RECOIL ION MOMENTUM SPECTROSCOPY : APPLICATION TO ATOMIC COLLISIONS AND NUCLEAR BETA DECAY

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Recoil ion momentum spectroscopy (RIMS) is a powerful technique that allows the measurement of the momentum transferred to one or more charged particles created in physics processes such as ion-atom/molecule collisions and nuclear beta decay. The complete momentum of the recoil ions is determined by measuring their time of flight and position of detection. Using an adapted extraction electric field generated by the spectrometer, this technique can be applied for a large recoil energy range. The only requirement is the detection of the charged particle in coincidence with a triggering event to obtain the time of flight of the recoil. Projectiles and beta particles can respectively play this role in atomic collisions and nuclear beta decay.

Three applications of this technique will be presented for different processes and different recoil energies. Coupling the standard RIMS technique with a cold target provided by a magneto-optical trap, $Na^+ + {}^{87}Rb(5s,5p)$ collisions with laser-prepared targets have been studied at the LPC-CAEN. The high resolution of the setup allows the observation of thin structures in the scattering angle distributions of projectiles, such as atomic-matter-wave diffraction. Scattering right-left asymmetry was then experimentally evidenced for collisions with oriented targets. This set of data provides an accurate test of molecular orbital close coupling calculations. Experimental approaches, based on the RIMS technique, used for the study of charge mobility on Van der Waals Argon dimers and beta-neutrino correlation parameter measurements will be also described.