ELECTRON CAPTURE AND IONIZATION IN LASER-ASSISTED ION - ATOM COLLISIONS

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It has been shown theoretically, that the presence of a strong laser field (above 10^{12} W/cm^2) can significantly alter electron capture and ionization probabilities in ion - atom collisions [1, 2, 3]. We have found a circular dichroism in the electron capture probability for proton – hydrogen-atom collisions in the presence of circularly polarized laser light, using a two-dimensional model of the scattering process to solve the time-dependent Schrödinger equation on a numerical grid, where the electron is confined in the scattering plane which also includes the laser electric field vector. In this scenario we have shown, that the capture and ionization probabilities crucially depend on the impact parameter and the absolute laser phase at the time of the collision (Fig. 1). In particular, we find an interesting strong dependence of the ionization probability on the impact parameter and the laser phase.

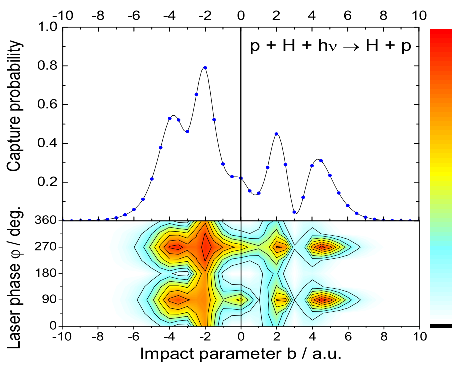

Fig. 1. Electron capture probability for proton – hydrogen collisions in a circular polarized laser field as a function of the impact parameter and the laser phase at the time of closest approach (laser intensity 5×10^{13} W/cm^2, wavelength 1064 nm, projectile energy 1.21 keV).

The dichroism effect for capture, as expressed in terms of the relative difference Δ of cross sections for left and right circular polarized light (i.e. co- versus counter-rotating laser electric field and internuclear axis), is largest for a laser intensity of 5×10^{13} W/cm^2 (Fig. 2).

We will discuss full 3-dimensional results of the laser-assisted collision in comparison with other theoretical approaches, such as the non–perturbative basis-generator method [1], time–dependent scattering theory [2], and grid-models of reduced dimensionality [3].

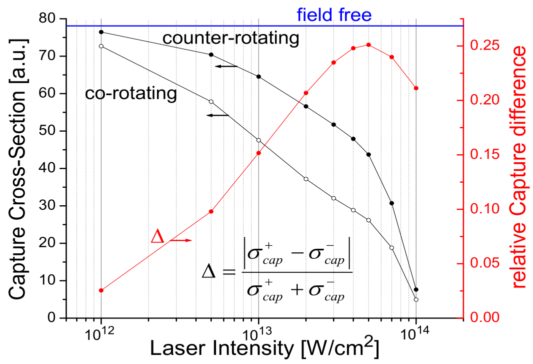

Fig. 2. Co- and counter-rotating total electron capture cross sections and their relative difference Δ as a function of the laser intensity.

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References

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