On- and Off-Resonance Double-Core-Hole Electron Dynamics in Neon

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Ultrafast electron dynamics of atomic and molecular systems after direct photoexcitation have been extensively investigated with attosecond resolution during recent years. We extend these measurements to the study of nonlinear excitation mechanisms in double-core-hole generation by following population and decay of resonant Rydberg versus non-resonant ionised states in gaseous neon via angular streaking. The high photon flux at the European XFEL allows to measure complete electron spectra in a single shot while at the same time characterising the X-ray pulses triggering the process, thus avoiding ambiguities due to the stochastic FEL pulse shapes.