NEUTRINO OSCILLOMETRY: NEW NEUTRINO OSCILLATION FEATURES WITH LOW ENERGY MONOENERGETIC NEUTRINOS

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Abstract

We will present novel features of neutrino oscillations, neutrino oscillometry, employing sources of monoenergetic very low energy neutrinos following electron capture by the nucleus[⋆]. Since the neutrino energy is very low the oscillation length associated with the larger δm^2 is appearing in an electronic neutrino disappearance experiment can be so small that the full oscillation can take place inside a small size detector enabling one to determine very accurately the relevant neutrino oscillation parameters. The proper energy of the source depends on δm^2. We will examine the following possibilities:

- $\delta m^2 \approx 2.4 \times 10^{-3}\text{eV}^2$ associated with the solar neutrino oscillation. In this case the oscillation probability is proportional to $\sin^2 2\theta_{13}$, one can perform neutrino electron scattering measurements to measure electron recoils to determine or set a better limit on the unknown parameter θ_{13}. This is quite important, since, if this mixing angle vanishes, there is not going to be CP violation in the leptonic sector. Employing a gaseous Spherical TPC (STPC) of radius of 1m one can find and employ sitable sources, like ^{157}Tb and ^{193}Pt E_ν= 10 and 45 KeV region. Another possibility is to employ the larger size LENA detector achieving higher rates by choosing, e.g., a ^{51}Kr with E_ν =747keV.

- Sterile neutrinos implied by the reactor antineutrino anomaly.
  In this case $\delta m^2 > 1.5\text{eV}^2$ with a mixing angle $\sin^2 2\theta_{14} = 0.14 \pm 0.08(95\%)$.
  This can be checked by neutrino oscillometry, which can be implemented by measuring electron recoils with a gaseous spherical TPC of modest dimensions and a very low energy threshold. The sensitivity to the mixing angle θ_{14} has in this case been estimated to be $\sin^2(2\theta_{14})$=0.05 (99%) for two months of data handling with ^{51}Cr. Alternatively the same goal can also be achieved by measuring nuclear recoils employing lighter gases. A sensitivity in the mixing angle θ_{14},

[⋆] Work performed in collaboration with Yu.N. Novikov and Y. Giomataris

$\sin^2(2\theta_{14})$=0.1 (99%), can be reached after a few months of data handling with the monochromatic sources ^{37}Ar, ^{51}Cr.
