Searching for Muon to Electron Conversion Below the 10^{-16} Level

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The Muon-to-Electron COnversion, or MECO experiment [1] at Brookhaven National Laboratory seeks to detect coherent, neutrinoless conversion of a muon into an electron in the field of a nucleus with a rate sensitivity four orders of magnitude lower than existing limits. I will review the current limits of charged lepton flavor violation search experiments, which presently range from 10^{-11} to slightly below 10^{-12} [2]. Recent observations of neutrino oscillation at Super-Kamiokande [3] imply that neutrinos both have mass and mix, but neutrino mixing alone yields an inaccessibly low rate of $\mu^- N \to \mathrm{e}^- N$, hence observation of a signal requires fundamentally new physics. I will highlight a few of the numerous extensions of the Standard Model that predict an observable signal at the 10^{-16} level. I will present a detailed description of the MECO experiment, which utilizes several new techniques to reach this level. These include the use of a high Z target and an axially graded solenoidal field in the production region, transport in a combination of solenoids and toroidal sections to filter the muon beam, and situating the muon stopping target within a second axially graded field to increase the acceptance of conversion electrons. If $\Gamma(\mu^-\mathrm{N} \to \mathrm{e}^-\mathrm{N})/\Gamma(\mu^-\mathrm{N} \to \nu_\mu \mathrm{N}') = 10^{-16}$ MECO should observe 5 events with a background of 0.45 events. I will conclude with a summary of the present status of the experiment.

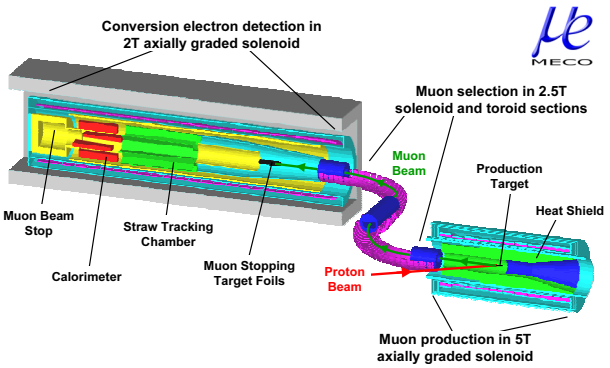

Figure 1: The MECO experiment.

References

[1] see http://meco.ps.uci.edu for more details.
[2] Y. Kuno and Y. Okada, Rev. Mod. Phys. **73** (2001) 151.
[3] Y. Fukuda *et al.*, Phys. Rev. Lett. **81** (1998) 1562.