FAST ATOM DIFFRACTION DURING GRAZING SURFACE SCATTERING

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Recently it was demonstrated that fast atoms and molecules with energies up to some keV show diffraction effects during scattering from surfaces under axial channeling conditions [1-3]. This at first glance surprising finding can be understood by specific features of scattering of fast atoms from surfaces under glancing angles of incidence with respect to the surface plane. Key issues in this respect are (1) the slow motion of projectiles normal to the surface plane so that the associated de Broglie wavelength is about two orders of magnitude larger compared to the free motion of the particles and (2) the suppression of excitations for electrons and atoms of the target which preserves quantum coherence in the scattering process. In basic features, the method is closely related to the scattering of thermal atoms (TEAS), however, it has the advantage of a simple tuning of the projectile energy by the acceleration voltage and the angle of incidence and of a highly efficient detection of the diffraction pattern by means of a position sensitive detector.

In detailed studies on the quantum coherence in the scattering process, we have correlated via a time-of-flight technique the shape of diffraction peaks to the energy loss of H atoms scattered from a LiF(001) surface and to the emission of electrons. From our studies we find that the coherence is closely related to the suppression of electronic excitations of the target surface. In the talk the recent status of our multi-coincidence experiments is discussed.

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[3] A. Schüller and H. Winter, Phys. Rev. Lett. **100**, 097602 (2008).