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Polarization and Angular Correlation of X-Rays Emitted in Relativistic Ion-Atom Collisions

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Particle and photon polarization phenomena occurring in collisions of relativistic ions with matter have recently attracted a lot of interest. In particular, investigations on the emitted characteristic x-ray and radiative electron capture (REC) radiation has been found a versatile tool for probing our present understanding of the dynamics of particles in extreme electromagnetic fields. For the $2p_{3/2} \rightarrow 1s_{1/2}$transition of H-like U^{91+} ions, for example, the interference between the electric-dipole (E1) and magnetic-quadrupole (M2) lines were found to affect considerably the measured angular distribution and to resolve the discrepancy between experiment and theory. Owing to the progress in x-ray detector techniques, in addition, measurements of the polarization of the REC photons became possible and enable one today to derive information about the polarization of the ion beams. In this talk, we review the recent experimental and theoretical progress on the (correlated) capture and decay processes of high-Z ions. Examples include (i) the angular distribution and polarization of the recombination and subsequent photons, (ii) the alignment of the (excited) levels as well as (iii) interferences due to magnetic multipoles. It is shown that the properties of the incident ions (and electrons) can be analyzed by means of the emitted x-ray radiation.