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Commissioning of the Transverse Free-Electron Target at the Heavy-Ion Storage Ring CRYRING@ESR

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Electron-ion collision experiments in a merged beams geometry (electron cooler) are well established at ion storage rings. A complete new range of experiments is possible if the geometry is changed to a crossed-beams setup in 90° angle between the electron and ion beams employing a dedicated free-electron target. The target bridges the gap between low-collision-energy experiments in electron coolers and those employing quasi-free electrons of gas-jet targets. Compared to the latter, the absence of a target nucleus enables unambiguous studies of processes, which are otherwise masked by competing reactions with the target nucleus. As compared to an electron cooler, the interaction region of a transverse target is spatially well localized. This facilitates X-ray and electron spectroscopy with relatively large solid angles. Over the last years, a specially tailored electron-target for heavy-ion storage rings was developed and built at the University of Giessen in cooperation with GSI. Its scientific prospects have been outlined in the CRYRING@ESR Physics Book [1]. The project benefits from decades-long experience of single-pass electron-ion-collision experiments [2–4]. The target is equipped with a versatile electron gun that is optimized for an operation in storage rings. The electron gun can be fully retracted from the storage ring to a position behind a gate valve. One of the specific design criteria was a rather large opening for the ion beam in order to accommodate ion injection into the storage ring on different orbits. First electron-ion beam experiments showed that in total only up to 20% of ions are lost due to the electron target which is a great success. The electron target creates a ribbon-shaped high-intensity electron beam with energies up to 12.5 keV (lab system). The multi-electrode assembly offers a decoupling of electron energy and electron density, which is beneficial for the ultrahigh vacuum conditions in the ring. It also offers a quasi-constant electron density over large energy ranges. We report on the latest achievements during the commissioning beamtimes of the electron target at the CRYRING@ESR. The evaluation of the performance and operation behaviour is ongoing.

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