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Neutrino electromagnetic properties: a window to new physics

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A review of the theory and phenomenology of neutrino electromagnetic properties is presented. A short discussion on derivation of the general structure of the electromagnetic interactions of Dirac and Majorana neutrinos is presented. Then we review experimental constraints on neutrino magnetic and electric dipole moments, electric millicharge, charge radius and anapole moments from the terrestrial laboratory experiments. A special credit is done to bounds on neutrino magnetic moments obtained by the reactor (MUNU, TEXONO and GEMMA) and solar (Super-Kamiokande and Borexino) experiments.
The effects of neutrino electromagnetic interactions in astrophysical environments are also reviewed. The main manifestation of neutrino electromagnetic interactions, such as: 1) the radiative decay in vacuum, in matter and in a magnetic field, 2) the Cherenkov radiation, 3) the plasmon decay, 4) spin light in matter, 5) spin and spin-flavour precession, 6) neutrino pair production in a strong magnetic field, and the related processes along with their astrophysical phenomenology are also considered.

The best world experimental bounds on neutrino electromagnetic properties are confronted with the predictions of theories beyond the Standard Model. It is shown that studies of neutrino electromagnetic properties provide a powerful tool to probe physics beyond the Standard Model.

References

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Experimental Collaboration

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