HIGH RESOLUTION VELOCITY-MAP IMAGED PHOTODETACHMENT SPECTRA OF O^- AND OH^-

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The 532 nm photodetachment spectra of O^- and OH^- have been measured using a negative-ion beam spectrometer which incorporates a velocity-map imaging (VMI) lens,[a] located co-axially within the ion beam. The VMI technique offers a number of advantages for the recording of photoelectron spectra, including the simultaneous detection of all kinetic energies and the complete angular distribution of photoelectrons.

To date, the energy-resolution reported for photoelectron spectra using imaging techniques have been limited to $\Delta E/E \geq 2\%$[b] with improvement in energy-resolution achieved only through the use of slow electrons. Our spectrum for O^- was recorded with electron energies near 0.87 eV with $\Delta E/E \leq 0.5\%$. This is a significant achievement for this technique, providing spectra with considerable detail, where individual fine-structure and some rotational transitions are resolved. Measurements above threshold provide more stringent tests on the usefulness of near threshold theories of photodetachment.

The VMI image of O^- is visually similar to OH^-, with a propensity for the electron to be ejected at $90°$ to the laser polarization (asymmetry parameter $\beta \sim -1$), reflecting the detachment of an electron from the $p-$orbital of the oxygen atom. Detail in the spectra reveal different angular distributions for individual transitions, reflecting the nature of the fine-structure transition and the interference between partial waves.

[a] A. T. J. B. Eppink and D. H. Parker, Rev. Sci. Instrum. 68, 3477 (1997).

[b] S. M. Sheehan, G. Meloni, B. F. Parsons, N. Wehres, and D. M. Neumark, J. Chem. Phys. 124, 064303 (2006).