Ultrafast Photoelectron Spectroscopy of Liquids and Spectral Retrieval Analysis

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Time-resolved photoelectron spectroscopy (TRPES) has been widely applied for studying electronic dynamics in gaseous and solid samples, while its application to liquids has a history only slightly longer than a decade [1]. With a liquid microjet technique and a magnetic bottle electron energy analyzer, TRPES of liquid with ultraviolet (UV) pulses is technically straightforward. However, photoelectrons in the liquid undergo elastic and inelastic scattering, which often distort the observed electron kinetic energy (eKE) distributions.

From the viewpoint of spectroscopy of liquids, a pragmatic solution to this problem is to employ extreme ultraviolet (EUV) laser pulse to create photoelectrons at a higher eKE region, where the scattering cross-sections diminish. The high harmonic generation technique enables us to perform such experiments and obtain clean photoelectron spectra. On the other hand, the EUV-TRPES apparatus is more complex than UV-TRPES ones, and a smaller probing depth of liquids with EUV radiation lowers an S/N ratio. An alternative solution to this problem is to correct the distorted eKE distribution measured using UV-TRPES. For the latter, we developed a spectral retrieval (SR) method [2, 3].

In this presentation, we compare EUV and UV photoelectron spectra of solvated electrons and discuss how the eKE distribution is distorted and discuss the SR analysis. Then, we compare spectra measured using EUV-TRPES and UV-TRPES&SR. If time allows, we will discuss some results for EUV-TRPES of aqueous nucleobases.

References:
1. Suzuki, T. Ultrafast photoelectron spectroscopy of aqueous solutions. *J. Chem. Phys.* **151**, 090901 (2019).
2. Yamamoto, Y. & Suzuki ,T. submitted.
3. Nishitani, J., Yamamoto, Y., West, C., Karashima, S. & Suzuki, T. Binding energy of solvated electrons and retrieval of true UV photoelectron spectra of liquids. *Sci. Adv.* **5**, aaw6896 (2019).