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Particle detectors for the observation of rare nuclear decay modes in storage rings

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Nuclear data such as masses, half-lives, reaction cross-sections and information on decay modes are vital in developing a deeper understanding of nucleosynthetic processes and the origin of the elements. However, these properties are not always constant, and can depend strongly on the atomic charge state experienced in different stellar environments. When nuclei exist as highly charged ions (HCI) for an extended period, they may exhibit changes in decay rates, as well as the availability of entirely new decay modes. This may have profound impact on nucleosynthesis pathways. Some examples of these effects include: the suppression of electron capture on fully ionised ⁷Be extending its effective half-life in stellar cores and impacting energy generation [1]; the bound-state β-decay of HCIs, which may otherwise be stable at lower ionisation states, and its impact on the *s*-process pathway [2]; or the shift in decay rate of highly charged α-emitters, with potential consequences for *r*-process nucleosynthesis [3].

Storage rings offer one option to explore rare and exotic decay modes which occur only under extreme stellar conditions. As stored ions decay and their mass-to-charge ratio changes, their trajectory changes and may leave the acceptance of the storage ring. Strategically placed particle detectors, such as the prototype CsISiPHOS detector [4], can then observe the decay products and, along with in-ring detectors, conduct symbiotic measurements of several nuclear properties at once under conditions not easily attainable by other means.

As part of FAIR Phase-0, experiments conducted by the ILIMA collaboration at the Experimental Storage Ring (ESR) at GSI, Germany, aim to use novel detection techniques to study these exotic decay modes, as well as provide a new method by which to measure β-delayed neutron emission. A newly commissioned upgraded particle detector will significantly increase the efficiency of these measurements.

Presented here is a detailed look at these detectors, their design and results from a commissioning run in Spring 2022. We will demonstrate their use for unique measurements of changes in decay rates of highly charged ions and how their use in storage rings can complement and advance more traditional methods.

[1] E. G. Adelberger, et al. Rev. Mod. Phys. 83.1 (2011): 195.
[2] Yu. A. Litvinov, and F. Bosch. Rep. Prog. Phys. 74.1, (2010): 016301.
[3] F. F. Karpeshin, M. B. Trzhaskovskaya, and L. F. Vitushkin. Phys. Rev. C 105.2 (2022): 024307.
[4] M. A. Najafi et al., NIMA 836, 1-6, (2016).

Author: GRIFFIN, Christopher

Co-authors: LECKENBY, Guy (TRIUMF); DILLMANN, Iris; LITVINOV, Yuri (GSI, Darmstadt); Dr GLORIUS, Jan (GSI); GERNHAEUSER, Roman August (Technische Universitaet Muenchen (DE)); Dr THOMAS, Faestermann (Technische Universität München); YAMAGUCHI, Takayuki (Saitama University (JP))

Presenter: GRIFFIN, Christopher

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