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Precision studies of radioactive molecules for nuclear science

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Investigating the properties of atomic nuclei through measuring their influence upon bound electrons is a powerful and well-established approach in modern nuclear physics [Yan23]. By measuring the hyperfine structure and isotope shift in the atomic structure of radioactive nuclei, nuclear spins, magnetic dipole and electric quadrupole moments and changes in mean-square charge radii can be determined in a nuclear model-independent manner. These observables offer critical and complementary insights into the electroweak structure of the ground- and isomeric states of atomic nuclei, enabling state-of-the-art models of nuclear theory to be tested.

Advances in experimental techniques have allowed laser spectroscopy techniques to push further away from stability, studying isotopes towards the extremes of existence. The unprecedented combination of experimental precision and sensitivity available to researchers has also enabled the first study of molecules containing radioactive nuclei [Gar20, Udr21], despite their significantly more complex structures.

This contribution will present recent highlights from studying radioactive molecules of particular interest for fundamental symmetries studies at ISOLDE-CERN [Udr24]. A highlight of which includes the first observation of the distribution of nuclear magnetization in the structure of a molecule [Wil24]. An outlook will be given on the range of opportunities for nuclear structure studies available studying radioactive molecules at the Facility for Rare Isotope Beams.

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