Probing Dynamic in Correlated Systems

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The development of femtosecond lasers brought advances in time-resolved investigations in the IR, visible and UV as well as enabling the capabilities of non-linear spectroscopies [1]. The revolutionary tool for observing molecular motion in real time has been pump-probe schemes [2-6].

The advent of ultrafast x-ray light sources, however, is timely, since, even with the major advances in the capabilities of lasers, we lack a detailed understanding of the mechanisms of the action of radiation at very short times following a broad range of energy depositions in an isolated system. We also lack understanding of the time-dependent energy dissipation from a quantum mechanical point of view. Comprehensive information on the interaction and decay pathways following energy deposition is much needed in gas-phase systems such as atoms, molecules, clusters, and their ions. Time-dependent studies of carefully selected systems and comparison with the results of forefront theoretical methods will provide the basic knowledge of the behavior of matter in the ultrafast and ultra-intene regime accessed for example by the future LCLS source.

We believe that ultrafast physics of atoms, molecules, clusters and their ions is an important and interesting grand challenge especially since it benefits from a strong connection with many theoretical groups. These studies enable a better understanding of many body-processes in photoionization and their various dynamic manifestations. Specifically, investigating the dynamics and competing mechanisms that lead to various phenomena when the inner-shell electrons of these systems are excited with ultrafast and ultra-intense linearly and circularly polarized light should provide new physics.

We will present recent work carried on inner-shell photodetachment of atomic and cluster negative ions, as well as out on van der Waals clusters at the ALS. We believe that the study of these targets represent excellent candidates for emerging scientific areas in the time domain science.

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