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Electromagnetic neutrinos: The basic interaction processes and constraints from laboratory experiments and astrophysics.

Thursday, 4 July 2024 11:30 (30 minutes)

We start with an introduction to the theory of neutrino electromagnetic properties [1]. Then we consider experimental constraints on neutrino magnetic μν and electric dν moments, millicharge qν, charge radii <rν2> and anapole aν moments from the terrestrial experiments (the bounds from MUNU, TEXONO, GEMMA, Super-Kamiokande, Borexino, COHERENT, XENON1T, CONUS and the most recent bounds from XENONnT [2] and LUX-ZEPELIN [3]).
Then we focus on the main manifestation of neutrino electromagnetic interactions, such as: 1) the radiative decay in vacuum, in matter and in a magnetic field, 2) the neutrino Cherenkov radiation, 3) the plasmon decay to neutrino-antineutrino pair, 4) the neutrino spin light in matter, and 5) the neutrino spin and spin-flavour precession are discussed. Phenomenological consequences of neutrino electromagnetic interactions (including the spin light of neutrino) in astrophysical environments are also reviewed. The best bounds from laboratory experiments and astrophysical observations on neutrino electromagnetic properties are confronted with the predictions of theories beyond the Standard Model.
[1] C.Guinti, A.Studenikin, Neutrino electromagnetic interactions: A window to new physics, Rev.Mod.Phys.87(2015)531.
[2] A.Khan, Light new physics and neutrino electromagnetic interactions in XENONnT, Phys.Lett.B837(2023)137650.
[3] M.Atzori Corona et al., New constraint on neutrino magnetic moment from LZ dark matter search results,Phys.Rev.D107(2023)053001.
[4] [4] S.Jana and Y.Porto, Resonances of supernova neutrinos in twisting magnetic fields, Phys. Rev. Lett. 132 (2024) 101005.

Section

Neutrino physics and nuclear astrophysics

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