Séminaire IJCLab

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Search for CP violation in nuclear beta decay: the MORA project

Why are we living in a world of matter? What is the reason for the strong matter – antimatter asymmetry we observe in the Universe?

In 1967, A. Sakharov expressed the 3 conditions which should be fulfilled for the baryogenesis process, giving rise to large matter – antimatter asymmetry observed in the universe. These conditions are: (i) a large C and CP violation; (ii) a violation of the baryonic number, (iii) a process out of thermal equilibrium. At high energy, CP violation has been observed in the decay of the K and B, and lately D^0 mesons. CP violation is incorporated in the Standard Model via the quark mixing mechanism, but at a level which cannot account for the large matter – antimatter asymmetry observed in the Universe. A much larger CP violation has yet to be discovered, out of reach from colliders, but for which low energy observables like the *D* and *R* correlations, appearing in the beta decay spectrum of polarized mirror nuclei, and Electric Dipole Moments, are sensitive probes. The *D* correlation offers the possibility to search for new CP-violating interactions in a region that is less accessible by EDM searches, in particular via the Leptoquark model. Leptoquarks are gauge bosons coupling leptons and quarks which appear in many extensions of the Standard Model. Their decay out of thermal equilibrium in the frame of Grand Unified Theories came rather evidently as the first hypothesis for the baryon and lepton number non conservation. As such, Leptoquarks still play a peculiar role among the many models now formulated for baryogenesis. The best limit for a non-zero *D* correlation presently comes from the neutron decay (Chupp et al.): $D_n \leq 2 \cdot 10^{-4}$. The "**M**atter's **O**rigin from **R**adio**A**ctivity" (**MORA**) project aims at measuring the *D* correlation to the 10^{-5} level, by making use of an innovative polarization technique, which combines the high efficiency of ion trapping with the one of laser orientation. The proof-of-principle of this technique is the main motivation for the first tests with $^{23}Mg^{+}$ ions at the University of Jyväskylä. As of 2024, the DESIR facility at GANIL will offer rich perspectives for MORA.

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