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Precision Experiments at Heavy-Ion Storage Rings

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The storage of freshly produced radioactive particles in a storage ring is a straightforward way to achieve the most efficient use of such rare species as it allows for using the same rare ion multiple times. Employing storage rings for precision physics experiments with highly-charged ions (HCI) at the intersection of atomic, nuclear, plasma and astrophysics is a rapidly developing field of research.

Until very recently, there were only two accelerator laboratories, GSI Helmholtz Center in Darmstadt, Germany (GSI) and Institute of Modern Physics in Lanzhou, China (IMP), operating such facilities. The experimental storage ring ESR at GSI and the experimental cooler-storage ring CSRe at IMP are able to store, cool and manipulate ion beams at energies of 400 A MeV, corresponding to $\beta=0.6$. The ESR is capable to slow down ion beams to as low as 4 A MeV ($\beta=0.1$).

Thanks to the fascinating results obtained at ESR and CSRe as well as to versatile experimental opportunities, there is now an increased attention to the research with ion-storage rings worldwide. Furthermore, experimental opportunities are being now dramatically enhanced through construction of dedicated low-energy storage rings, which enable stored and cooled secondary HCIs in previously inaccessible low-energy range. The first such facility, CRYRING, has just been constructed at GSI to receive decelerated beams of HCIs from ESR. Dedicated ring facilities are proposed for ISOLDE at CERN, TRIUMF, LANL, and JINR. In this contribution, some highlight research programs at present and future heavy-ion storage rings will be presented.

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