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Estimation of ^{32}Si and ^{32}P background rate in CDMS II experiment

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The Cryogenic Dark Matter Search experiment II (CDMS II) was a direct dark matter search experiment that operated between the years 2003 to 2012 at Soudan Underground Laboratory, Minnesota, USA [1]. The experiment deployed a total of 19 germanium (Ge) and 11 silicon (Si) cryogenic detectors each having a mass of $\sim$ 250 g and $\sim$ 100 g respectively, in a 5 tower configuration, at a temperature of $\sim$ 40 mK. The detection principle of this experiment involved measuring the recoil energy of the target mass (Ge or Si) after a dark matter particle elastically scatters off it. The detector measured charge and phonon signals from an interaction with the target. The spin-independent interaction cross-section of a dark matter particle with a nucleon is of the order of $\sim 10^{-41}$ cm^2 for the dark matter mass ≤ 10 GeV/c^2. The predicted dark matter event rate in a germanium target is ~ 0.05 /kg-day for the nuclear recoil energy in the order of a few keV [2]. So, the interaction of dark matter particles is very rare and occurs at a rate that is well below the background radiation rate. Hence the identification and rejection of the backgrounds in these experiments are crucial.
^{32}Si is an isotope of Si which is present in the Si detectors from the time of fabrication [3]. It emits β particles which act as a source of background in the CDMS II experiment. The endpoint energies of the β spectrum are 227 keV for ^{32}Si $\rightarrow$ ^{32}P and 1710 keV for ^{32}P $\rightarrow$ ^{32}S. The β particles create electron recoils in the detector. Our analysis goal is to estimate the decay rate of ^{32}Si and ^{32}P in the Si detectors using CDMS II data. We will present the recent results towards obtaining the ^{32}Si and ^{32}P. We will be using the likelihood method to calculate the ^{32}Si and ^{32}P decay rate. Our analysis is important for the SuperCDMS SNOLAB experiment, the successor of CDMS and other experiments that uses Si detectors [4] to look for rare events.

References:

[1] Gianfranco Bertone, Dan Hooper, and Joseph Silk. Physics Reports 405 (5) (2005) 279-390.

[2] J.D. Lewin and P.F. Smith. Astroparticle Physics 6 (1996) 87-112.

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[4] R. Agnese et al. Physical Review D 95 (8) (2017) 082002.

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