Beating complexity through selectivity: excited state dynamics and multi-centre dynamics with X-rays

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The selectivity of resonant X-ray spectroscopy is at the core of scientific progress, where electronic, chemical, magnetic properties are derived in an atom specific way. Despite the unique selectivity of resonant soft X-ray spectroscopy time resolved investigations of dynamic processes pose three fundamental challenges. Firstly the fraction of excited moieties within materials is difficult to separate from the unexcited surrounding, secondly cross sections are low and thirdly the dynamics detected at one atomic centre cannot determine the nature of a transfer of excitation between different atomic centres. To yield excited states selectivity Anti-Stokes resonant X-ray Raman scattering create unique selectivity [1,2] to enhance cross-sections and to reach multi-centre dynamics non-linear soft x-ray probes [3,4] and two colour X-ray experiments show promising capabilities [5,6]. An alternative route to create unique excited state selectivity is the exploitation of low energy excitations present in critical fluctuations through constructive interference conditions in resonant inelastic X-ray scattering from ongoing work, which could lead in connection to time resolved experiments to insights on how phase transitions are driven by selective modes.

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