Time-resolved photoelectron imaging using hollow-core photonic crystal fibres and capillaries

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1) This work was supported by EPSRC Grants EP/R000448/1 and EP/P001459/1, and by the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation program: Starting Grant agreement HISOL, No. 679649.

References
Time-Resolved Photoelectron Imaging

Velocity Map Imaging (VMI) Spectrometer

Raw VMI Image

Molecular Movie

Potential Energy

Adiabatic IP

Rotational timescales: ps
Vibrational timescales: fs
Electronic timescales: as

Increasing pump-probe delay
Tuneable UV Generation Light Source
Hollow Core-Photonic Crystal Fibre (HC-PCF)

Broadly tuneable over UV/VUV region 350-120 nm
Vastly improved efficiency (2-3 orders of magnitude)
Ultrashort pulses (<10 fs)

TRPEI and HC-PCF Experiment

Ionisation scheme (1+1')
Pump Photon (HC-PCF): 248 nm
Probe Photon (BBO): 267 nm

Cross Correlation: \( \sim 160 \) fs

Styrene Photoelectron Spectrum

Decay Associated Spectra (DAS) Plots
Exploiting the time-resolution
Incorporate fibre in both pump and probe beams

- Tuneability Vis-UV
- Limited time resolution due to GVD

- Tuneability Vis-VUV
  - No GVD, pulses as short as 7 fs
TRPEI and HCF Experiment

- MgF₂ window, 1mm
- Capillary ~1m, Ø320 µm, He 9 bar
- 50/50 BS
- Chirped mirrors
- Motorised stage
- Capillary ~0.5m, Ø150 µm, Ar 0.35 bar
- HC-PCF Ø 25 µm
- HCF Ø 150 µm

Butadiene cross correlation

Pump λ=250 nm
Probe λ=800 nm

FWHM ~ 10 fs