

# Ultrafast Nuclear Motion in Cl 1s Core-Excited HCl and DCl probed by Resonant Inelastic X-Ray Scattering: Experiment and Theory.

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Observation of electron dynamics in the attosecond domain using core-hole spectroscopy as an internal clock was recently demonstrated [1]. Taking advantage of very short core-hole lifetime (0.9 fs), we have investigated sub-femtosecond nuclear dynamics following resonant inner-shell excitation at the chlorine K-edge of gas phase HCl [2] and DCl. A newly developed experimental setup was used at the Advanced Light Source (Berkeley, USA) to perform Resonant Inelastic X-Ray Scattering (RIXS) measurements of the KV and KL x-ray emission [3]. Emission lines with asymmetrical profiles and dispersive behavior with the excitation energy were observed. These effects are described in terms of resonant x-ray Raman scattering [4] using the topology of the potential energy curves *ab initio* calculated. The observed vibrational collapse is interpreted by the theory. The elastic scattering emission is shown to be highly asymmetric at resonance. This asymmetry is interpreted as a signature of nuclear motion in the intermediate excited state. In this communication, we will compare experimental and theoretical results obtained on HCl and DCl.

## References:

[1] Föhlisch et al, Nature 436, 373 (2005), [2] M. Simon et al. Phys. Rev. A 73, 020706 (2006), [3] A. Hudson et al, to be published, [4] F. Gel'mukhanov and H. Ågren, Phys. Rep. 312, 87 (1999)