Contribution ID: **25** Type: **not specified**

The MORA Experiment: Measuring the Time-Reversal Odd D Correlation in Nuclear Beta Decay

Why are we living in a world made of matter? The "Matter's Origin from RadioActivity"(MORA) experiment [1] is looking for answers. CP violation is one of the three famous Sakharov conditions needed for explaining the matter –antimatter imbalance observed in the Universe [2]. The measurement of the CP violating D correlation in the beta decay of trapped and laser polarized 23Mg+ and 39Ca+ ions, as proposed in the framework of MORA, complements the search for Electric Dipole Moments to look for new interactions, that would explain this imbalance [3].

MORA employs an innovative polarization technique, combining the high efficiency of ion trapping with that of laser orientation. The experiment is currently taking data using 23Mg+ beams from the IGISOL facility, at the University of Jyväskylä, Finland, where the proof-of-principle for the laser polarization technique has recently been achieved [4]. This validation, along with recent advancements in beam purity, will enable MORA to measure the D correlation to a precision of 5·10-4 in the coming years - rivaling the best current limits from neutron decay [5].

The potential of 39Ca+ to further enhance these measurements is being explored through the ANR-funded ACCLAIM MORA project. By utilizing both isotopes at DESIR - delivered as high intensity beams (> 107 pps) from the GANIL/SPIRAL 1 facility and purified by the HRS - MORA aims to push sensitivities for D to ~10-5, venturing into uncharted territory. At this level, MORA will not only by probe CP-violating effects via the D correlation but also investigate CP –conserving new physics through Final State Interactions [6].

The MORA project is supported by ANR under contract number ANR-25-CE31-4222.

[1] P. Delahaye, E. Liénard, I. Moore et al., "The MORA project," Hyp. Int. 240(2019)63. *

[2] A. D. Sakharov, "Violation of CP invariance, C asymmetry, and baryon asymetry of the universe," JETP Letters, 5(1967)24.

[3] A. Falkowski and A. Rodriguez-Sanchez, "On the sensitivity of the D parameter to new physics", (2022)," Eur. Phys. J. C 82(2022)1134. *

[4] N. Goyal et al. , "Performance of the MORA apparatus for testing time-reversal invariance in nuclear beta decay", Eur. Phys. J. A 61(2025)221*[5] H. P. Mumm et al., "New Limit on Time-Reversal Violation in Beta Decay," PRL107(2011)102301.*

[6] E. Alviani and A. Falkowski, "On the Coulomb corrections in nuclear beta decay", arXiv:2412.17702 [hep-ph]

Articles marked with an asterik are articles from the MORA collaboration.

Author: DELAHAYE, Pierre (GANIL)