PROBING DIPOLE-BOUND STATES USING HIGH-RESOLUTION RESONANT PHOTOELECTRON IMAGING OF CRYOGENICALLY-COOLED ANIONS

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Negative ions do not possess Rydberg states, but polar anions may have diffuse dipole-bound states just below the detachment threshold, analogous to Rydberg states of neutral molecules. Excitation to vibrational levels of the dipole-bound state can induce autodetachment via vibronic coupling. The resulting resonant photoelectron spectrum is highly non-Franck-Condon and yields much richer vibrational information than conventional photoelectron spectroscopy. We developed an experimental apparatus integrating an electrospray ionization source with photoelectron spectroscopy [1], which allowed negative ions from solution samples to be studied in the gas phase. Subsequent development of a cryogenically-cooled Paul trap to create cold anions from electrospray [2] has allowed high-resolution photoelectron imaging to be conducted for complex molecular anions [3], opening opportunities to probe dipole-bound excited states using photodetachment spectroscopy and resonant photoelectron imaging [4]. I will present recent advances in our investigation of dipole-bound excited states, including the observation of pi-type dipole-bound states [5], electron correlation induced by the electric field of the diffuse dipole-bound electron [6], the observation of polarization-assisted dipole-bound states.

References: [1] L. S. Wang, C. F. Ding, X. B. Wang, and S. E. Barlow, Rev. Sci. Instrum. 70, 1957-1966 (1999). [2] X. B. Wang and L. S. Wang, Rev. Sci. Instrum. 79, 073108 (2008). [3] L. S. Wang, J. Chem. Phys. 143, 040901 (2015). [4] G. Z. Zhu and L. S. Wang, Chem. Sci. 10, 9409-9423 (2019). [5] D. F. Yuan, Y. Liu, C. H. Qian, Y. R. Zhang, B. M. Rubenstein, and L. S. Wang, Phys. Rev. Lett. 125, 073003 (2020). [6] D. F. Yuan, Y. Liu, C. H. Qian, G. S. Kocheril, Y. R. Zhang, B. M. Rubenstein, and L. S. Wang, J. Phys. Chem. Lett. 11, 7914-7919 (2020).