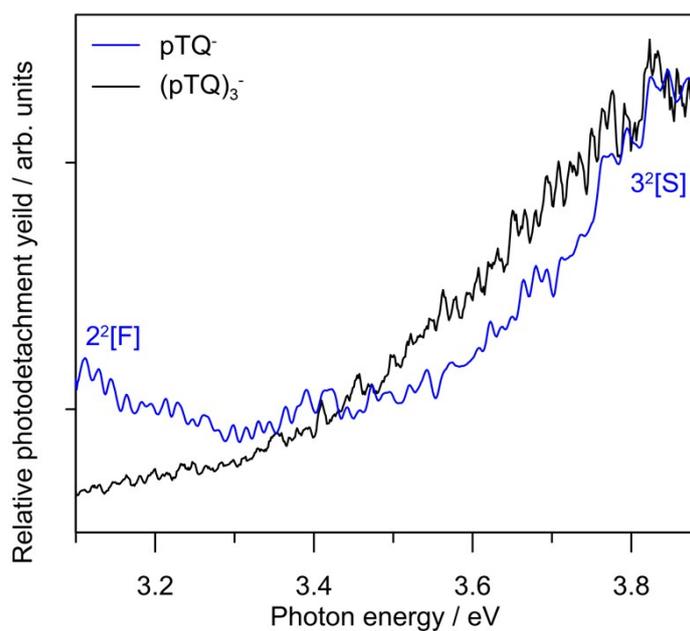


Electronic Supplementary Information for “Dynamics of π^* -resonances in anionic clusters of *para*- toluquinone”

James N. Bull and Jan R. R. Verlet

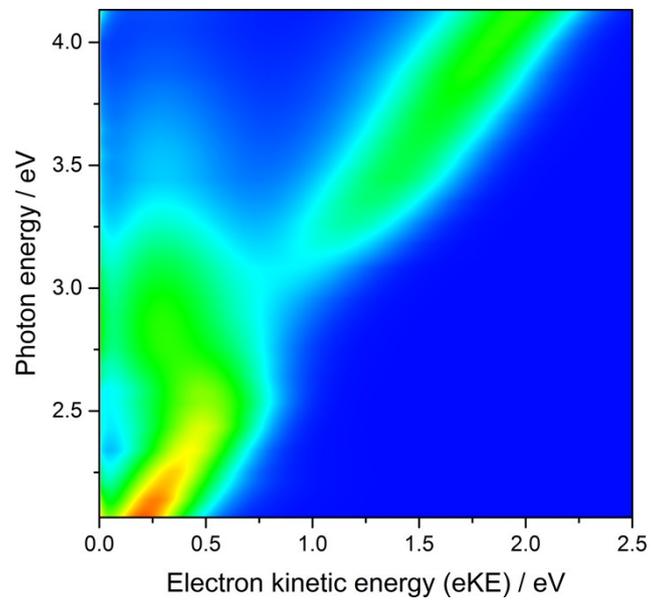
Photodetachment yield spectra for pTQ^- and $(\text{pTQ})_3^-$

Photodetachment yield spectra for pTQ^- and $(\text{pTQ})_3^-$, which plot total photoelectron signal with photon energy, are shown below. For pTQ^- , the photoelectron yield for $h\nu > 3.6$ eV corresponds to the onset of the bright $3^2[\text{S}]$ resonance. The MCP gate width was 50 ns for both spectra.



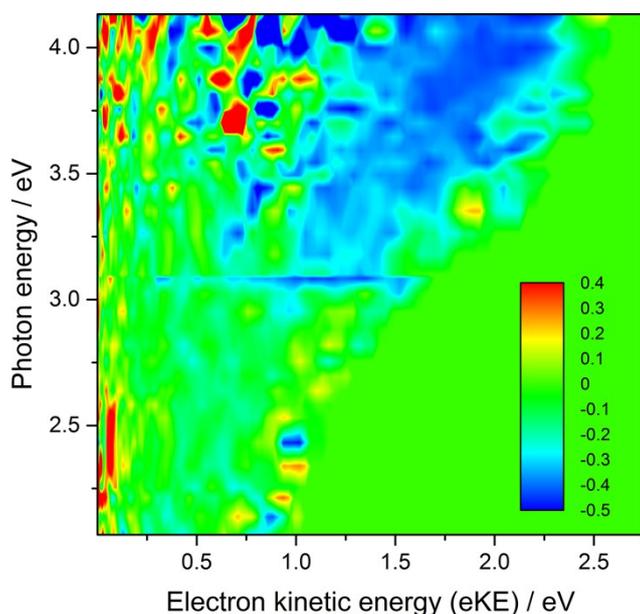
Global fit of the pTQ^- frequency-resolved spectrum

The global fit of the pTQ^- frequency-resolved spectrum, from which the detachment channel contributions were obtained, is shown below. There is excellent agreement between the experimental data and fit for all $h\nu$.

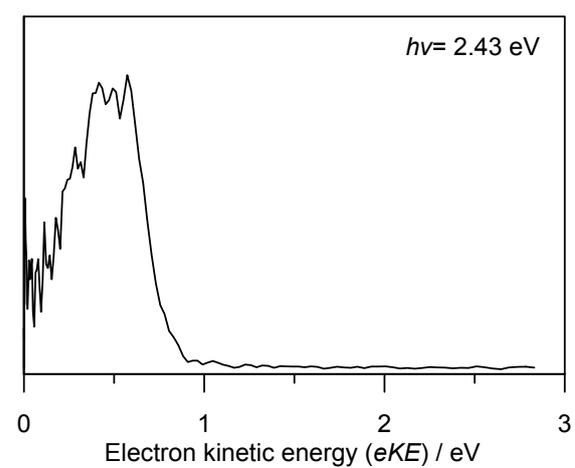
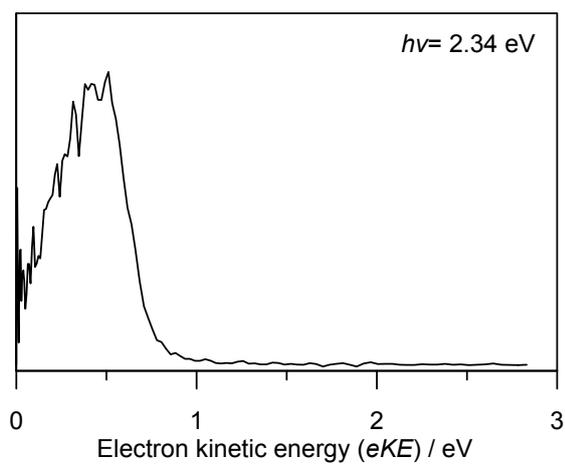
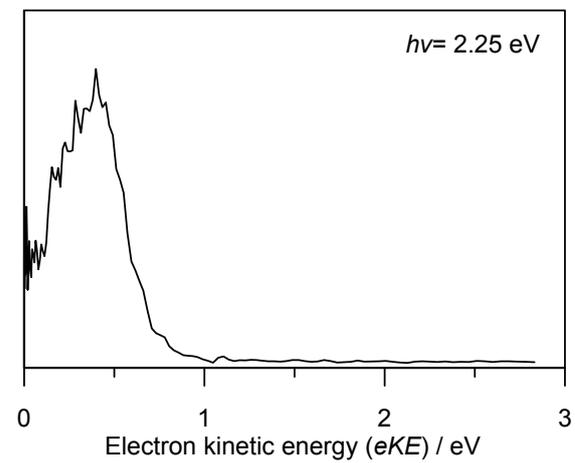
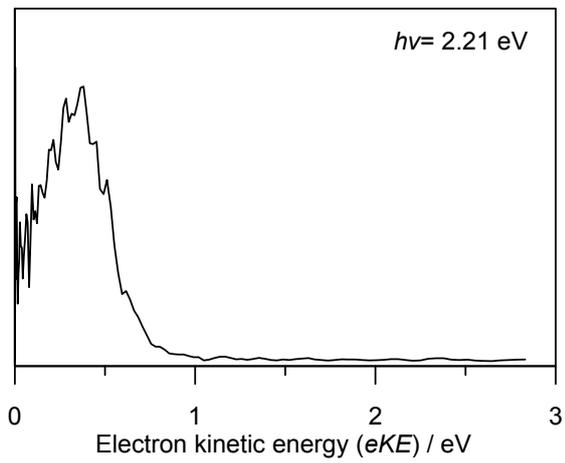
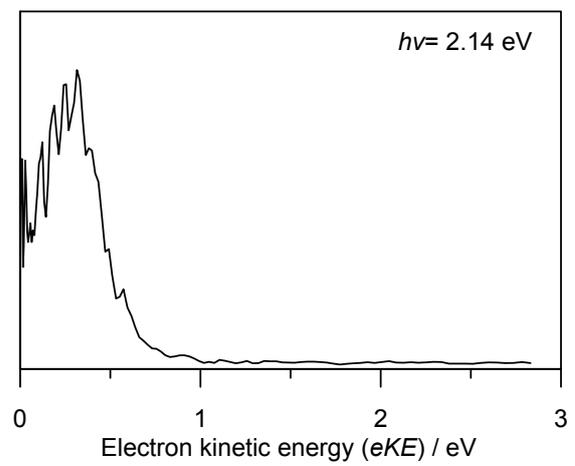
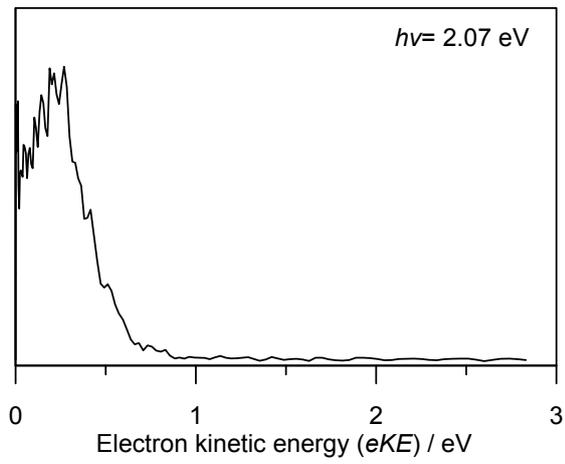


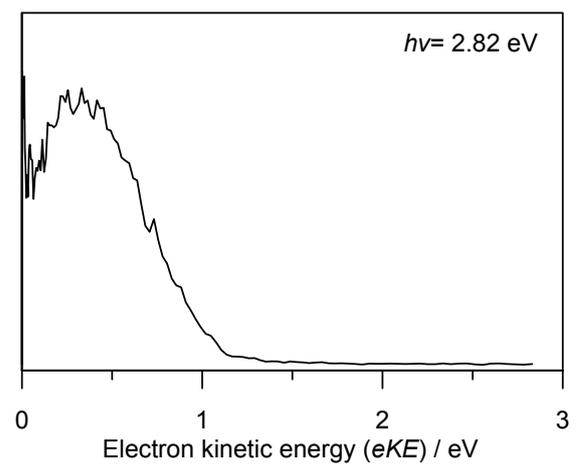
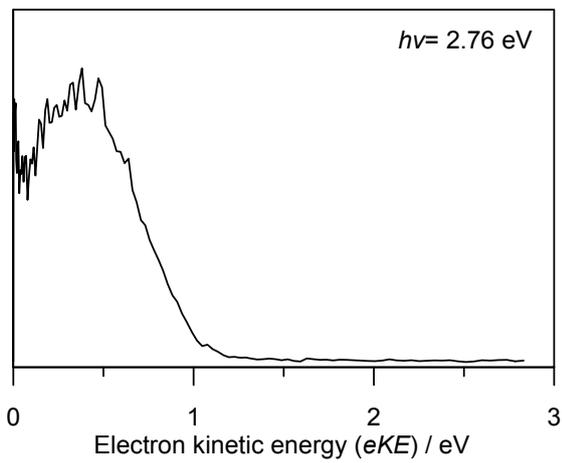
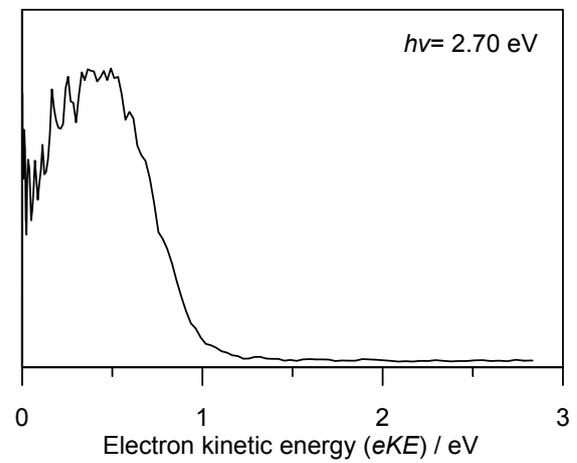
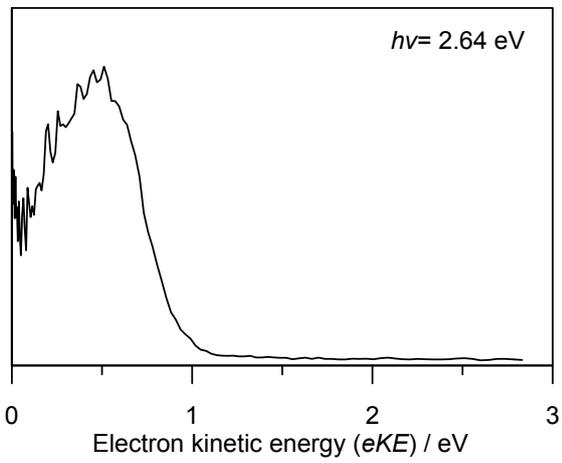
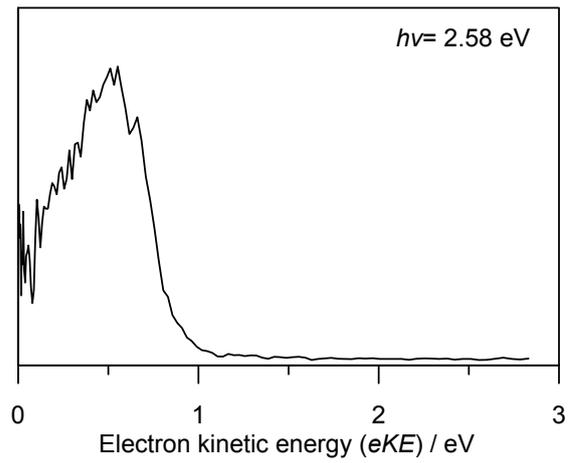
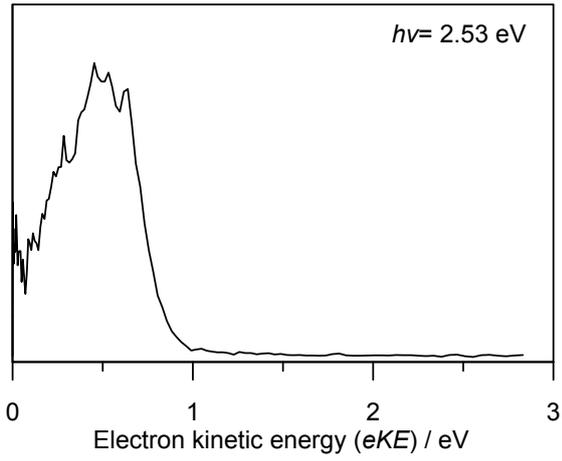
Angular distributions for the pTQ⁻ frequency-resolved spectrum

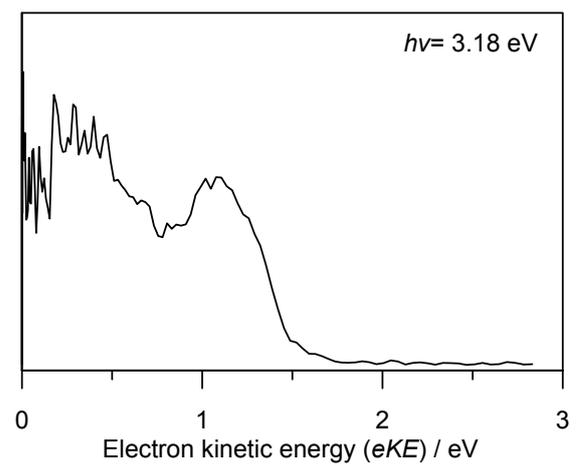
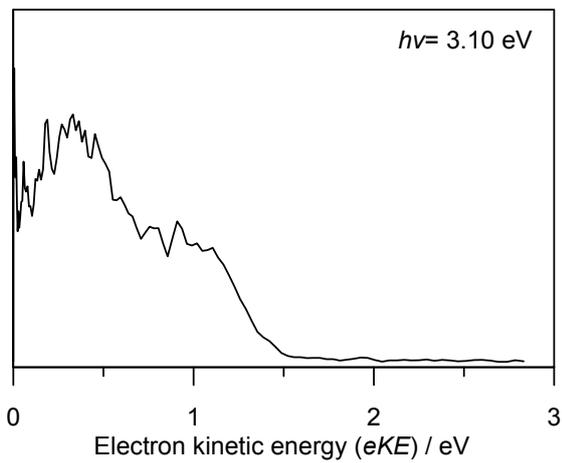
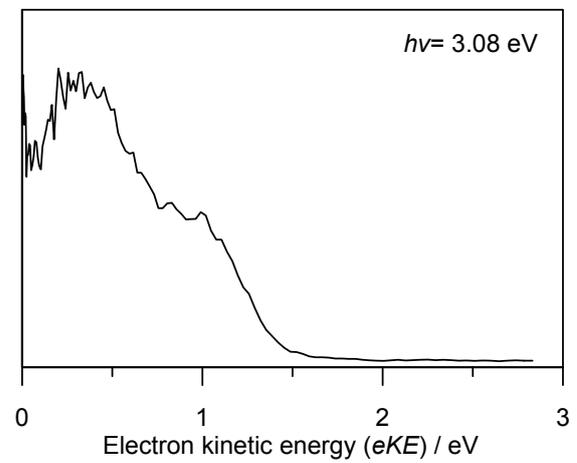
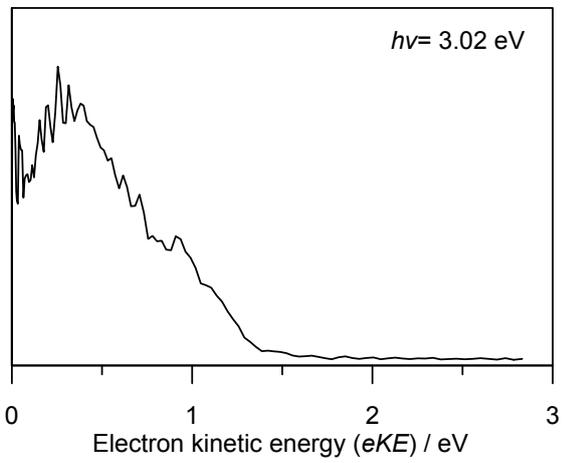
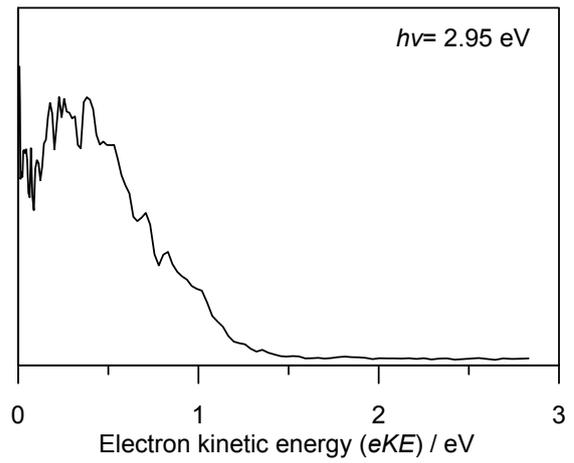
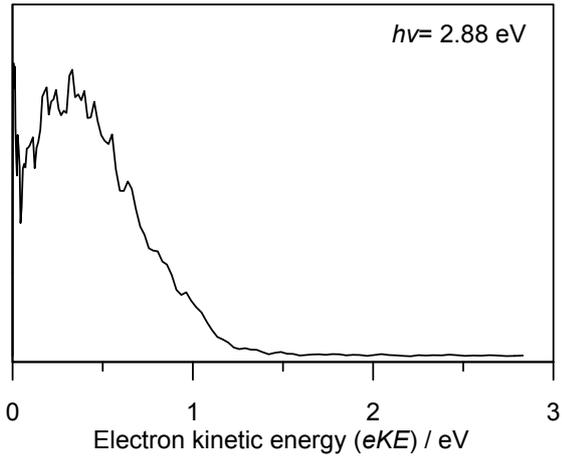
The photodetachment angular distributions associated with the frequency-resolved spectrum for pTQ⁻ are shown below. Angular anisotropy is quantified in terms of the conventional β_2 parameter, ranging $-1 \geq \beta_2 \geq 2$, where -1 and 2 correspond to electron ejection parallel and perpendicular with the laser polarization vector, respectively. $\beta_2 = 0$ corresponds to isotropic electron ejection. Overall, these β_2 are less pronounced than those for pBQ⁻ [see West et al., *J. Phys. Chem. A*, 2014, **118**, 11346]. For example, pBQ⁻ shows clear positive and negative β_2 parameters for PD and DA channels for $h\nu < 3.3$ eV; corresponding β_2 for pTQ⁻ are ~ 0 . We attribute the reduction of β_2 for pTQ⁻ to be a result of the reduced symmetry of pTQ⁻ (C_s compared with D_{2h} for pBQ). The negative β_2 region (-0.4) for $h\nu > 3.1$ eV at an eKE consistent with PD confirms electron detachment occurs on a timescale fast compared with molecular rotation.

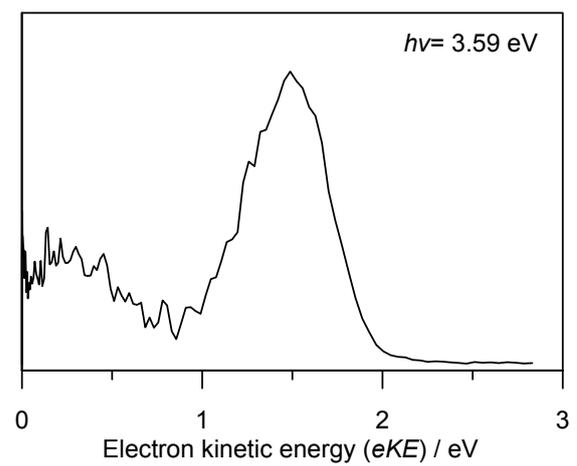
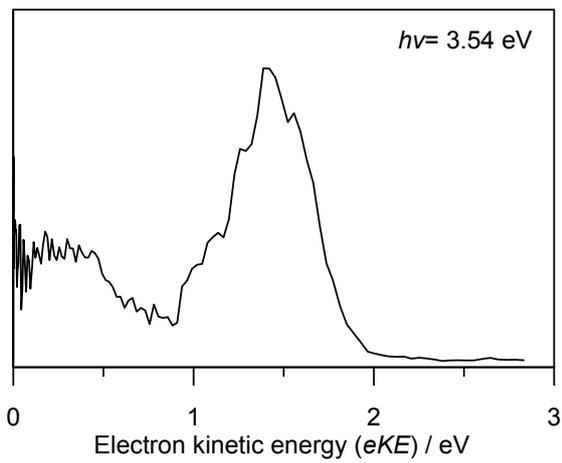
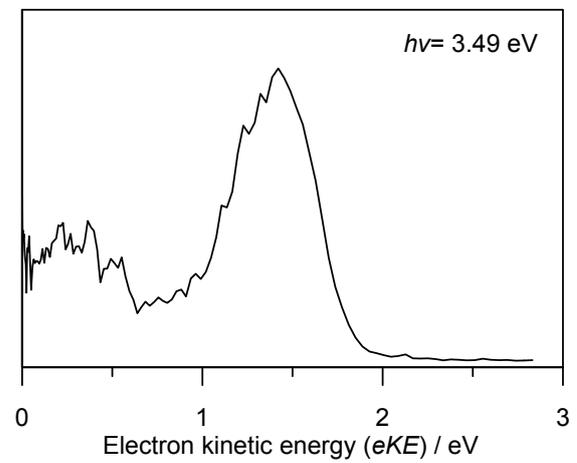
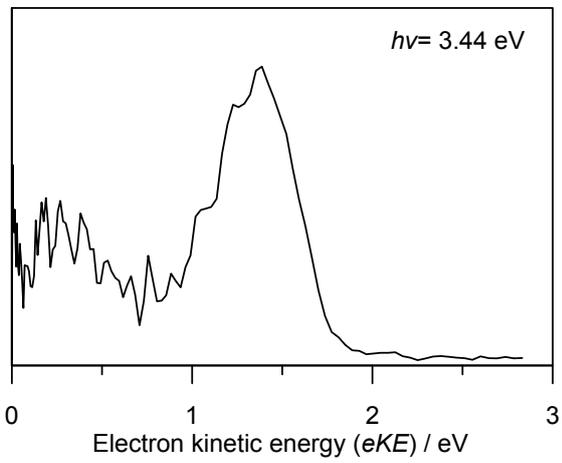
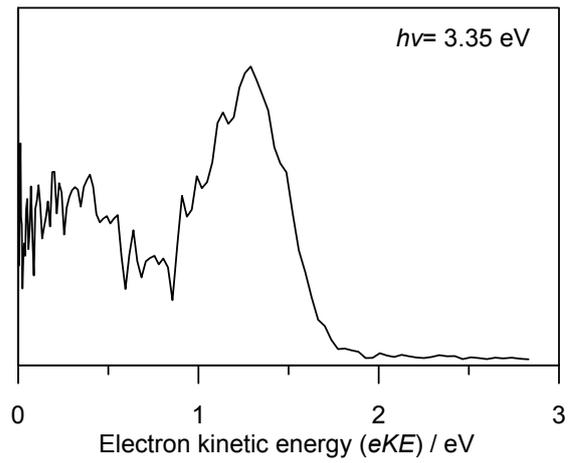
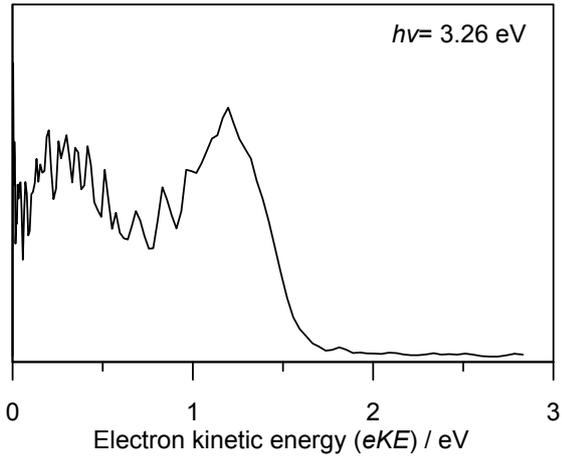


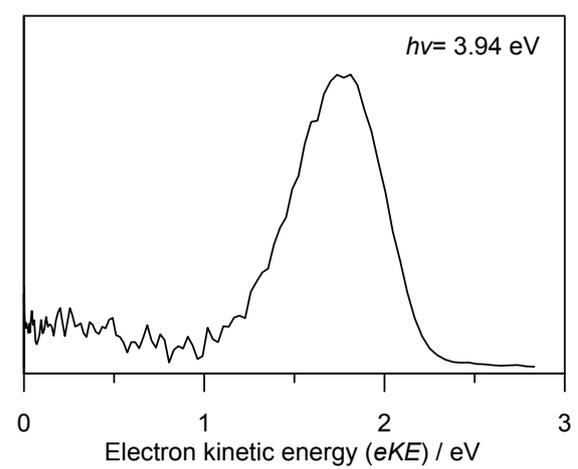
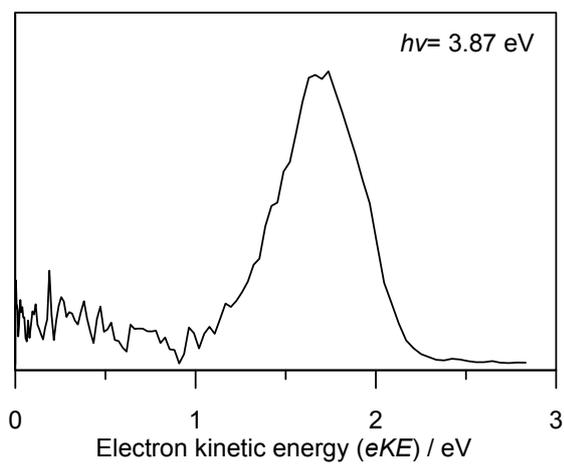
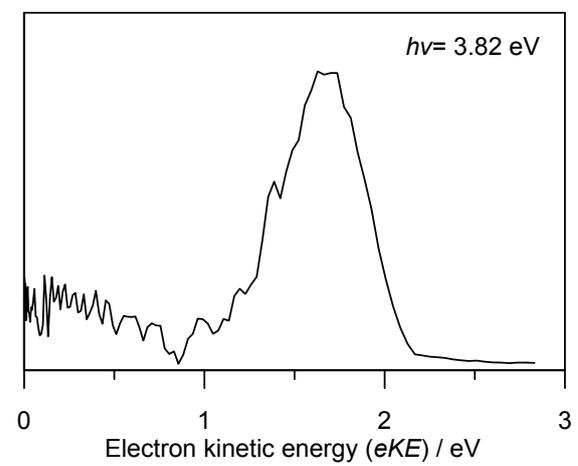
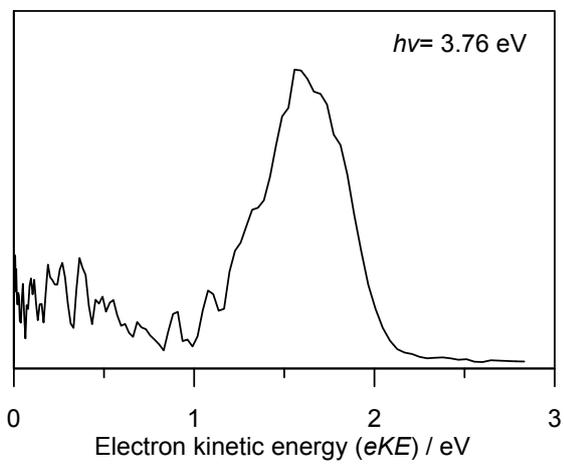
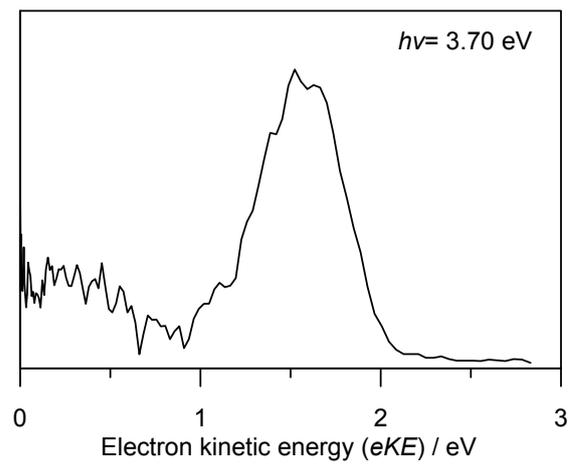
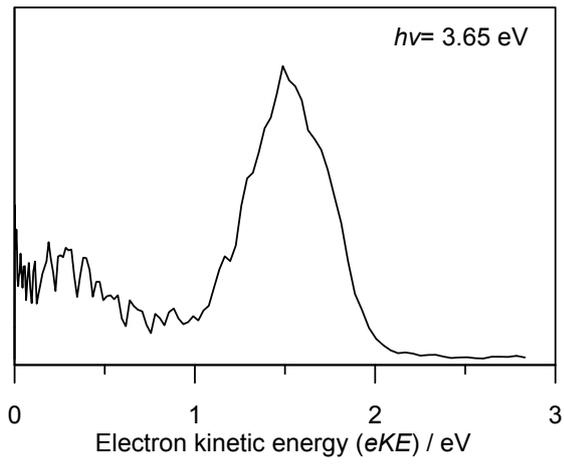
All individual pTQ⁻ frequency-resolved photoelectron spectra

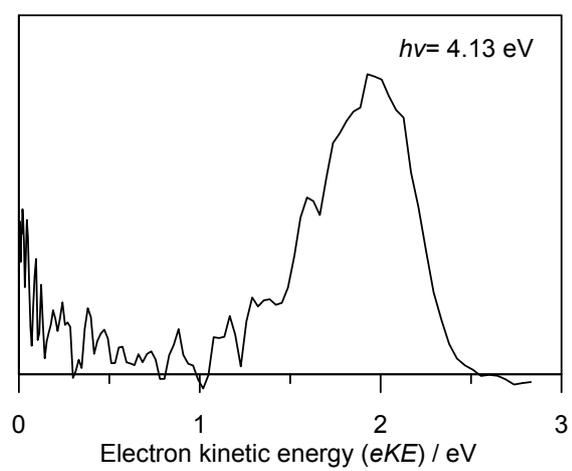
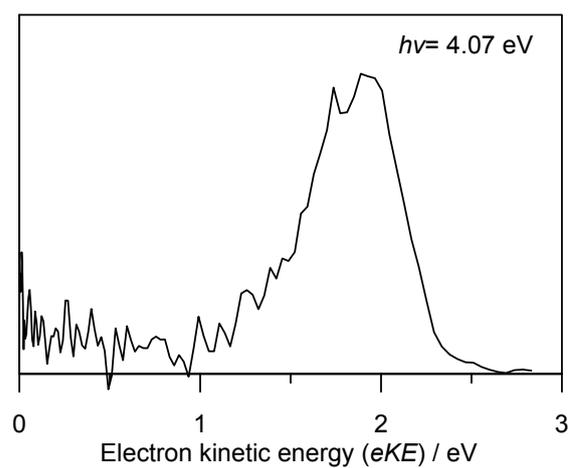
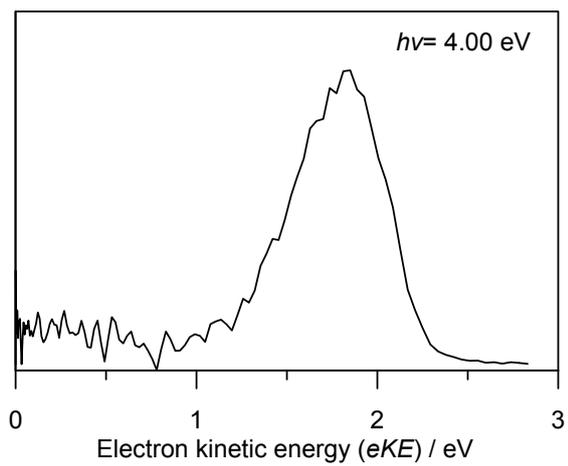












All individual (pTQ)₃⁻ frequency-resolved photoelectron spectra

