CFEL SCIENCE

SEMINAR

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CFEL – Building 99, seminar room I+II (ground floor)

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2D-detectors for Photo Ionization Studies of Atoms, Molecules and Clusters at Elettra

In the study of the electronic structure of atoms, molecules, and clusters, Velocity Map Imaging (VMI) of charged particles produced by photon impact is a valuable research tool, boosted in recent years by advances in both 2D detectors and light sources. At the Italian facility Elettra, featuring a third generation synchrotron and the free electron laser FERMI, the ongoing collaboration between the Atomic and Molecular Physics group, and the Instrumentation and Detector Laboratory, has resulted in a prototype set-up, built around a VMI spectrometer, with the flexibility to perform synchrotron radiation (SR) as well as free electron lasers (FEL) experiments, just by changing the last stage of detection.

In SR experiments, at the GasPhase synchrotron beamline, a crossed-delay-line detector is used, coupled to a 4-channel time-to-digital converter that reconstructs the position of the electrons. It operates in tandem with a Time-of-Flight (TOF) mass spectrometer, used to acquire photoion spectra. Such a system allows PhotoElectron-PhotoIon-Coincidence (PEPICO) spectroscopy of atoms, molecules and clusters, by correlating the kinetic energy and emission angle of photoelectrons with a specific photoion mass.

FEL experiments notably differ from SR experiments in the much higher rate of events produced and detected, which forces one to forfeit coincidence detection. At the Low Density Matter (LDM) beamline of the free electron laser FERMI, a Micro Channel Plate (MCP) a phosphor screen and a CCD camera are used; the system is capable of shot-by-shot collection of practically all events, albeit without time resolution. Femtosecond pump-and-probe experiments can be performed to access the electron dynamics.

New generation SR and FEL sources require novel concepts of photon beam diagnostics, arising from the need for accurate monitoring of position,intensity, and temporal structure. I will illustrate the capabilities of the two VMI detection systems with recent results of experiments on rare-gas atoms and clusters, and present preliminary results on diamond Photon Beam Monitors.

Host: Sebastian Trippel / CFEL Molecular Physics Seminar