Journal of Physics: Conference Series

PAPER • OPEN ACCESS

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To cite this article: A Dimitriou *et al* 2015 *J. Phys.: Conf. Ser.* **635** 092083

XXIX International Conference on Photonic, Electronic, and Atomic Collisions (ICPEAC2015) IOP Publishing
Journal of Physics: Conference Series **635** (2015) 092083 doi:10.1088/1742-6596/635/9/092083

Ionization of strontium atoms by ultrashort pulses of a Ti-Sapphire laser

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Synopsis We present experimental photoelectron spectra obtained by ionizing two-valence electron Sr atoms with ≈25 fs Ti-Sapphire laser pulses and we show preliminary evidence that electron-electron correlation effects dominate for laser intensities $<0.4\times10^{13}$ W·cm^{-2}, while a single electron picture prevails when the laser intensity is increased further.

The two-electron Alkaline Earth atoms present dense manifolds of doubly excited autoionizing states above their first ionization threshold. Hence, their continua are structured and these states are dominated by electron-electron interaction effects. The interaction and subsequent ionization of Alkaline Earth atoms with intense laser fields reveals the absorption of photons within the structured continua. For laser pulses of long duration (~ns), there exist above-threshold-absorption pathways which are dominated by the presence of these doubly excited states and lead to the production of excited ions [1]. On the contrary, for pulses of short duration (~fs) energy level structure issues are of much less importance and one expects a single-active-electron picture to prevail [2,3]. In this case ions should be mostly produced to their ground state. This latter expectation is here experimentally examined by ionizing Sr atoms via ~25 fs, ~800 nm laser pulses, with intensities ranging from $I\approx2\times10^{12}$ W·cm^{-2} to $\approx5\times10^{13}$ W·cm^{-2}. A preliminary analysis of measured photoelectron spectra (recorded via a velocity map imaging (VMI) apparatus [4] at Institute Lumière Matière (ILM), Université Lyon 1) shows that for $I<0.4\times10^{13}$ W·cm^{2} electron-electron interaction dominates and population is created at excited states of Sr^{+}. As the laser intensity is further increased, however, the spectra are composed solely by a series of Above Threshold Ionization (ATI [3]) electron peaks (see Fig. 1) and consequently the single-active-electron picture appears to dominate. These findings suggest that the key factor controlling the dominance of one or the other mechanism is laser intensity, rather than pulse duration.

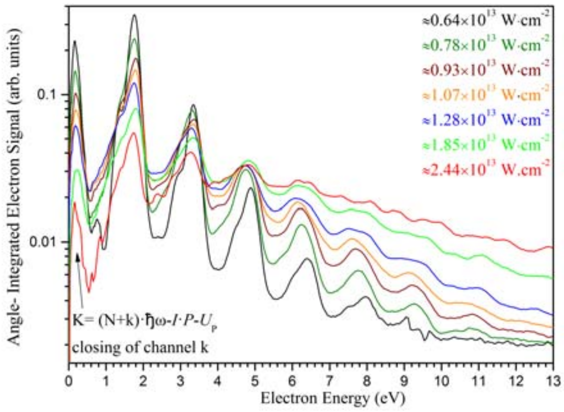

Figure 1. High laser intensity electron energy spectra of Sr ionized by 25 fs Ti-Saphire laser pulses.

This research has been co-financed by the European Union (European Social Fund – ESF) and Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) - Research Funding Program: THALES (ISEPUMA). Investing in knowledge society through the European Social Fund.

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