Non-equilibrium matter states using ultrashort engineered laser beams; matter dynamics in extreme conditions

Laboratoire Hubert Curien, CNRS UMR 5516 Université Jean Monnet, Saint Etienne
Optics and Photonics Department / Radiation-mater interaction Group

The "Optics and Photonics" department (Radiation-matter interaction group) at the Laboratoire Hubert Curien, CNRS UMR 5516, Jean Monnet University in Saint Etienne, France, is currently seeking a postdoctoral candidate for its research activities. Applications are invited for a position that will open in April 2019. The position is for one year, with possible prolongation.

Environment: Hubert Curien Laboratory is a mixed research unit, jointly run by the "Centre National de la Recherche Scientifique - CNRS" and the Jean Monnet University. The proposed subject concerns laser-assisted transformation of bulk optical materials on micro- and nano-scales. The Ultrafast laser platform located at the Hubert Curien Laboratory hosts state-of-the-art equipment for beam engineering, laser processing, and process characterization.

Project: Defining matter structural characteristics is key for designing materials and functions. To this, ultrafast laser-induced extreme conditions of pressure and temperature in bulk materials can synthetize novel extraordinary phases via potential creation of non-equilibrium excited matter and assist in developing volume integrated 3D optical systems. To this end we develop new concepts of spatio-temporal beam engineering to optimize energy deposition and time-resolved microscopy techniques to observe the dynamics of material transformation in silica. This is of interest in view of its technology potential but equally, its fundamental interest as marker in geophysical high-energy interactions.

Objective: The activity will focus on the achievement of extreme states with record thermodynamic parameters and evolution controllable in space and time, to achieve superdense phases in silica materials. Combining ultrafast non-equilibrium and strong thermo-mechanical constraints, it aims at identifying the drive forces using space-time design of irradiation sources and dynamic observation and simulation of structural dynamics. We expect significant gain in understanding material behaviors in extreme conditions and strong deformation yields.

Job description. The project proposes a scientific introspection into the fundamental mechanisms of laser material modification by studying their dynamics. For this aim, a range of time-resolved (pump-probe) laser-based approaches will be developed via direct or spectral imaging in visible domains, time-resolved quantitative phase microscopy, and time-domain THz probing of the transient anisotropic dielectric function. In parallel techniques of beam engineering would be applied to control and optimize laser interaction, notably time-shaped non-diffractive concepts to be implement with pump-probe experiments. Ex-situ measurements involve high-resolution TEM studies and microscale mechanical tests.

Candidate profile. We are looking for a highly motivated researcher with a strong interest in fundamental and experimental physics and a strong background in optics, mechanics and materials. Experience in developing optical systems and in the utilization of lasers is a plus. Candidates should have a PhD degree in physics or engineering, and show interest for interdisciplinary work in the field of laser-material interactions. The application should be supported by sound academic records and recommendation letters. Expertise is required in the following areas: ultrafast laser-material interactions, condensed matter, microscopy, solid-state physics, spectroscopy, ultrafast optics, laser-induced ultrafast phenomena, mechanics. Programming skills and a good command of English are also required.

Payment: Postdoctoral fellowship (net salary 2000-2500€ according to the experience)
Duration: 12 months, **Application Deadline:** 31/01/2019

Contact (with customary documents: CV, letter of intent, recommendation letters.).
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Note: The Laboratoire Hubert Curien is a restricted access area. The fellowship is conditioned by a security clearance, to be applied for during the application (two months process time). To apply for a security clearance we need the following documents: exhaustive CV, passport copy.