Contribution ID: **13** Type: **not specified**

The RAdium-Fluride Ion Catcher Instrument - A path towards offline eEDM experiments with RaF

Tuesday, 5 March 2024 16:15 (45 minutes)

Molecules have proven to be powerful laboratories to explore unknown aspects of the fundamental forces of nature and to search for physics beyond the standard model. By choosing molecules containing radioactive isotopes with different spins and nuclear deformation one can explore aspects of the strong and weak forces even further and reach unparalleled enhancement of symmetry-violating properties. Among many others, Radium-monofluoride (RaF) has been proposed as a potent candidate. However, the production of radioactive molecules in general has proven to be challenging and availability of molecular radioactive ion beams has been identified as a bottleneck for future research. Particularly as suitable radioactive partner species have to be produced at large scale online beam facilities, preventing decentralized experiments at universities or smaller laboratories.

In this contribution we will introduce the RAdium-Fluride Ion Catcher Instrument (RAFICI) which will allows the production of 224RaF ions by harvesting 224Ra ions from the nuclear decay of a 228Th sample within a gas filled stopping cell. The scheme was successfully tested at the FRS Ion Catcher at GSI and first offline production of 224RaF ions could be shown via gas phase reactions of the nuclear recoil daughters with SF6 inside an RFQ ion trap. Further, several other radioactive molecules, such as 216PoF and 212PbF, 212PoOH were produced and could be studied. The envisioned RAFICI device, currently under development at the University of Edinburgh, will offer experiments with radioactive molecules to be performed in low background / low noise environments away from large radioactive beam facilities.

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