Electron Spectroscopy of four-photon-ionized strontium in the 715-737 nm wavelength range

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We report on electron energy analysis experiments aiming to elucidate the single and double ionization pathways when ground state strontium atoms interact with dye laser pulses of $\approx$ 5 ns duration and $\approx 4 \times 10^{11}$ W/cm^2 maximum intensity. Within the examined 715–737 nm wavelength range there are the 4d5p $^1P_1$ and (4d5p+5s5f) $^1F_3$ three-photon resonant, four-photon ionized bound states and the four-photon excited $5p^2$ $^1S_0$ highly correlated autoionizing state, located just above the first ionization threshold. The recorded electron spectra (Fig.1) probe the accumulation of population in the excited $4d_j$ and $5p_j$ Sr^+ states. This observation signifies the absorption of at least two photons above the first ionization threshold. However, the $4d_j$ state is found to be much more heavily populated that the $5p_j$ one. This finding identifies the dominant pathway to double-ionization within the same laser pulse, as stemming from multiphoton ionization out of the $4d_{3/2,5/2}$ levels of Sr^+. Hence, this question, which remained open in earlier work performed using the same excitation and ionization scheme but based solely on the detection of ion and ionic-fluorescence yields [1] is here clarified. Finally, the recording of photoelectron angular distributions from four- as well as higher-photon ionization for selected laser wavelengths, revealed the dominant contributing partial waves at each ionization step. These latter results are compared to those obtained by relevant earlier studies on magnesium atom [2,3].

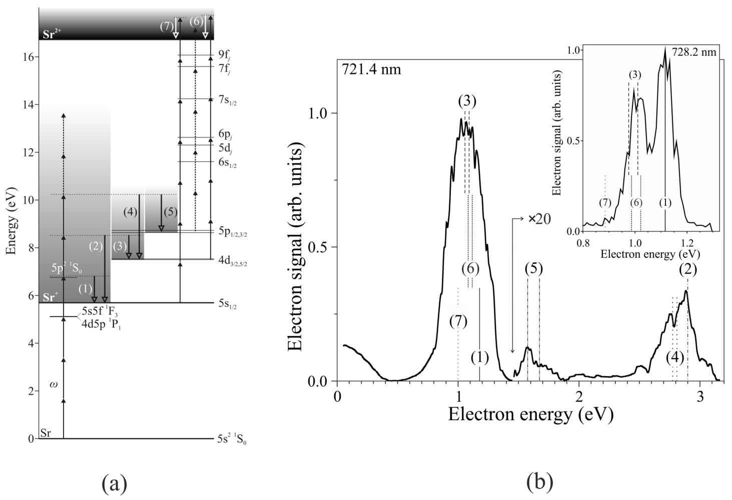

Figure 1: *(a) Energy level diagram and single/double ionization pathways. (b) Electron spectra recorded at selected wavelengths. The main graph refers to the 5s5f $^1F_3$ resonance and it was obtained with a resolution of $\Delta E \sim 0.3$ eV. The inset shows the corresponding electron spectrum at the 4d5p $^1P_1$ resonance ($\Delta E \sim 0.06$ eV). Various single and double ionization channels are numbered in (a) and (b).*

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