LABORATORI NAZIONALI DEL GRAN SASSO

SEMINAR ANNOUNCEMENT

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New Dark Matter Detectors using DNA for Nanometer Tracking

Weakly Interacting Massive Particles (WIMPs) may constitute most of the matter in the Universe. While there are intriguing results from DAMA/LIBRA, CoGeNT and CRESST-II, there is not yet a compelling detection of dark matter. The ability to detect the directionality of recoil nuclei will considerably facilitate detection of WIMPs by means of "annual modulation effect" and "diurnal modulation effect". Directional sensitivity requires either extremely large gas (TPC) detectors or detectors with a few nanometer spatial resolution. In this paper we propose a novel type of dark matter detector: detectors made of DNA could provide nanometer resolution for tracking, an energy threshold of 0.5 keV, and can operate at room temperature. When a WIMP from the Galactic Halo elastically scatters o of a nucleus in the detector, the recoiling nucleus then traverses thousands of strings of single stranded DNA (ssDNA) (all with known base sequences) and severs those ssDNA strands it hits. The location of the break can be identified by amplifying and identifying the segments of cut ssDNA using techniques well known to biologists. Thus the path of the recoiling nucleus can be tracked to nanometer accuracy. In one such detector concept, the transducers are a few nanometer-thick Au-foils of 1m┐ 1m, and the direction of recoiling nuclei is measured by "DNA Tracking Chamber" consisting of ordered array of ssDNA strands. Polymerase Chain Reaction (PCR) and ssDNA sequencing are used to read-out the detector. The detector consists of ↑about 1 kg of gold and 0.1 kg of DNA packed into (1m)^3. By leveraging advances in molecular biology, we aim to achieve about 1,000-fold better spatial resolution than in conventional WIMP detectors at reasonable cost.

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