X-Ray Spectroscopy of U^{90+} using Metallic Magnetic Calorimeters

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Recent developments regarding metallic magnetic calorimeters (MMCs) have resulted in a new class of detectors for precision X-ray spectroscopy. One of them being the maXs series of detectors [1] (cryogenic microcalorimeter arrays for high resolution X-ray spectroscopy), which have been developed within the SPARC collaboration. They work as follows: The energy deposition of an incident X-ray photon leads to a measurable temperature rise of an absorber. At operation temperatures below 50 mK this leads to a change in the magnetisation of a paramagnetic sensor which can be measured by a superconducting quantum interference device (SQUID) [2]. MMC detectors combine a very high energy resolution (better than 100 eV FWHM at 100 keV) comparable to crystal spectrometers, with the broad bandwidth acceptance of semiconductor detectors (0.1 – 100 keV) [3].

These detectors are especially well suited for X-ray spectroscopy of highly charged ions. Helium-like ions, for example, are the simplest atomic multibody systems. 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 [4]. 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 maXs-100 detectors were placed at observation angles of 0° and 180° with respect to the ion beam axis. 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 $K_{\alpha 2}$ lines.

<u>References</u>

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