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Effect of temperature distribution on the spectra of RaF

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With the advancement of spectroscopic techniques at radioactive beam facilities, the spectroscopy of radioactive molecules has been achieved in the past few years at ISOLDE using the Collinear Resonance Ionization Spectroscopy (CRIS) experiment [1].

Thanks to its strong electric field gradient and the rich electronic, vibrational, and rotational structure inherent in molecules, radium monofluoride (RaF) has become the center of attention for theoretical and experimental investigations in search of the electron electric dipole moment and nuclear Schiff moments [2-4]. Such future searches depend on preparatory spectroscopic studies of the electronic structure of the molecule.

The RaF molecules arrive at CRIS after going through ISCOOL, a radio frequency quadrupolar cooler-buncher. This device aims to cool the molecules to room temperature using a helium buffer gas and release the continuous beam in bunches [5]. The final beam temperature can be probed by measuring the population distribution of the molecules in different rotational states, extracted from the relative intensities of the rotational transitions. As such, the presence of different temperature groups in a bunch leads to a more complex spectrum, and the temperature groups can be extracted from the spectral analysis.

RaF spectra measured in the 2021 CRIS campaign from transitions to high-lying electronic states up to 30,000 cm-1 have been analyzed using the molecular analysis code PGOPHER. The results show that most of the spectrum requires fitting with at least three different temperature distributions within each bunch from ISCOOL, with temperatures as high as 1000 ℃.

This poster will present the results of the analysis of the excited states in RaF, with a particular focus on extracting the beam temperature distribution. Thus, a comparison of the extracted beam temperatures with different distribution models will be shown, along with future outlooks.

References

[1] Garcia Ruiz, Ronald Fernando, et al. “Spectroscopy of short-lived radioactive molecules.” Nature 581.7809 (2020): 396-400.
[2] Kudashov, A. D., et al. “Ab initio study of radium monofluoride (RaF) as a candidate to search for parity- and time-and-parity–violation effects.” Physical Review A 90.5 (2014): 052513.
[3] Isaev, T. A., S. Hoekstra, and R. Berger. “Laser-cooled RaF as a promising candidate to measure molecular parity violation.” Physical Review A 82.5 (2010): 052521.
[4] Osika, Y., & Shundalau, M. (2022). Fock-space relativistic coupled cluster study on the RaF molecule promising for the laser cooling. Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, 264, 120274.
[5] Catherall, R., et al. “The ISOLDE facility.” Journal of Physics G: Nuclear and Particle Physics 44.9 (2017): 094002.

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