PRECISION SPECTROSCOPY STUDIES OF RADIOACTIVE MOLECULES FOR FUNDAMENTAL PHYSICS

SILVIU-MARIAN UDRESCU, SHANE WILKINS, RONALD FERNANDO GARCIA RUIZ, ALEX BRINSON, ADAM VERNON, *Physics, MIT, Cambridge, USA*; ALEXANDER A. BREIER, THOMAS GIESEN, *Physics, University Kassel, Kassel, Germany*; ROBERT BERGER, KONSTANTIN GAUL, CARSTEN ZULCH, *Chemistry, Philipps-Universitaet Marburg, Marburg, Germany*; BRAN VAN DEN BORNE, THOMAS COCOLIOS, RUBEN DEGROOTE, ANAIS DORNE, SARINA GELDHOF, LOUIS LALANNE, GERDA NEYENS, *Physics, KU Leuven, Leuven, Belgium*; KIERAN FLANAGAN, HOLLY PERRETT, JORDAN REILLY, JULIUS WESSOLEK, *Physics, University of Manchester , Manchester , UK*; MICHAIL ATHANASAKIS-KAKLAMANAKIS, MIA AU, KATHERINA CHRYSALIDIS, AGOTA KOSZORUS, SEBASTIAN ROTHE, *Physics, CERN, Geneva, Switzerland*; TIMUR A. ISAEV, *Physics, NRC "Kurchatov Institute" PNPI, Gatchina, Russia*; IVANA BELOSEVIC, *Physics, TRIUMF, Vancouver, Canada*; SERGE FRANCHOO, *Physics, Irène Joliot-Curie Lab, Paris, France*; SONJA KUJANPAA, *Physics, University of Jyväskylä, Jyväskylä, Finland* ; MIRANDA NICHOLS, *Physics, University of Gothenburg, Gothenburg, Sweden*; XIAOFEI YANG, *Physics, Peking University, Beijing, China*.

Precision molecular experiments provide a unique tool in the search for physics beyond the Standard Model (SM) and exploration of the fundamental forces of nature. Compared to atoms, certain molecules can offer more than eleven orders of magnitude enhanced sensitivity to violations of fundamental symmetries, enabling precision tests of the SM and the possibility to probe energy scales beyond hundreds of TeV. Containing octupole-deformed nuclei, radium monofluoride (RaF) is expected to be particularly sensitive to symmetry violating nuclear properties [Phys. Rev. A 82, 052521 (2010); J. Chem. Phys. 152, 044101 (2020)]. In this talk, I will present the latest results obtained from a series of laser spectroscopy experiments performed on short-lived RaF molecules at the ISOLDE facility at CERN. Using a collinear resonant ionization setup, the rotational and hyperfine structure of ^{226}RaF and ^{225}RaF were measured with high precision. This allowed us to establish a laser cooling scheme for these molecules, and to explore nuclear structure effects at the molecular level. Our new results represent an increase in precision of at least 3 orders of magnitude compared to our previous studies [Nature 581, 396 (2020); Phys. Rev. Lett. 127, 033001 (2021)] being the first of their kind performed on radioactive, short-lived molecules and opening the way for future precision studies and new physics searches in these systems.