Collaborations

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Michael Meyer: Associated scientist on the "Two-colour experiments" programme, LIXAM Orsay (soon ISMO)
LCPMR: Laboratoire de Chimie Physique Matière et Rayonnement - Paris
LCAM: Laboratoire de Collisions Atomiques et Moléculaires - Orsay
LCP: Laboratoire de Chimie Physique - Orsay
ISMO: Institut des Sciences Moléculaires d'Orsay
SPAM: Service des photons, atomes et molécules, CEA - Saclay
Department of Physics and Materials Science: Uppsala University - Sweden
Institute of Chemistry and Biochemistry: Freie Universität Berlin - Germany
IMS: Institute for Molecular Science - Okazaki - Japan
KTH: Royal Insitute of Technology - Stockholm - Sweden


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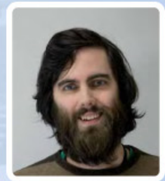
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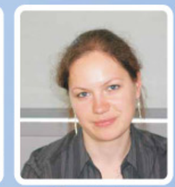
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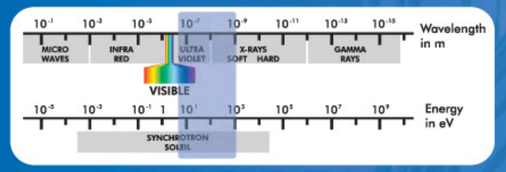
Post-doc


Victor Kimberg
Post-doc


Svante Svensson
Guest professor

Energy range of PLEIADES: 7 – 1000 eV



PLEIADES

Polarized Light source for Electron and Ion Analysis from Diluted Excited Species
High resolution soft X-rays for spectroscopy in the diluted phase

Light source:
Two undulators: an electromagnetic HU256 undulator and a permanent magnet helicoidal HU80 undulator, used according to the desired energy range (7-400 eV or 35-1000 eV)

Investigation techniques used:

- High resolution photoemission and Auger spectroscopy
- Electron-ion coincidence spectroscopy with high energy and angular resolution
- Soft X-ray spectroscopy of ions generated by an ECR (Electron Cyclotron Resonance) source
- 2-colour spectroscopy combining (UV and visible) lasers and synchrotron radiation

Topics and applications

→ Relaxation dynamics of inner-shell excited species

- Nuclear motion/electronic relaxation competition in molecules, clusters and isolated nanoparticles studied by energy and angle resolved resonant Auger-Raman spectroscopy and Auger electron-ion coincidence measurements
- Role played by inner-shell excitation/ionization in irradiated biological matter degradation processes: fragmentation dynamics of biomimetic compounds
- Dispersed fluorescence spectroscopy of inner-shell excited species (LIXAM)
- Photodissociation processes of inner-shell excited molecules studied through pump-probe experiments (laser + synchrotron radiation) (LIXAM)

Applications: ultrafast dynamics, nanoscience, radiobiology

Schematic diagram of the fragmentation of the CO_2 molecule induced by K-shell excitation of the carbon atom by an X-ray photon. The geometry change of the molecule in its excited state affects its Auger relaxation and thus its further dissociation.

→ Single and multiple photo-ionization of atoms and molecules. Photo-ionization of ions

- Atom and diatomic molecules momentum imaging (LIXAM)
- Spectroscopy of many-electron processes / electron correlations (LCPMR, LIXAM)
- Dissociative photo-ionization of inner-shell ionized simple molecules using the vector correlation method (LCAM)
- Non dipolar effects near inner-shell ionization thresholds (LCPMR)
- Photo-ionization of singly or multiply charged atomic or molecular ions (LIXAM)
- Auto-detachment relaxation of negative ions (LCPMR)

Applications: astrophysics, plasma physics


MAIA (Multi-Analysis Ion Apparatus) ion photo-ionization experiment using an ECR (Electron Cyclotron Resonance) plasma source.


Planetary nebula "Cat's eye Nebula" (NGC 6543) observed by the Hubble telescope (NASA/ESA) in 2004.
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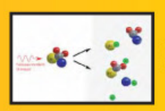
→ Chemical reactivity and photochemistry

- Selective photochemistry of inner-shell ionized molecules
- Reactions between doubly charged ions and molecules (LCP)
- Inner-shell spectroscopy of mass selected mixed clusters
- Chemical reactivity of clusters and isolated nanoparticles investigated by soft X-ray electron and ion spectroscopy

Applications: photochemistry, nanochemistry, catalysis


Selective photo-dissociation process of CH_2BrCl for Br 3d or Cl 2p shell ionization.

Zoom: EPICEAA electron-ion coincidence setup

EPICEAA is the French acronym for "energy and angle resolved photo-ion / Auger electron coincidence experiment".

Relaxation of an inner shell excited isolated species occurs through a number of processes in which nuclear and electronic motions compete. In the case of K-shell vacancies of light elements (C, N, O, ...) the lifetime of the vacancy has the same characteristic time-scale as the nuclear motion of the molecule, i.e. a few femtoseconds.

We are particularly interested in resonant processes inducing significant geometrical changes in the studied molecular system, which leave it in a non-equilibrium state and lead to complex relaxation dynamics. In order to obtain detailed understanding of such fast dynamics (some femtoseconds) and associated fragmentation processes, coincident measurements of the electron kinetic energy and emission angle, on the one hand and of the fragment ions mass, kinetic energy and emission angles, on the other hand, must be performed.

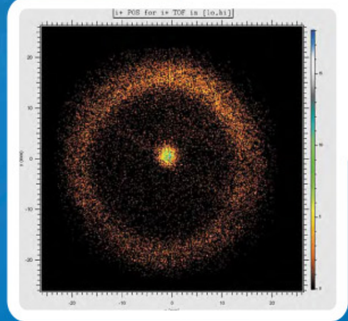


Image from the electron spectrometer's position sensitive detector of the EPICEAA experiment. Two ions with the same mass to charge ratio (m/q), resulting from different relaxation mechanisms, can be distinguished, owing to their different impact position determined by their kinetic energy and emission angle.

The electrons are analyzed with an original double toroidal electron spectrometer designed for optimal collection efficiency. The setup combines the electron spectrometer and charged particle imaging devices enabling electron and fragment ion energy and angular correlation measurements to be carried out on molecules, clusters and isolated nanoparticles.

SOLEIL SYNCHROTRON