# Recent Collinear Resonance Ionisation Spectroscopy (CRIS) experiments at ISOLDE-CERN

B. van den Borne[1], M. Athanasakis-Kaklamanakis[1,2], M. Au[2,3], R. Berger[4], C. Bernerd[1], A. Borschevsky[5], K. Chrysalidis[2], T.E. Cocolios[1], R.P. de Groote[1], A. Dorne[1], Ch.E. Düllmann[3,6,7], K.T. Flanagan[8], R.F. Garcia Ruiz[9], S. Geldhof[10], W. Gins[1], D. Hanstorp[11], M. Heines[1], R. Heinke[2], T.A. Isaev[12], J. Johnson[1], A. Kiuberis[5], Á. Koszorús[1], S. Kujanpää[13], L. Lalanne[2], M. Mougeot[2], G. Neyens[1], L. Nies[2,14], M. Nichols[11], J. Reilly[8], S. Rothe[2], L. Schweinkhard[14], A.R. Vernon[9], S.G. Wilkins[9], and X. Yang[15]

[1] *Instituut voor Kern- en Stralingsfysica, KU Leuven, B-3001 Leuven, Belgium*
[2] *CERN, CH-1211 Geneva, Switzerland*
[3] *Department Chemie, Johannes Gutenberg-Universit, D-55099 Mainz, Germany*
[4] *Fachbereich Chemie, Philipps-Universit, 35032 Marburg, Germany*
[5] *Van Swinderen Institute for Particle Physics and Gravity, University of Groningen, The Netherlands*
[6] *GSI Helmholtzzentrum fur Schwerionenforschung, 64291 Darmstadt, Germany*
[7] *Helmholtz Institute Mainz, 55099 Mainz, Germany*
[8] *School of Physics and Astronomy, University of Manchester, Manchester M13 9PL, United Kingdom*
[9] *Massachusetts Institute of Technology, Cambridge, MA 02139, USA*
[10] *GANIL, 14076 CAEN, France*
[11] *University of Gothenburg, 41296 Gothenburg, Sweden*
[12] *Petersburg Nuclear Physics Institute, 188300 Gatchina, Russia*
[13] *Department of Physics, University of Jyväskylä, FI-40014 Jyväskylä, Finland*
[14] *Universit at Greifswald, Institut fur Physik, 17487 Greifswald, Germany and*
[15] *Peking University, Beijing 100871, China*

Exploring nuclear properties far from stability is a powerful tool to investigate our understanding of the nuclear structure, and challenge state-of-the-art nuclear theory. Laser spectroscopy can measure many ground-state properties (spin, nuclear electromagnetic moments, changes in the charge radius) upon which the structure of these nuclei is based. Furthermore, its application at ISOL facilities can give access to the same properties for long-lived states (>10ms). The Collinear Resonance Ionisation Spectroscopy (CRIS) experiment at ISOLDE-CERN exploits the high selectivity of resonant ionisation spectroscopy combined with the high resolution of collinear laser spectroscopy to measure these ground-state properties of radioactive nuclei and molecules. Recently, the elements indium[1] ($Z$=49) and silver[2] ($Z$=47), and the molecules RaF[3–4] ($Z$=88+9) and AcF[5] ($Z$=89+9) were studied at CRIS successfully.

In this seminar I will present the core principles of the CRIS experiment at ISOLDE-CERN and the results of these experiments. The nuclear spin and electromagnetic properties of several isomeric states were deduced for indium and silver, and various molecular electronic levels were identified in RaF and AcF. These data provide a benchmark for both nuclear and atomic theory, further broadening our knowledge close to the nuclear shell closure ($Z$=50) and molecular electronic structure.

REFERENCES

[1] A. Vernon *et al.*, Nature **607** (2022) 260-265.
[2] R.P. de Groote *et al.*, CERN-INTC-2020 / INTC-P-551 (2020).
[3] R.F. Garcia Ruiz *et al.*, CERN-INTC-2018 / INTC-P-546 (2018).
[4] S. Udrescu *et al.*, Nature Physics (2023) (submitted).
[5] M. Athanasakis-Kaklamanakis *et al.*, CERN-INTC-2021 / INTC-P-615 (2021).