Recent developments for laser spectroscopy at radioactive ion beam facilities

Laser spectroscopy is a powerful and well-established technique for the study of nuclear ground-state properties at radioactive ion beam facilities. It provides access to the mean-square charge radii differences and electromagnetic moments of the nuclear ground state as well as of long-lived isomers by measuring the isotope shifts and hyperfine structures of the atoms' spectral lines [1, 2]. While in-source laser spectroscopy in a hot cavity or in a gas cell are very sensitive methods that are able to measure rare isotopes with production rates below one ion per second [3,4], the spectral resolution of this method is limited by Doppler broadening. Collinear laser spectroscopy (CLS) on the other hand, provides an excellent spectral resolution. However, conventional fluorescence-based CLS requires yields of more than 100 or even 10,000 ions/s depending on the specific case and spectroscopic transition [5]. Techniques for both in-source as well as for collinear laser spectroscopy at radioactive ion beam facilities are being developed to push the limits of sensitivity and spectral resolution further than what is possible today. Some of these recent developments will be presented in this talk.

[1] K. Blaum, et al., Phys. Scr. T152, 014017 (2013)
[2] P. Campbell et al., Prog. Part. and Nucl. Phys. 86, 127-180 (2016)
[3] B. Marsh et al., Nature Physics 14, 1163-1167 (2018)
[4] M. Laatiaoui et al. Nature 538, 495-498 (2016)
[5] R. Neugart, J. Phys. G: Nucl. Part. Phys. 44 (2017)