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Experiment GEMMA: Search for the Neutrino Magnetic Moment

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The laboratory neutrino magnetic moment (NMM) measurement is based on its contribution to the neutrino scattering on free electron (FE) or on an atom [1] via its ionization (AI). In both cases the observable is the recoil electron energy, the sensitivity increases with lowering the detection threshold.
In our experiment GEMMA[2] we use HPGe detector of 1.5 kg placed under the standard 3 GWth reactor of the Kalinin Nuclear Power Plant (KNPP, Russia) at 13.9 m distance from the core center which provides the antineutrino flux of 2.7x10ˆ13 1/cmˆ2/s. The data analysis is based on the comparison of energy spectra measured in the range from 3 to 55 keV in the reactor operation (ON) and shutdown (OFF) periods.
As a result of the measurement (about 13000 ON hours and 3000 OFF hours of active time) the best world-wide upper limits of 5.0x10ˆ−12μB and 3.2x10ˆ−11μB at 90% C.L. were found for the NMM with and without using the AI mechanism respectively.
At present, analysis of the data taken under improved conditions has just been started but it indicates that further sensitivity improvement of the spectrometer can be reached only by its significant upgrading. Within the framework of the new project (GEMMA-II) we will use the antineutrino flux of ˜ 5.4x10ˆ13 1/cmˆ2/s, increase the mass of the germanium detector by a factor of four and decrease the level of the background. The main improvement is expected to be the significant lowering of the energy threshold (below 1 keV). These measures will provide the possibility of achieving the NMM limit at the level of 1.0x10ˆ−12μB.

[1] H.T. Wong, H.-B. Li, S.-T. Lin, (2010) hep-ph/1001.2074.
[2] A.G. Beda et al. Yad. Fiz. (Rus.) 70 (2007) 1925, [Phys. At. Nucl. 70 (2007) 1873]; hep-ex/0705.4576.

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