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Exploring the Impact of Tl Dopant Concentration on the Measurement of Quenching Factor in NaI Crystals

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NaI-based experiments are becoming increasingly popular in the field of direct dark matter searches with the DAMA-LIBRA experiment being stand out for its reported observation which is in direct contrast with other results. Most of these experiments use Tl-doped NaI crystals as single-channel scintillation-only detectors. In these types of experiments, a precise measurement of the quenching factor (QF) is crucial for accurately calibrating the energies of hypothetical WIMP-induced nuclear recoil signals and conclusively validating the DAMA/LIBRA results. However, QF values for NaI(Tl) measured in various studies exhibit inconsistencies, and the impact of Tl dopant concentration on the QF of NaI has not been systematically studied yet.

To address these discrepancies, a systematic study was conducted by COSINUS (Cryogenic Observatory for Signatures seen in Next-generation Underground Searches) in collaboration with TUNL (Triangle Universities Nuclear Laboratory). Five ultra-pure NaI crystals, each with different Tl dopant concentrations, were irradiated using a mono-energetic neutron beam to extract the QF values as a function of energy. This study aims to shed light on the QF mystery in the field and provide a better understanding of the discrepancies reported by various experiments, particularly in the low-energy range of 1-30 keV_{nr}. The latest results of our investigation will be presented in this presentation.

Submitted on behalf of a Collaboration?

Yes

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