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Precision X-Ray Spectroscopy of He-like Uranium using Metallic Magnetic Calorimeters

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Helium-like ions are the simplest atomic multibody systems and their study along the isoelectronic sequence provides a unique testing ground for the interplay of the effects of electron–electron correlation, relativity and quantum electrodynamics. However, for high-Z ions with nuclear charge Z > 54, where inner-shell transition energies reach up to 100 keV, there is currently no data available with high enough resolution and precision to challenge state-of-the-art theory [1]. In this context the recent development of metallic magnetic calorimeter (MMC) detectors is of particular importance. Their high spectral resolution of a few tens of eV FWHM at 100 keV incident photon energy in combination with a broad spectral acceptance down to a few keV will enable new types of precision x-ray studies [2].

We report on the first application of MMC detectors for high-resolution x-ray spectroscopy at the electron cooler of the low-energy storage ring CRYRING@ESR at GSI, Darmstadt. Within the presented experiment, the x-ray emission associated with radiative recombination of stored hydrogen-like uranium ions and cooler electrons was studied. Two MMC detectors developed within the SPARC collaboration [3] were placed at observation angles of 0° and 180° with respect to the ion beam axis. The detectors and their extraordinary capabilities for x-ray spectroscopy will bepresented. Special emphasis will be given to the achieved spectral resolution of better than 90 eV at x-ray energies close to 100 keV enabling for the first time to resolve the substructure of the $K\alpha_1$ and K_2 lines.

References

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