Contribution ID: **61** Type: **Oral**

Precision spectroscopy studies of radioactive molecules for fundamental physics

Friday, 17 June 2022 09:30 (20 minutes)

Precision molecular experiments provide a unique tool for the measurement of electroweak nuclear properties and searches for physics beyond the Standard Model (SM). 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) molecules are expected to be highly sensitive to the parity-violating nuclear anapole moment as well as to the parity- and time-reversal violating nuclear Schiff and magnetic quadrupole moments [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 extract the value of the nuclear magnetic moment of the ^{225}Ra nucleus. Our new results exhibit high sensitivity to the distribution of the nuclear magnetization in the ^{225}Ra nucleus and 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)]. They are the first of their kind performed on radioactive, short-lived molecules, opening the way for future precision studies of electroweak nuclear properties and new physics searches in these systems.

Primary authors: UDRESCU, Silviu-Marian (Massachusetts Institute of Technology); WILKINS, Shane (Massachusetts Institute of Technology); ALEX, Breier (University of Kassel); ATHANASAKIS-KAKLAMANAKIS, Michail (KU Leuven, CERN); AU, Mia (CERN); BELOSEVIC, Ivana (TRIUMF); BERGER, Robert (Philipps –Universität Marburg); VAN DEN BORNE, Bram (KU Leuven); BRINSON, Alex (Massachusetts Institute of Technology); CHRYSALIDIS, Katerina (CERN); COCOLIOS, Thomas (KU Leuven); DORNE, Anais (KU Leuven); FLANAGAN, Kieran (7 - Photon Science Institute, The University of Manchester, CERN); FRANCHOO, Serge (Irène Joliot-Curie Lab); GARCIA RUIZ, Ronald Fernando (Massachusetts Institute of Technology); GAUL, Konstantin (Philipps –Universität Marburg); SARINA, Geldhof (KU Leuven); GIESEN, Thomas (University of Kassel); DE GROOTE, Ruben (KU Leuven); ISAEV, Timur (Moscow State University); KOSZORÚS, Agota (KU Leuven); KUJANPAA, Sonja (University of Jyväskylä); LALANNE, Louis (KU Leuven); NEYENS, Gerda (KU Leuven, CERN); NICHOLS, Miranda (University of Gothenburg); PERRETT, Holly (The University of Manchester); REILLY, J. (The University of Manchester); ROTHE, Sebastian (CERN); VERNON, Adam (Massachusetts Institute of Technology); WESSOLEK, Julius (The University of Manchester); YANG, X.F. (Peking University); ZULCH, Carsten (Philipps –Universität Marburg)

Presenter: UDRESCU, Silviu-Marian (Massachusetts Institute of Technology)

Session Classification: NS2022 Plenary

Track Classification: Oral Presentations