

Ph.D. scholarship in Supercontinuum generation with rugged femtosecond fibre lasers

A 3 year Ph.D. position is available in the Department of Photonics, Technical University of Denmark (DTU). The Ph.D. project is a part of the Marie Skłodowska Curie Initial Training Network SUPUVIR (SUPERcontinuum broadband light sources covering UV to IR applications), which is a European PhD school that commences on October 1, 2016. It combines the efforts of 6 academic and 4 non-academic partners across Europe, and 15 new Ph.D. positions (5 in Denmark) are now open. Additionally the network launches a comprehensive international training program within the technology of supercontinuum laser sources at leading photonics research labs across Europe.

Project description

The goal of this specific project is to investigate supercontinuum generation with rugged mode-locked femtosecond fibre lasers. Using femtosecond pumping for supercontinuum generation is attractive because the coherence properties of the supercontinuum are superior compared to pumping with longer pulses, and the fibre-laser technology is the most attractive platform for rugged application-oriented supercontinuum modules. Specifically Yb-fibre lasers (1030 nm) and Er-fibre lasers (1550 nm) will be investigated, and possibly also Tm-fibre lasers (1950 nm). A critical aspect is to use a fiber or waveguide suitable for the femtosecond pump laser. Various types of fibres from NKT photonics will be tested, as well as soft-glass (tellurite) fibres developed within other PhD projects in SUPUVIR will be tested, designed to have ZDW below the pump laser wavelengths for soliton-based near- to mid-IR supercontinuum generation. Also quadratic nonlinear crystals (bulk or waveguides) are interesting as cascaded harmonic generation could give new results in the UV ($\omega+\omega=2\omega$ followed by $\omega+2\omega=3\omega$), or by quasi-phase matching in lithium niobate, as well as a mid-IR component; this will be in collaboration with the other SUPUVIR PhD projects at DTU Fotonik. A part from commercial Er femtosecond fibre lasers, DTU owns two NKT Yb-based prototypes (either 1 W 200 fs at 20 MHz or 20 W 200 fs at 1 MHz) that will be used as pump. The latter allows pumping bulk crystals for high-power vis-near-IR-mid-IR SCG, useful for multi-tone (ground-tone/overtone) vibrational spectroscopy. A goal is to generate a high-power multi-Watt vis-near-IR-mid-IR SC (0.5-3.5 μm) using a high-power near-IR fibre laser amplifier in a bulk LN crystal.

The candidate will work closely with the other SUPUVIR candidates, especially the 4 other Danish-based students and the students in France and Poland responsible for developing novel fibres. Secondments at the Danish company NKT Photonics and at the French company LEUKOS are planned.

Background to SUPUVIR

The initial training network SUPUVIR involves 15 Ph.D. positions within the broad field of supercontinuum sources, which essentially are laser sources emitting coherent laser light that is broadband enough to be considered white. Scientifically, SUPUVIR aims at solving current challenges preventing supercontinuum light sources from taking over key market shares or from being used for cutting-edge research. Specifically the objectives are to reduce noise and increase pulse energy of supercontinuum modules, as well as investigate supercontinuum generation in emerging wavelength regimes (UV and mid-IR) including fabrication of novel fibres and waveguides, and finally using supercontinuum sources for applications as to gain valuable knowledge of application requirements. This research and development will give improved supercontinuum sources and supercontinuum spectra enabling new science and applications for optical imaging, spectroscopy, sensing and control, e.g. optical coherence tomography, IR multimodal spectroscopy, confocal and fluorescence microscopy, photoacoustic imaging and food quality control.

Supercontinuum sources is an area where Europe has developed internationally competitive research and commercial activity. SUPUVIR will exploit new emerging opportunities brought forward by the supercontinuum source through its unique properties of delivering a stable, bright, broadband and coherent light beam. SUPUVIR will provide the co-evolution of technology and applications, and hence contribute to the strategic transition of Europe to a knowledge-based society, driving the transformation of industry towards higher added value and sustainable development.

SUPUVIR involves interdisciplinary research, blending nonlinear physics, applied mathematics, numerical modelling, fibre optics, material science, laser physics, as well as intersectoral applications in diverse scientific areas like physics, material science, chemistry, and bio-medicine and in the industrial sector for applications like production line monitoring, gas sensing, imaging etc. The knowledge and experience in these complementary disciplines are present in the consortium, and will contribute to significant advancements in the field.

Qualifications

Candidates are required to have a Master's degree or very good first degree in Physics, Engineering or Material Science, ideally with a track record within the areas of nonlinear optics, fibre optics and waveguides, and laser physics. At the time of recruitment by the host organization, candidates must be in the first four years (full-time equivalent research experience) of their research careers, and have not been awarded a doctoral degree.

Researchers can be of any nationality. They are required to undertake transnational mobility (i.e. move from one country to another) when taking up their appointment. Nationality is therefore not a criterion. Rather the location of the researcher's residence or main activity during the 3 years prior to their recruitment is determining. At the time of recruitment by the host organisation, researchers must not have resided or carried out their main activity (work, studies, etc.) in the country of their host organisation for more than 12 months in the 3 years immediately before the reference date. Compulsory national service and/or short stays such as holidays are not taken into account.

Approval and Enrolment

The scholarship for the PhD degree are subject to academic approval, and the candidates will be enrolled in one of the general degree programs of DTU. For information about the general requirements for enrolment and the general planning of the scholarship studies, please see the [DTU PhD Guide](#). You can read more about Department of Photonics Engineering on www.fotonik.dtu.dk

Salary and appointment terms

Salary and appointment terms are consistent with the current rules for PhD degree students. The PhD candidate will be employed on a 3 year contract at a salary equivalent to €50,494 per year supplemented by a monthly mobility allowance of €1,100 (candidates with family responsibilities) or €600 (candidates without family responsibilities).

Further information

Associate professor Morten Bache, phone: +45 4525 5775, email: moba@fotonik.dtu.dk