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Galactic abundances as a relic neutrino detection scheme

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(Submitted on 19 Jul 2011)

We propose to use the threshold-free process of neutrino capture on beta-decaying nuclei (NCB) using all available candidate nuclei in the Milky Way as target material in order to detect the presence of the Cosmic neutrino background. By integrating over the lifetime of the galaxy one might be able to see the effect of NCB processes as a slightly eschewed abundance ratio of selected beta-decaying nuclei. First, the candidates must be chosen so that both the mother and daughter nuclei have a lifetime comparable to that of the Milky Way or the signal could be easily washed out by additional decays. Secondly, relic neutrinos have so low energy that their de Broglie wavelengths are macroscopic and they may therefore scatter coherently on the electronic cloud of the candidate atoms. One must therefore compare the cross sections for the two processes (induced beta-decay by neutrino capture, and coherent scattering of the neutrinos on atomic nuclei) before drawing any conclusions. Finally, the density of target nuclei in the galaxy must be calculated. We assume supernovae as the only production source and approximate the neutrino density as a homogenous background. Here we perform the full calculation for 187-Re and 138-La and find that one needs abundance measurements with 24 digit precision in order to detect the effect of relic neutrinos. Or alternatively an enhancement of of the relic neutrino density by a factor of 10^{15} to produce an effect within the current abundance measurement precision.

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