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# Optical spectroscopy - probing the size, shape and single-particle properties of exotic nuclei

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## Abstract

High-resolution optical measurements of the atomic level structure readily yield fundamental and model-independent data on nuclear ground and isomeric states, namely changes in the size and shape of the nucleus, as well as the nuclear spin and electromagnetic moments [1]. Laser spectroscopy combined with on-line isotope separators and novel ion manipulation techniques provides the only mechanism for such studies in exotic nuclear systems.

The ion guide method of producing low-energy radioactive beams at the IGISOL facility, Jyväskylä, is fast and element independent. For almost two decades, collinear laser spectroscopy has been used in combination with cooled and bunched beams of refractory elements, probing nuclear structure in different regions of the nuclear chart. Methods of optical manipulation have been developed to expand the range of elements accessible to laser spectroscopy. Most recently, charge exchange of fast ionic beams has now opened up the reach to atomic systems at the IGISOL.

In this presentation I will present results from recent experiments which have focused on the regions near Z=40 and Z=50, including neutron-rich isotopes of Y, Nb and Ag. These experiments provide detailed insight into shape changes, coexistence of shapes, and sensitivity to the migration of level structure via ground state spins and magnetic dipole moments. In the past year, Penning trap techniques with single-ion sensitivity have been combined with laser spectroscopy to provide a more complete overview of changes in nuclear structure. New ion source developments have opened up access to very neutron-deficient isotopes, where optical information is now available to $^{96}$Ag, with the ultimate aim of producing and studying the exotic N=Z isotope $^{94}$Ag in the near future.

An exciting programme of laser spectroscopy on actinide elements will be pursued in the future following developments on the production of new targets as well as sensitive methods of spectroscopy. This will form an important aspect of new EU projects, including LISA, a recently funded Marie Curie Innovative Training Network.

## References

[1] P. Campbell, I.D. Moore and M.R. Pearson, *Progress and Part. and Nucl. Phys.* **86** (2016) 127.