Imaging controlled nanoparticles

PhD / PostDoc project

CFEL SCIENCE
Controlled Molecule Imaging

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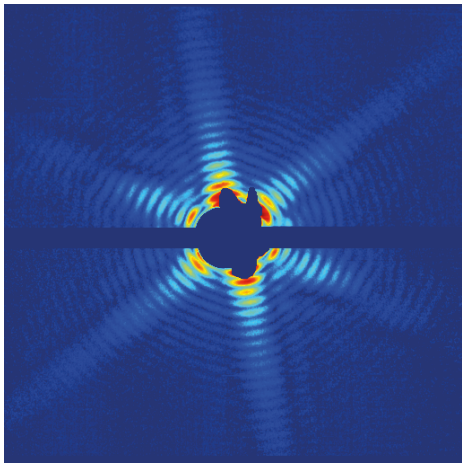
The Controlled Molecule Imaging group at the Center for Free-Electron Laser Science at DESY and Universität Hamburg performs novel experiments on the control and imaging of gas-phase molecules and their ultrafast dynamics with applications in fundamental physics, chemistry and structural biology.

We develop new experimental approaches to cool and control complex molecules, such as spatial separation of individual molecular species, alignment and orientation of molecules in space, and the creation of well-defined molecular wavepackets. We image molecular structures and dynamics — recording movies of molecules at work — using ion and electron imaging as well as coherent diffractive imaging techniques with x-rays and electrons. This work is accompanied by sophisticated data analysis, computational modeling, and *ab initio* theory developments.

Cooling, controlling, and imaging of nanoparticles

Within this project, you will use newly developed sources for cold nanoparticles and bio-molecules, such as cryogenic buffer-gas cells, and develop advanced methods to strongly control these systems. The shock-frozen, cold samples emitted from the buffer-gas cell can be further controlled using strong inhomogeneous electric fields. This allows one to select single structural isomers, i.e., different structural arrangements such as folded vs. globular proteins, based on their distinct interactions with the field. Furthermore, in combination with strong ac electric or laser fields these systems can be aligned and oriented in space, rendering the individual molecules practically identical even in laboratory space.



X-ray diffraction pattern from isolated particle.

The developed experimental setups will be employed for novel diffractive- imaging experiments, both at FEL facilities as well as in laboratory based setups.

Int. Rev. Phys. Chem. **34**, 557 (2015) – DOI: 10.1080/0144235X.2015.1077838
Opt. Exp. **24**, 6507 (2016) – DOI: 10.1364/OE.24.006507

CMI offers unique research opportunities in an interesting, open, international team and with first-class experimental and computational facilities. Our group is embedded in the Center for Free-Electron-Laser Science, Deutsches Elektronen-Synchrotron DESY, Universität Hamburg, and the Hamburg Center for Ultrafast Imaging.

https://www.controlled-molecule-imaging.org

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