



IMPRS UFAST Call for PhD applications 2026/2027

SP - Ultrafast surface X-ray imaging for fusion research, relativistic particles and laser nano-processing



Title of PhD Project	Ultrafast surface X-ray imaging for fusion research, relativistic particles and laser nano-processing
Type	Experimental
Supervisor(s)	First Supervisor: Sakura Pascarelli (EuXFEL IMPRS faculty member) Second supervisors: Motoaki Nakatsutsumi, S.V. Rahul, Ulf Zastrau
Affiliation(s):	European XFEL
Number of positions:	1
Abstract:	The project will develop a reflection-geometry X-ray imaging capability at the European XFEL. By probing the surfaces and subsurfaces of laser-driven matter under extreme conditions, this technique will provide nanometer-scale height sensitivity and reveal crucial interfacial information in matter driven by the advanced lasers available at the HED-HiBEF instrument; ReLaX/DiPOLE/PP lasers (see “Research Group Website”). The ultra-intense ReLaX laser generates energetic electron and proton beams relevant to fast-ignition approaches to inertial-confinement fusion. Structured surfaces, such as gratings, are expected to enhance plasma heating and laser-particle coupling; however their ultrafast evolution has not yet been directly visualized. Millijoule-class femtosecond lasers (e.g. PP laser) can create nano-gratings transiently or permanently through laser-Induced Periodic Surface Structures (LIPSS). This project will enable real-time visualization their formation dynamics. High-energy nanosecond-duration lasers are used to compress fusion fuels, but interfacial instabilities and mixing can reduce compression efficiency. We will therefore investigate the transient evolution of surface and interface morphologies using our DiPOLE nanosecond-duration laser. The project will establish grazing-incidence imaging capability at XFEL facilities and develop X-ray propagation models, incorporating machine learning or artificial intelligence where appropriate. The PhD researcher will participate in experiments at major XFEL facilities, including European XFEL, SACLA, and LCLS, and collaborate with international partners.
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Research Group Website:	https://www.xfel.eu/facility/instruments/hed/index_eng.html