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Towards next-generation in-beam gamma-ray spectroscopy at the RIBF with HYPATIA

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Since advent of the RIBF, the NaI(Tl) based scintillation array DALI2+ [1] has been the workhorse for in-beam γ-ray spectroscopy experiments with fast beams. Due to its modest energy resolution, caused by large opening angles and intrinsic energy resolution of NaI(Tl) scintillators, long absorption lengths of the scintillation material, as well as modest time resolution, the long-term potential is limited. Limited available budget makes low cost alternatives to 4π Ge tracking arrays with superior features in terms of time resolution, full energy peak efficiency and peak-to-total, desirable. Consequently, a new-generation scintillator array for in-beam γ-ray experiments, the HYPATIA (HYbrid Photon detector Array To Investigate Atomic nuclei) project, has been launched in 2023. For HYPATIA, HR-GAGG and CeBr3 scintillators have been identified as the most promising crystals. Key advantages for the former include its high density, low radiation length, and that it's not hygroscopic and emits no self-activity, while the latter offers a better intrinsic resolution and extremely fast decay time.

HYPATIA is envisaged to be employed at different experimental stations of the upgraded RIBF and its magnetic spectrometers (ZeroDegree, SAMURAI, SHARAQ), each having different performance requirements and constraints. Key experiments to be carried out in the future at the RIBF at intermediate energies involve inelastic scattering on high-Z targets to induce Coulomb excitation, as well as inelastic scattering and quasi-free (p,2p) and (p,pn) reactions on liquid hydrogen.

In my presentation, I will provide an overview of the HYPATIA project, including how well its performance compares to other existing and planned γ-ray spectrometers, and examples of possible future experiments beyond spectroscopy
of the first excited 2^+ state.

[1] S. Takeuchi et al., NIMA 763, (596) 2014.

Collaboration

HYPATIA Collaboration

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