Service des Photons, Atomes et Molécules
SÉMINAIRE

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Multimass imaging with fast pixel detectors

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Velocity-map imaging has truly captured the imagination of the reaction dynamics community, and has become the detection technique of choice when investigating the photodynamics of small molecules. Photofragment velocity distributions are highly sensitive to the detailed dynamics of the fragmentation process, and imaging experiments on state-selected fragments have allowed us to explore such processes at unprecedented levels of detail. The success of velocity-map imaging in the field of reaction dynamics has led us to consider broader applications for the technique in the more general area of time-of-flight mass spectrometry. We are currently investigating the possibility of developing a next-generation mass spectrometer which, in addition to the conventional mass spectrum, records the complete velocity or spatial distribution of the ions at their point of formation for each mass. In contrast to a conventional velocity-map imaging setup, such an instrument requires a means of universal (rather than state-specific) ionization, improved mass resolution, and the ability to record images of multiple ions on each time-of-flight cycle. Incorporating a universal ionization source into a velocity-map imaging setup is relatively straightforward, and we currently have two such ionization sources, employing VUV ionization at 118 nm (10.48 eV), and electron impact ionization, respectively. Achieving true multimass imaging is much more challenging, requiring a camera capable of recording and storing multiple frames with exposure times on the nanosecond timescale within a typical time-of-flight data acquisition cycle of tens to hundreds of microseconds. We will report early of both velocity-map and spatial-map imaging mass spectrometry using three suitable detectors: a fast framing CCD camera, the TimePix CMOS sensor developed for particle physics applications at CERN; and the dedicated PImMS (Pixel Imaging Mass Spectrometry) event-counting CMOS image sensor developed in collaboration between the University of Oxford and the Rutherford Appleton Laboratory.
