The Max-Born Institute for Nonlinear Optics and Short Pulse Spectroscopy (MBI) conducts basic research in the field of nonlinear optics and ultrafast dynamics arising from the interaction of light with matter and pursues applications that emerge from this research. It develops and uses ultrafast and ultra-intense lasers and laser-driven short-pulse light sources in a broad spectral range in combination with methods of nonlinear spectroscopy.

With its research, MBI fulfills a national mission and is an integral part of the international scientific community. The Max-Born-Institute invites applications for the position

2 PhD students (m/f/d)

The positions are part of the Innovative Training Network (ITN) “SMART-X”. The network is devoted to the investigation of carrier transport in materials by time-resolved soft X-ray absorption spectroscopy. It is funded under Marie Sklodowska-Curie actions (H2020-MSCA-ITN-2019, grant agreement number: 860553).

Job profile:

The quest for the generation of **efficient, clean and secure renewable energy** represents one of the greatest challenges humankind is facing in the 21st century. While our society is heavily based on the use of fossil fuels, the climate change caused by the emission of greenhouse gases together with the depletion of the available resources calls for alternative solutions. This challenge has been identified in Horizon 2020 by the European Community as one of seven *societal challenges* that must be addressed in the mid- and long-term scenarios. The quest for “Secure, clean and efficient energy” is particularly urgent and strategical and it is tightly bound to interdisciplinary fundamental research between physics, chemistry, and engineering. Among the various alternatives, the development of methods for **efficient harvesting of solar light** is particularly important and relies on the understanding of charge transfer processes in a number of correlated systems, such as photovoltaic and photocatalytic materials including semiconducting materials and both organic and inorganic molecular systems.

In this context, the development of novel sources of ultrashort pulses at large-scale facilities, such as synchrotrons, Free Electron Lasers (FELs), and based on table-top high harmonic generation (HHG) process, is particularly interesting since it allows extending transient absorption spectroscopy in the X-ray spectral range with a time resolution reaching the attosecond timescale. **Ultrafast X-Ray spectroscopy** allows the study of light-matter interaction with unprecedented temporal and spatial resolution with the further advantages of being *element-selective and oxidation- and spin-state specific*, providing an excellent probe of ultrafast charge dynamics in molecules and materials.

The SMART-X network aims at the study of the key processes that regulate electron and charge transfer in materials relevant for renewable energy by the development of a new approach based on ultrafast soft X-ray spectroscopy to unravel ultrafast dynamics in materials.

The two PhD positions (m/f/d) have the following objectives:

1. Charge transfer processes in metallic-oxide semiconductors that are pertinent to the fabrication of solar fuel cells. We aim to unravel the fundamental forces driving electron dynamics in oxide semiconductors, such as Fe2O3 and CuWO4, used as the photoanode performing the oxidation half-reaction in solar fuel cells. We expect to understand the physical mechanisms that are currently limiting the charge carrier mobility in oxide semiconductors and to identify the role of dopants and electrocatalysts such as Ni in promoting the water splitting performance of oxide semiconductors. To achieve this goal, we will perform femtosecond XUV absorption experiments in oxide semiconductors following photoexcitation using a newly developed table-top source of ultrashort XUV pulses.

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2. Charge transfer processes in push-pull chromophores. When the two units of a molecule that exchange an electron are linked by a bridge, it is commonly denoted as an intramolecular charge transfer process (ICT). Molecules that consist of an electron-rich donor and an electron-deficient acceptor group, linked together by chains of different structure and length such as π-conjugated polyene or aromatic linking moieties are prototypical systems for intramolecular electron transfer processes. Understanding the dynamics of ultrafast charge transfer processes in donor-acceptor molecular systems generally requires a femtosecond time resolution to identify the vibrational coupling modes responsible for the electron transfer and to directly visualize the electronic motions. We will perform first transient soft X-ray absorption experiments to unravel charge transfer processes in simple acceptor-donor molecular systems in solution, using an ultra-thin liquid flat-jet and a table-top source of soft X-ray pulses providing photons in the water window (280-540 eV) spectral range.

The work will be done at the MBI which offers excellent working conditions and a state-of-the-art infrastructure in a highly dynamic and international environment at the forefront of research. The candidates will work on the development and optimization of a state-of-the-art source of ultrashort soft X-ray pulses and use it to perform femtosecond soft X-ray absorption experiments in various samples. This work will be done in collaboration with Greateyes, a non-academic partner of the network, that will develop in the course of the project a new high repetition rate CMOS camera for efficient X-ray detection.

As part of the SMART-X network, the candidates will be exposed to the broadest possible research environment through carefully planned secondments at various academic and non-academic partners of the consortium for periods extending to 1 or 2 months. The candidate will also participate in face-to-face network-wide events involving all the network participants, symposiums and scientific schools organized by the network.

Requirements:

We are looking for a PhD student (m/f/d) holding a Master Degree in physics or equivalent. The research program is at the frontier between many fields including femtosecond lasers, ultrafast and nonlinear optics, material science and photochemistry requiring a highly motivated candidate with a strong background in one or more of these areas. Please attach scientific publications that you have (co)authored. This research has many interdisciplinary aspects that demand highly motivated candidates with strong analytical abilities, and someone who is able to think out of the box. The diverse aspects of the project require a background that includes ultrafast and nonlinear optics, physics, physical chemistry, and material science. Experience in ultrafast (vibrational/electronic) spectroscopy is another asset. Knowledge of the English language is essential. In conjunction to the application the candidate must be accepted by the doctoral school of the Freie Universität Berlin.

Specific Requirements:

1. Applicants must, at the date of recruitment by SMART-X, be in the first four years (full-time equivalent research experience measured from the date when the researcher obtained the degree entitling him/her to embark on a doctorate of their research careers.
2. They should not have been awarded a doctoral degree.
3. Applicants must not have resided or carried out their main activity (work, studies, etc.) in Germany for more than 12 months in the 3 years immediately before the recruitment date. This excludes short stays such as holidays or compulsory national service.

Offer:

The researcher position is available immediately and initially limited to 3 years. It is a full time employment, including mobility allowance. If applicable also a family allowance will be paid.

MBI is an equal opportunity employer and places particular emphasis on fostering career opportunities for women. Qualified women are therefore strongly encouraged to apply. If equally qualified, severely handicapped persons are given preference.

MBI supports the reconcilability of family and working life and is certified as family-friendly by the "family audit".

Please use the button "Apply online" and upload your application with a motivation letter, detailed CV, transcripts of diplomas as well as three letters of reference electronically via the MBI online recruiting platform at https://mbi-berlin.de/de/karriere. The deadline for applications is **31st December 2019.**

For further information and inquires please contact Dr. Rouzée, (rouzee@mbi-berlin.de).