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Searches for high energy solar axions and heavy sterile neutrinos with the Borexino detector

A search for 5.5 MeV solar axions produced in the p(d,3He)A (5.5 MeV) reaction was performed using the Borexino detector. The Compton conversion of axions to photons, the axioelectric effect, the decay of axions into two photons and inverse Primakoff conversion on nuclei are considered. Model-independent limits on axion-electron (gAe), axion-photon (gAg), and isovector axion-nucleon (g3AN) couplings are obtained: |g_{Ae} x g^3_{AN}| < 5.5x10^{-13} and |g_{Ag} x g^3_{AN}| < 4.6x10^{-11} GeV^{-1} at m_A < 1 MeV (90% C.L.). These limits are 2–4 orders of magnitude stronger than those obtained in previous laboratory-based experiments.

If heavy neutrinos with mass m_H > 2me are produced in the Sun via the 8B beta-decay in a side branch of pp-chain, they would undergo the observable decay into an electron, a positron and a light neutrino. The Borexino data are used to set a bound on the existence of such decays. We constrain the mixing of a heavy neutrino with mass (1.5 - 14) MeV to be |U_{eH}|^2 < (10^{-3}-4x10^{-6}), respectively. These are tighter limits on the mixing parameters |U_{eH}| than obtained in previous experiments at nuclear reactors and accelerators.

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