



Contribution ID: 27

Type: not specified

## EC on H-, He and Li-like $^{37}\text{Ar}$ , $^{64}\text{Cu}$ and $^{68}\text{Ga}$

In-trap decay spectroscopy of highly charged ions (HCIs) is the main objective of the HINA (Highly Charged Ions for Nuclear Physics and Astrophysics) project, which aims to exploit a dedicated setup combining an Electron Beam Ion Trap (EBIT) and an electrostatic trap to produce, confine, and study the decay of HCIs. In such systems, where only a few bound electrons remain, electron-capture (EC) decay rates can differ from those of neutral atoms due to the hyperfine interaction providing unique insights into nuclear structure and decay processes relevant to nuclear astrophysics.

Following the day-1 experiment of the HINA experiment, we propose the first investigation of the EC decay rate of H-, He- and Li-like in  $^{37}\text{Ar}$ ,  $^{64}\text{Cu}$  and  $^{68}\text{Ga}$  using in-trap decay spectroscopy. The first objective is to confirm the theoretical prediction of decay rate in such a system [1,2].

If a sufficient amount of H-like ions can be produced and good vacuum conditions allow it, we aim to measure the half-life of H-like  $^{37}\text{Ar}$ , which will have direct implications in the modelling of Galactic Cosmic Rays (GCR) propagation in our Galaxy.

The second candidate,  $^{64}\text{Cu}$ , represents an interesting case of hyperfine-controlled electron-capture decay in hydrogen-like ions, where the EC decay can be almost completely suppressed, leading to lifetimes of order magnitude longer than in the neutral atom, having a half-life of 12.7 h. Although the EBIT electron beam cannot coherently drive hyperfine transitions, it can induce collisional hyperfine mixing, effectively quenching long-lived hyperfine states and enabling the observation of electron-capture decay. Since the branching ratio for EC is 43%, the challenge would be to distinguish this latter from  $\beta^+$  (17%) and  $\beta^-$  (40%) decays. Since  $Q_{\beta^-}$  is very low, we expect to trap the daughter nucleus  $^{64}\text{Zn}$  and therefore be able to distinguish this decay rate. Since  $\beta^+$  decay rate should not change, we should be able to deduce indirectly EC decay rate.

The third candidate  $^{68}\text{Ga}$  having a branching ratio for EC of 10% might be the most challenging.

The measurements will rely on X-ray detection following dielectronic recombination induced in the EBIT by the electron beam or, in the electrostatic trap of the set-up employing the signal induced on a pick-up electrode by the confined ions.

[1] Z. Patyk et al, Orbital electron capture decay of hydrogen- and helium-like ions, PRC77 (2008)

[2] K. Siegień-Iwaniuk and Z. Patyk, Nuclear electron capture in Li-like ions, Phys. Rev. C 84 (2011)

**Author:** SGUAZZIN, Michele (IJCLab - CNRS)