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Precision Studies at the Intersection of Nuclear Structure, Atomic and Astrophysics

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Tremendous efforts are undertaken worldwide to produce secondary beams at radioactive ion beam facilities. Their incarcerating in a dedicated ring or a trap is a straightforward way to achieve the most efficient use of such rare species. In this context, employing heavy-ion 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. The present contribution will concentrate on recent highlight results obtained within the FAIR Phase-0 research program at storage ring facilities of GSI, Darmstadt. These are the experimental storage ring ESR and the recently commissioned dedicated low-energy storage ring CRYRING.
The focus will be laid at studies of exotic decay modes. The ESR is presently the only instrument enabling precision studies of decays of HCIs. First, the measurement of the bound-state beta decay of fully-ionized ^{205}Tl was proposed about 35 years ago and was finally accomplished in 2020. Implementation of combined Isochronous and Schottky mass spectrometry enabled us to directly measure two-photon decay branch of the first 0+ state in ^{72}Ge.
The performed experiments will be put in the context of the present research programs at GSI/FAIR and in a broader, worldwide context, where, thanks to fascinating results obtained at the presently operating storage rings, a number of new exciting projects is planned.

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