

The proton-capture campaign at the GSI storage rings

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Radiative proton-capture reactions play a crucial role in explosive nucleosynthesis. In the corresponding stellar scenarios, e.g. supernovae or X-ray bursts, the nuclear reaction flow predominantly proceeds in the domain of radioactive nuclei, making reactions studies in the laboratory challenging. The most promising approach to cross section measurements on radionuclides is to prepare them in inverse kinematics at a rare ion beam facility like GSI/FAIR [1]. After production at higher energies in the fragment separator the secondary beam can be injected into the ESR storage ring, where it is decelerated to the Gamow window and used efficiently for reaction studies.

In this contribution the experimental method will be outlined with a focus on the challenges of particle detection in ultra-high vacuum and the storage of low-energy ions in a ring. Additionally, an extended overview of the proton-capture studies at the ESR will be given. This will include a discussion of results for the $^{96}\text{Ru}(p,\gamma)$ pilot experiment [2], the ongoing analysis of the $^{124}\text{Xe}(p,\gamma)$ reaction [3] as well as the technical improvements achieved in the meantime.

Finally, an outlook to future experiments will be given. Here, special emphasis will be put on the CRYRING@ESR facility [4], which is designed for the storage of heavy ions between several 100 keV/u and up to 10 MeV/u making it the perfect device to study reactions in the Gamow window.

References

- [1] R. Reifarth *et al.*, J. Phys.: Conf. Ser. **665** (2016) 012044.
- [2] B. Mei *et al.*, Phys. Rev. C **92** (2015) 35803.
- [3] J. Glorius *et al.*, J. Phys.: Conf. Ser. **875** (2017) 092015.
- [4] M. Lestinstsky *et al.*, Eur. Phys. J. Spec. Top. **5** (2016) 225.