Collisions dynamics of electrons, photons, and highly-charged ions with clusters to probe the aggregation in a pulsed supersonic jet

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Collimated intense supersonic beams of atoms, molecules, and clusters constitute an ideal target for many collision investigations in which the kinematics have to be well defined. Reliable predictions of cluster size distribution [1, 2], clustering rate and absolute atomic densities [3] remain still debated and require to be quantitatively determined. Combining three different experimental approaches, we achieve a good understanding of the temporal evolution of a pulsed rare gas supersonic jet. More precisely we discriminate between the temporal contribution of the atomic density and the cluster one within the same bunch. Looking at the X-ray emission resulting from inner-shell vacancy production [4], we exploit the fact that those experiments with the supersonic jet are: i) sensitive to all atoms, aggregated or not when interacting with a well collimated beam of electrons, ii) only sensitive to clusters with intense ultra-short laser pulses [5] and iii) mainly sensitive to unclustered atoms with Highly Charged Ions [6]. Those three measurements, performed under well-controlled conditions, are fully consistent with each other and give access, for the first time, to the clustering rate in a rare gas supersonic jet. Further experiments, currently under progress, should provide a full characterization of the aggregation depending upon different parameters of the cluster jet.

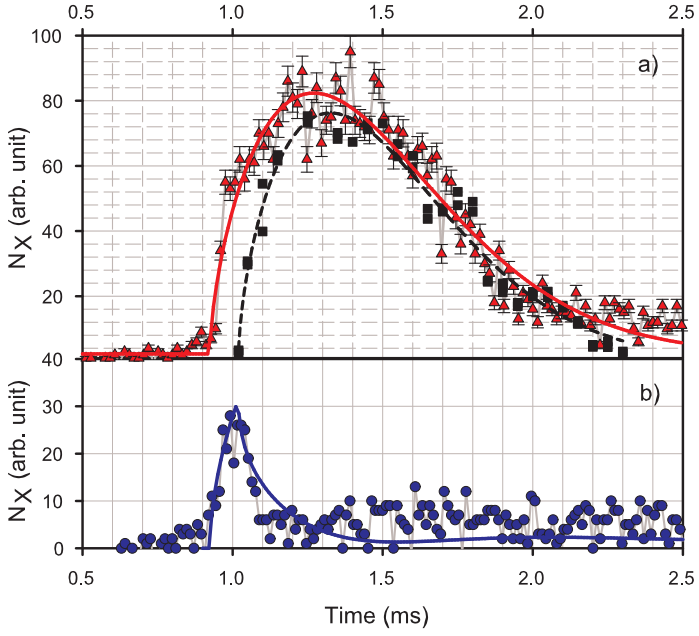

Figure 1: *Time dependant X-ray signal for the interaction of argon cluster bunches with electron (a - triangle), fs laser pulses (a - square), with Highly Charged Ions (b).*

References

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