

IMPRS UFAST Call for PhD applications 2026/2027

JK&AS - Cryogenically cooled and controlled beams of proteins for single-particle diffractive imaging

Title of PhD Project	Cryogenically cooled and controlled beams of proteins for single-particle diffractive imaging
Type	Experimental
Supervisor(s)	Prof. Dr. Jochen Küpper, Dr. Amit Samanta
Affiliation(s):	IMPRS, CFEL, DESY, UHH
Number of positions:	1
Abstract:	We develop novel sample preparation and control concepts for structural biology at x-ray free-electron lasers. We implement and advance techniques to shock-freeze solvated biological nanoparticles and macromolecules to image and characterize these samples with atomic resolution. This project especially focuses on developing and implementing experimental methodology that allows the spatial separation of macromolecular conformers in sample-injection pipelines for XFEL single-particle imaging (SPI) experiments. In the Controlled Molecule Imaging group, we have extensive experience in developing novel approaches to cool and control polyatomic molecules, to spatially separate individual species, to align and orient them in space, and to create well-defined quantum-mechanical wave-packets and novel states of molecular matter. We are aiming to exploit this strong background and extend these methods to bio-macromolecules, e.g., proteins, and to create high-density beams of individual conformers. We will also exploit the cryogenic buffer-gas cooling technique to control the protein beam temperature and improve their spatial separation. These experiments will be accompanied by state-of-the-art data analysis and computational modeling. The created high-density beams of spatially separated bio-macromolecular conformers will benefit a wide range of experiments in structural biology, including high-resolution single-particle x-ray and electron diffractive imaging. To this end, we collaborate closely with colleagues in (time-resolved) structural biology, infection biology, and the life sciences.
Contact person for scientific questions about the project:	Prof. Jochen Küpper: jochen.kuepper@cfel.de Dr. Amit Samanta: amit.samanta@cfel.de
Research Group Website:	https://www.controlled-molecule-imaging.org