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Precision Physics with Stored Exotic Ions

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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 heavy-ion storage rings coupled to radioactive-ion production facilities. The experimental storage ring ESR at GSI and the experimental cooler-storage ring CSRe at IMP offer beams at energies of several hundred A MeV. The ESR is capable to slow down ion beams to as low as 4 A MeV ($\beta=0.1$). Beam manipulations like deceleration, bunching, accumulation, and especially the efficient beam cooling as well as the sophisticated experimental equipment make rings versatile instruments. The number of physics cases is enormous. The focus here will be on the most recent highlight results achieved within FAIR-Phase 0 research program at the ESR.

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