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Commissioning Highly Charged Ions Collinear Laser Spectroscopy on 36,38,40Ar^{5+,6+}

The installation of the HINA (Highly Charged Ions for Nuclear Physics and Astrophysics) project and the related Electron Beam Ion Trap (EBIT) will represent a unique opportunity to access spectroscopy studies on highly charged ions. Our aim at the DESIR facility is to combine the availability of highly charged ions (HCIs) with the existing collinear laser spectroscopy (CLS) setup, LUMIERE/LASAGN, to perform high-precision nuclear measurements of isotope shifts and extract observables such as nuclear charge radii.

To study the feasibility of this method at DESIR, we propose a first laser spectroscopy measurement on highly charged stable argon isotopes $^{36,38,40}\mathrm{Ar}^{5+,6+}$. These nuclei can be easily produced at SPIRAL1, while the 5^+ and 6^+ charge states can be rapidly populated by the EBIT developed within the HINA framework. The experimental procedure will rely on three main phases: injection of singly charged ions into the trap, the charge breeding process, extraction (pulsed or continuous) from the EBIT, and final transmission to LUMIERE/LASAGN.

Stable argon nuclei in the 5^+ and 6^+ charge states represent an ideal commissioning case. They combine accessible optical transitions with moderate electronic complexity, and their high production intensities provide reliable beams suitable for investigating HCIs production and transmission efficiencies to LUMIERE/LASAGN. Comparing different charge states enhances sensitivity to nuclear and isotope shifts, and the availability of extensive benchmark data will allow direct comparison with the obtained results.
The results will validate the experimental concept and the synergy between HCI production and collinear laser spectroscopy at DESIR, opening future opportunities for studies of HCI laser spectroscopy on short-lived nuclei.

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