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Searching for solar neutrino absorption with the DEAP-3600 experiment

We propose to detect solar neutrinos using the reaction $\nu_e + {}^{40}\mathrm{Ar} \rightarrow {}^{40}\mathrm{K}^* + e^-$ in the DEAP-3600 dark matter direct detection experiment at SNOLAB. This process has not been observed before. The 3.3 tonne active mass, high light yield, and ultra-low backgrounds in DEAP-3600 make it a promising tool for observing such rare processes.

Neutrinos with energies above 3.9 MeV can efficiently induce the superallowed Fermi transition from ^{40}Ar to an excited state of ^{40}K which would de-excite via the emission of characteristic gamma-rays. Moreover, about half of the Fermi transitions pass through a metastable state with a 480 ns lifetime and allowed Gamow-Teller transitions additionally increase the cross section. The total signal (from electrons and gammas) is 1.5 MeV less than the neutrino's energy.

The main source of background for energies up to 10 MeV is high-energy gammas from neutron capture events initiated by the nuclear decay of radioactive isotopes in the PMT glass. Above 10 MeV the background is low with the most significant contributions from cosmogenic events and the highest energy neutron capture gammas.

This on-going study explores the sensitivity of DEAP-3600 to solar neutrinos, aiming for the first observation of ^{8}B solar neutrino charged-current interactions on ^{40}Ar.

Submitted on behalf of a Collaboration?

Yes

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