Two-photon Stark Spectroscopy and Photoionization Microscopy on the Mg atom

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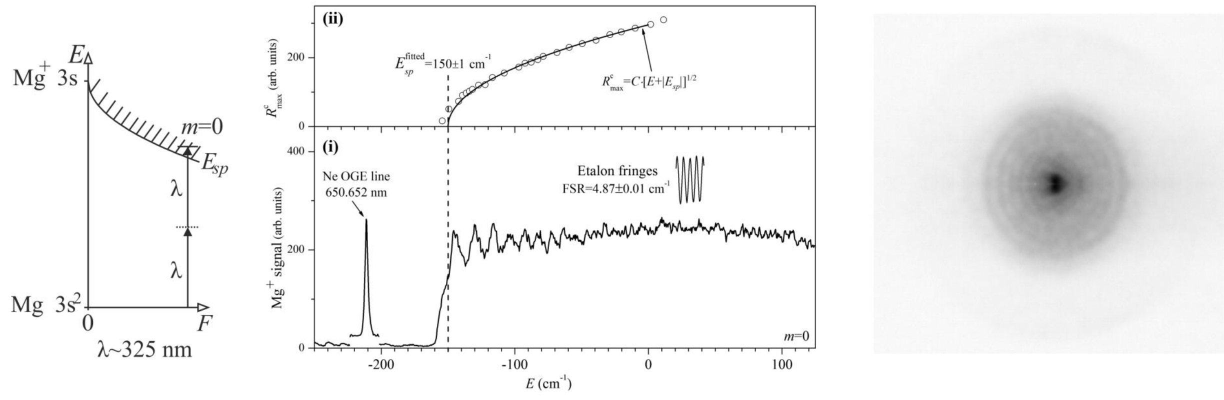
Photoionization microscopy (PM) allows the visualization of the atomic wave function at a macroscopic scale. PM refers to photoionization of an atom in the presence of a uniform static electric field and the subsequent magnified imaging of the liberated slow (∼meV) electrons on an MCP/phosphor-screen detector. PM was initially tested in the heavy (Z=54) Xe atoms but the recorded images revealed solely the continuous part of the electronic wave-function [1]. Recently, the wave-functions of quasi-bound Stark states in the light Li [2], H [3] and He [4] atoms (Z=3,1 and 2, respectively) were recorded and verified 30-year-old theoretical predictions [5]. Here we present two-photon Stark spectra (Figs. 1(a) and 1(b-i)) of the magnesium atom (Z=12) near the saddle point energy and the corresponding, preliminary, PM images (Fig. 1(c)). Stark spectra constitute a necessary first step towards the identification of Stark resonances, as well as the accurate determination of the classical saddle point energy (E_{sp}=-2$F^{1/2}$ atomic units, where F is the electric field strength). As it may be seen in Figs. 1(b-i) and 1(b-ii), the rise of the Mg^+ signal occurs slightly before the E_{sp} value determined by a fit to the outer (so-called indirect [6]) radii of the recorded PM images. The radii-based E_{sp} determination leads to the knowledge of the field strength within 1%. These findings are to be presented in detail in the conference.



(a) **(b)** **(c)**

Figure 1: *(a) Excitation scheme.(b-i)Stark spectrum (F≈600 V/cm) near the saddle point E_{sp} including the zero field ionization threshold (E=0). Laser polarization parallel to the electric field. A Ne optogalvanic line and etalon fringes provide wavelength calibration. (b-ii)Outer radii obtained from the recorded PM images (circles) and the fitted classical curve (line). (c) PM image showing the direct and the, hardly visible, indirect contributions (F≈430 V/cm and $E/|E_{sp}| \approx -0.2$).*

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