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Estimation of the internal radiation background of Sn-Bi bolometers for TIN.TIN

The India-based tin detector (TIN.TIN) proposes to explore neutrinoless double beta decay in the isotope ^{124}Sn by employing an array of cryogenic tin-based bolometers which will be operated at ˜10 mK. However, pure tin is susceptible to tin pest, an allotropic phase transition of tin near ambient conditions which results in the mechanical failure of the tin sample. This poses a concern for the longevity of the bolometer array. Sn-Bi alloys are resistant to tin pest and suitable for the fabrication of superconducting bolometers.

The present work reports the evaluation of the anticipated internal background from Sn-Bi bolometers. ^{209}Bi can decay by emitting an α particle of ˜3.1 MeV. However, the α decay is extremely rare, having a half-life of $2 \times 10^{19} y$ (comparable to the typical half-life of a $\beta\beta$ candidate). The background from surface α radiation of ^{209}Bi was estimated using GEANT4 simulations. The anticipated internal background from U/Th impurities was also simulated and compared to the background from ^{209}Bi α decay. The α decay from ^{214}Bi (product of the ^{238}U chain) was found to be the limiting background, while the radioactivity of ^{209}Bi had negligible effect on the background (˜$10^{-5} cts.keV^{-1}.kg^{-1}.y^{-1}$).

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Author: APARAJITA , Mazumdar (Tata Institute of Fundamental Research)

Co-authors: REBECCA PACHUAU (DNAP, Tata Institute of Fundamental Research); V. VATSA (INO, Tata Institute of Fundamental Research); A. REZA (DNAP, Tata Institute of Fundamental Research); V. NANAL (DNAP, Tata Institute of Fundamental Research); R. G. PILLAY (Department of Physics, IIT Ropar); A. SHRIVASTAVA (NPD, Bhabha Atomic Research Centre and Homi Bhabha National Institute); A. THAMIZHAVEL (DCMP&MS, Tata Institute of Fundamental Research)

Presenter: APARAJITA , Mazumdar (Tata Institute of Fundamental Research)

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