APR06-2006-000178

Abstract for an Invited Paper
for the APR06 Meeting of
the American Physical Society

Next generation of neutrino-less double beta decay experiments and their reach

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Study of the neutrino-less double beta decay is a sensitive, and likely the only practical, tool of testing whether the total lepton number is conserved or not, and consequently whether neutrinos are Majorana fermions as many particle physics models suggest. Moreover, if the neutrino-less decay is ever observed, and if one can convincingly show that the virtual exchange of light Majorana neutrinos is responsible, a unique information on the absolute neutrino mass could be deduced from the experimentally determined decay rate. In the talk I will briefly review the present status of the existing experiments and describe the next generation of proposals with ∼100 kg sources that should reach sensitivity to ∼0.1 eV effective neutrino mass and explore the so-called 'degenerate' mass region as well as test the existing claim of observation of the decay. This neutrino mass range can and will be explored also by observational cosmology and/or tritium beta decay, probes that are independent on the charge conjugation properties of the neutrinos. I will also review the status of the determination of the corresponding nuclear matrix elements and their uncertainties which are an important part of the problem, needed for interpreting and planning of the experiments. In longer run, experiments with ∼ton size sources are envisioned that will extend the sensitivity to the effective masses to the range of 10-20 meV, and thus explore the 'inverted hierarchy' neutrino mass region. Several of the ∼100 kg proposed experiments could be enlarged to this size, provided that the projected background suppression can be achieved. Thus, within the next decade or so, there is a realistic chance that a substantial part of the allowed neutrino mass range will be explored.