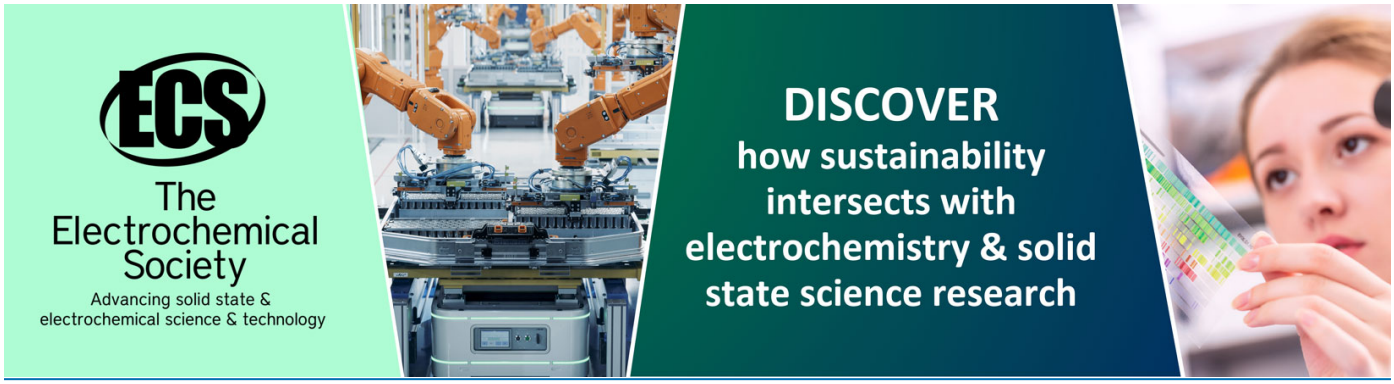
Impact parameter sensitive study of inner-shell atomic processes in Xe^{54+}, Xe^{52+} → Xe collisions



Impact parameter sensitive study of inner-shell atomic processes in Xe^{54+}, Xe^{52+} → Xe collisions

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Synopsis In this work, we present a pilot experiment in the experimental storage ring (ESR) at GSI devoted to impact parameter sensitive studies of inner shell atomic processes for bare and He-like xenon ions (Xe^{54+}, Xe^{52+}) colliding with neutral xenon gas atoms. The projectile and target x-rays have been measured at different observation angles for all impact parameters as well as for the impact parameter range of ∼35 - 70 fm.

In this contribution, we present an impact parameter sensitive study of inner shell atomic processes in symmetric ion-atom collisions. The measurement was performed at the Experimental Storage Ring (ESR) at GSI Darmstadt with bare and He-like xenon ions (Xe^{54+}, Xe^{52+}) colliding with neutral xenon gas atoms. This choice of the projectile charge states was made in order to compare the effect of a filled K-shell with the empty one. The beam energy (for both charge states) was 50 MeV/u. This value of the beam energy was chosen as a compromise between the adiabaticity of the collision and the reasonable beam lifetime/intensity in the ESR after deceleration. In order to obtain information concerning the impact parameter and, in particular to pick out close collisions which are especially important for observing two-center (or quasi-molecular) effects, the scattered projectile ions which had undergone close collisions with the target atoms were detected by a particle detector (plastic scintillator) mounted in a specially constructed movable pocket at ∼3.5 m downstream from the target. In addition to the detector for the scattered projectiles, the x-rays emitted from the interaction zone were observed by an array of semiconductor and scintillator detectors mounted at different angles with respect to the ion beam direction. The physical processes leading to the x-ray emission are: excitation of the projectile/target electrons and electron capture from the neutral target into the highly-charged xenon ions. By looking at the coincidences between the x-rays and the scattered projectiles, we were able to clearly demonstrate the possibility of picking out the characteristic x-rays stemming from the close collisions only. This offers us a new observable for the atomic collision experiments at the ESR storage ring. The experimental results will be presented together with the state-of-the-art relativistic calculations [1].

References

[1] Kozhedub Y S *et al* 2014 *Phys. Rev. A* **90** 042709

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