Photodetachment microscopy of tin

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A beam of Sn^- ions produced by a Cs^+ sputtering ion source is photodetached in the presence of an electric field, with a single mode ring Ti:Sa laser. The laser wavelength, about 806 nm, is set just above the excitation threshold of the $^3P_2$, highest fine-structure sublevel of the ^3P ground-term of Sn I. The photoelectron energy, in the range 34-103 µeV, is measured by photodetachment microscopy.

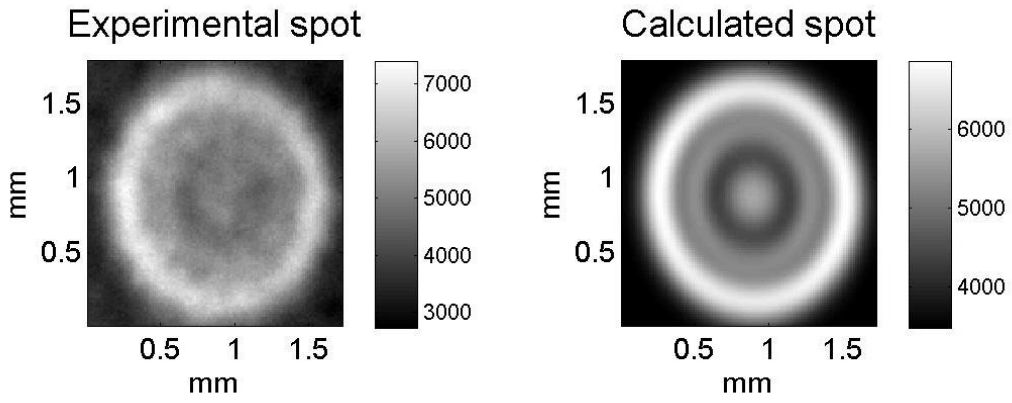

Figure: A photoelectron interferogram (left) obtained in an electric field 267 V/m at a laser wavelength 806.6113 nm (vacuum). The photoelectron current is measured in arbitrary units. The major part of the photoelectron background is produced by detachment leaving neutral tin in one of the lower $^3P_0$ and $^3P_1$ states. The photoelectron energy in the $^3P_2$ channel, as deduced from the phase of the best-fitting image (right), is 66.7(5) µeV.

Subtracting the electron-interferometry determined photoelectron energy from the photon energy, and making a correction for the Doppler effect [1], one gets a measure of the threshold energy necessary to detach Sn^- and leave Sn at the excited $^3P_2$ level: 1239711.8(11) m^{-1}. Subtracting the known energy 342767.1(3) m^{-1} of the $^3P_2$ level [2] from this threshold value, one gets an improved value of the $^3P_0$ threshold energy, or electron affinity of tin: 896944.7(13) m^{-1} or 1.112070(2) eV.

References:

[1] Christophe Blondel, Christian Delsart & Fabienne Goldfarb, J. Phys. B: At. Mol. Opt. Phys. **34,** L281 and erratum 2757 (2001).

[2] David A. Gillett, Stephen J. Diggines & John M. Brown, J. Phys. B: At. Mol. Opt. Phys. **27**, 5175 (1994)