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Collinear laser spectroscopy of exotic Pd isotopes at the IGISOL facility

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High-resolution laser spectroscopy has been proven to be a powerful tool to extract nuclear structure data in an almost model-independent manner [1]. The isotope shift which can be extracted from the hyperfine spectra of exotic nuclei gives direct access to their changes in mean-square charge radii. This provides information on e.g. deformation and shape coexistence, proton-neutron pairing correlations, and the presence of nuclear shell closures. In recent years, measurements of nuclear charge radii have also been proven exceptionally potent in testing state-of-the-art nuclear Density Functional Theory (DFT) and ab-initio approaches [2-4].

The Pd isotopes are located in a transitional area in between smooth parabolic trends observed in the changes in mean-square charge radii in the Sn, In, Cd and Ag chains, and a region below where the trend in changes in mean-square charge radii shows evidence of a dramatic shape change observed at N=60, maximized and centred around the yttrium system. In this area between both regions however, i.e. the Tc, Ru, Rh and Pd isotopes, no optical spectroscopic information has been available for radioactive nuclei so far. This is in part due to the refractory character of these nuclei, which makes their production challenging for many facilities, but also due to their complex atomic structure.

At the IGISOL facility, these difficulties were overcome thanks to the chemically insensitive production method, and the recent installation of a charge-exchange cell and a new cw Ti:sapphire laser. Collinear laser spectroscopy was performed on exotic Pd isotopes, which are known to be deformed from decay spectroscopy studies, although there is disagreement on the origin and character of the (possible) change in deformation. The measured nuclear charge radii will be presented in this contribution, and the implication on the deformation/shape of the isotopes will be discussed. In addition, the results will be compared to state-of-the-art DFT calculations using Fayans Energy Density Functionals [3,5]. Recent benchmarks of nuclear DFT were performed on spherical systems, close to (doubly-)magic systems [3,6,7], so this presents the first test of the performance of these functionals for well-deformed isotopes.

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