

Effects of neutrino electromagnetic properties and spin state in elastic neutrino-nucleon scattering

Wednesday 3 July 2024 16:45 (15 minutes)

Electromagnetic neutrino properties can be a manifestation of new physics [1]. We study electromagnetic contribution to elastic neutrino-nucleon scattering processes. Following our approach developed for the case of elastic neutrino-electron [2] and neutrino-proton [3-6] collisions, in our formalism we account for possible electromagnetic form factors of massive neutrinos: the charge, magnetic, electric, and anapole form factors of both diagonal and transition types. Considering Dirac neutrinos from an astrophysical source arriving at a detector on Earth, we assume them to have arbitrary spin polarization due to effects of neutrino spin oscillations induced by neutrino magnetic moment interactions with magnetic fields both in the astrophysical source and in the interstellar environment. When treating the nucleon electromagnetic vertex, we take into account not only charge and magnetic form factors of a nucleon, but also its electric and anapole form factors. We numerically examine how the effects of electromagnetic properties and spin polarization of the cosmic neutrinos can influence the differential cross sections of their elastic scattering on nucleons in the detector.

[1] C. Giunti and A. Studenikin, Neutrino electromagnetic interactions: A window to new physics, *Rev. Mod. Phys.* 87, 531 (2015), arXiv:1403.6344.

[2] K. Kouzakov and A. Studenikin, Electromagnetic properties of massive neutrinos in low-energy elastic neutrino-electron scattering, *Phys. Rev. D* 96, 099904 (2017), arXiv:1703.00401.

[3] K. Kouzakov, F. Lazarev, and A. Studenikin, Electromagnetic neutrino interactions in elastic neutrino-proton scattering, *PoS(ICHEP2020)* 205 (2020).

[4] K. Kouzakov, F. Lazarev, and A. Studenikin, Electromagnetic effects in elastic neutrino scattering on nucleons, *J. Phys.: Conf. Ser.* 2156, 012225 (2021).

[5] K. Kouzakov, F. Lazarev, and A. Studenikin, Neutrino electromagnetic properties in elastic neutrino-proton scattering, *Phys. Atom. Nucl.* 86, 257 (2023)

[6] K. Kouzakov, F. Lazarev, and A. Studenikin, Elastic neutrino-nucleon scattering and electromagnetic properties of neutrinos, *Moscow Univ. Phys. Bull.* 78, 797 (2023)

Section

Neutrino physics and nuclear astrophysics

Primary author: LAZAREV, Fedor (MSU)

Co-authors: STUDENIKIN, Alexander (Department of Theoretical Physics, Moscow State University); Prof. KOUZAKOV, Konstantin (Lomonosov Moscow State University)

Presenter: LAZAREV, Fedor (MSU)

Session Classification: Neutrino physics and nuclear astrophysics