect these direct searches of the dark matter. Sensitivities have been steadily improving for about forty years, profiting from the development of new detection strategies, application of a variety of target nuclei, and improving the ultra-low-radioactive background techniques. I will make a personal selection of detection techniques and experimental results to review the status and prospects of these searches with the focus on WIMP (Weakly Interacting Massive Particles) dark matter candidates.

One of those detection techniques is particularly interesting because of the long-standing puzzling result of DAMA/LIBRA experiment, which has observed for more than twenty years an annual modulation in the detection rate of their NaI(Tl) detectors. The observed modulation shares all the features expected for the galactic dark matter signal. However, no other experiment has observed any hint supporting this interpretation of the DAMA/LIBRA result, and it seems very difficult to reconcile the plethora of negative results from different experiments (using different targets and techniques) with the DAMA/LIBRA signal. However, most sensitive experiments cannot be compared with DAMA/LIBRA result in a model-independent way because of the unknowns and uncertainties in the model parameters involved in such a comparison. Only recently, three-sigma sensitivity to DAMA/LIBRA result is at hand using the same target material, NaI, which allows to cancel all the signal dependences on the particle dark matter model and the dark halo model, and then, it enables a model independent testing. The status of the testing of the DAMA/LIBRA result at present, as well as a revision of the possible systematics involved and the sensitivity prospects for the near future will be presented with the focus on the ANAIS experiment, taking data at the Canfranc Underground Laboratory.

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