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Precision X-Ray Spectroscopy of Helium-Like Uranium Using Metallic Magnetic Calorimeter Detectors (MMC)

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Metallic-magnetic microcalorimeter detectors for X-ray precision spectroscopy provide excellent energy resolution combined with a broad bandwidth acceptance. This opens up new experimental possibilities, in particular for bound-state QED studies in highly charged ions. Using a pair of such detector systems, we recently conducted a landmark experiment, as presented in [P. Pfäfflein et al. Quantum electrodynamics in strong electromagnetic fields: Substate resolved Kα transition energies in helium-like uranium, PRL 134, 153001 (2025)].
At CRYRING@ESR, we recorded the X-ray spectra for the electronic transitions into the ground- and excited states for electron-cooled, helium-like uranium (U90+) ions. This provided us with an unmatched spectral resolution close to 90 eV FWHM. That enables to resolve and to determine precisely the four components of the Kα groundstate transitions. The results are in good agreement with state-of-the-art bound-state QED calculations for the strong-field regime. In this contribution, we will present a summary of this measurement as well as a first glance at data obtained in a follow-up experiment conducted this summer.

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