

Spécialité de Master « Optique, Matière, Plasmas »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage

Date de la proposition :

Responsable du stage / internship supervisor:	
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Adresse / address: 11 rue Pierre et Marie Curie 75005 Paris	
Lieu du stage / internship place: LCPMR et SOLEIL	

Titre du stage / internship title: Schrodinger's cat at the molecular level: quantum superposition studied via core-hole localization or delocalization in molecular photoionization.
Résumé / summary <p>Contrary to valence electrons that are intrinsically delocalized in molecular systems, core electrons are localized, and the localized or delocalized nature of inner holes created on two equivalent atomic sites in diatomic molecules has recently been the subject of different studies [1,2,3]. These previous studies on core photoionization have shown either complete delocalization or a partial localization of the core hole under specific conditions. Our recent results on the photoionization of CS₂ at the S 1s edge have provided a wealth of information on the fragmentation dynamics and quantum entanglement at the molecular level. Depending on the selected fragmentation pathway, the 1s core hole appears either fully localized or fully delocalized.</p> <p>Following these findings, the objective of the present proposal is to extend the study of core localization or delocalization to deep core photoionization in two complementary systems, namely Cl₂ and SOCl₂. Because these two systems present both two equivalent Cl atoms, but different symmetry degrees and interatomic distances, they are perfect candidates to study effects of electronic states entanglement in deep core photoionization. Molecular frame photoelectron angular distributions (MFPAD) are unique fingerprints of these effects.</p> <p>We will measure MFPAD after core Cl1s photoionization by multiple particle correlations in the 'tender' x-ray domain, 1keV to 8keV. The CELIMENE experimental setup is based on a double time-of-flight spectrometer equipped with delay-line position sensitive detectors to apply the Vector Correlation method to the experimental study of site-selective photoionization and fragmentation of molecules. The technique allows the measurement of momentum vector correlations between charged particles emitted during the photoionization of gas phase species by measuring the velocity vectors of each particle (ions and electrons) detected in coincidence [4,5]. The physical observables provided by this type of measurements are directly linked to dipole matrix elements, amplitudes and relative phases, and thus constitute the most stringent test for theory at this time. Measurements will be done at the French synchrotron source SOLEIL during the first semester of 2014.</p> <p>[1] D. Rolles <i>et al.</i>, Nature 437, 711 (2005). [2] F. Martin <i>et al.</i>, Science 315, 569 (2007). [3] M.S. Schöffler <i>et al.</i>, Science 320, 920 (2008). [4] R. Guillemin <i>et al.</i>, Phys. Rev. A 84, 063425 (2011). [5] R. Guillemin <i>et al.</i>, Phys. Rev. Lett. 109, 013001 (2012).</p>

Ce stage pourra-t-il se prolonger en thèse ? Possibility of a PhD ? : Oui			
Si oui, financement de thèse envisagé/ financial support for the PhD: Bourse MESR ou CNRS/SOLEIL			
Lasers, Optique, Matière		Lumière, Matière : Mesures Extrêmes	X
Plasmas : de l'espace au laboratoire			

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