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Radioactive Molecules - New Probes for New Physics

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Molecules in which one of its constituting atoms contain a short-lived, radioactive nuclide were recently introduced as intriguing objects of research. These radioactive molecules can be tailored to maximize the sensitivity to new physics beyond the Standard Model of particle physics. For example, when incorporating octuple-deformed ('pear-shaped') radionuclides into polar molecules, one obtains captivating probes for molecular electric dipole moments (EDMs) with unparalleled sensitivity to phenomena associated with time-reversal-symmetry breaking, especially inside the atomic nucleus. Uncovering novel sources of time-reversal violation has the potential to resolve one of the most tantalizing puzzle in modern physics, i.e. why there is more matter than antimatter in the universe.

Due to their short half-lives, spanning mere weeks, days, or even less, the radioisotopes of interest do not occur naturally but can be synthesized at radioactive ion beam (RIB) facilities such as at TRIUMF, Canada's particle accelerator centre. There, the recently formed RadMol collaboration is pursuing a program to fully exploit the science potential of radioactive molecules.

In this talk, RadMol's scientific vision will be presented along with its recent experimental advances. Among others, these include the formation of molecules or their sympathetic cooling via co-trapped and laser cooled ions, both achieved in cooler-bunchers commonly available at modern RIB facilities.

Keyword-1

precision experiments

Keyword-2

BSM searches & radionuclides

Keyword-3

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