Search for BSM Physics with Beta Decay: The MORA (Matter's Origin from RadioActivity) Experiment*

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Nuclear beta decay offers a unique avenue to probe physics beyond the Standard Model (BSM) [1]. In particular, the measurement of the so-called D correlation in mixed Fermi and Gamow - Teller (GT) decays provides sensitivity to potential new interactions that could signal CP violation [2]. Strong CP violation is one of the three Sakharov conditions [3] required for baryogenesis - the process, which led to the dominance of matter over antimatter in the early Universe, yet remains inadequately accounted for in the Standard Model. The D correlation serves as a complementary probe to electric dipole moment (EDM) searches in exploring these symmetry-violating processes [4].
The MORA experiment aims to measure the D correlation with unprecedented precision using a transparent Paul trap to confine and polarize radioactive $^{23}Mg^{+}$ and $^{39}Ca^{+}$ ions [5]. A combination of plastic scintillators for beta detection and recoil-ion time-of-flight detectors, arranged around the trap, is used to reconstruct the decay kinematics. Initial measurements are being conducted at the IGISOL facility at the University of Jyväskylä, where a key milestone was recently reached with the successful demonstration of in-trap polarization. Progress in beam purification techniques is ongoing to enable the first D correlation measurement in the decay of $^{23}Mg^{+}$ ions [6]. In the next phase, MORA will move to the DESIR facility at GANIL, where ambitious precision goals will be pursued. To this end, a comprehensive simulation framework is being developed to characterize and control systematic effects, which will be essential for the most sensitive future measurements.

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