Project 3.2. High-power robust all-fiber laser source for fast multicolor Stimulated Raman Scattering microscopy.

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WWW: http://www.ichf.edu.pl/res/CL/index_en.html

Background:
High resolution optical imaging has enabled exciting applications in biology and medicine. Raman microscopy techniques offer new opportunities for bio-imaging, including non-invasive and label-free character, rapid measurement, no need for sample preparation, high spatial resolution, and high chemical selectivity. Stimulated Raman Scattering (SRS) is an emerging technique, which provides major advantages over spontaneous Raman scattering and coherent anti-Stokes Raman scattering. It requires, at least, two, temporally and spatially overlapped, high power beams with properly set difference of central frequencies to drive a molecular motion of the sample in a coherent way. Until quite recently, achieving these conditions has typically required state-of-the-art, free-space cavity, solid-state lasers that are bulky, costly and environmentally sensitive, thus not suitable for use in a clinical environment. The latest advances in fiber laser technology has recently allowed to develop novel tunable two-color SRS light source based on ultrafast mode-locked fiber laser [1]. The main oscillator was composed of a mode-locked Erbium-doped fiber laser, which is, up to now, mainly realized in the soliton regime of net cavity anomalous dispersion. However, it is known that to generate pulses of high energy it is more advantageous to work in the net normal dispersion regime. Development of a novel low-cost and compact light sources for SRS microscopy is currently a hot topic [2]. Fiber laser technologies also remain a subject of constant intense research attention [3].

Aim:
To develop a high-energy mode-locked Erbium-doped fiber laser. The objective is to design a new all-fiber cavity with a net normal path-averaged dispersion, thus operating in the regime of dissipative solitons and/or dispersion-managed solitons. All cavities will be realized in polarization-maintaining fibers and fiber components. New concepts of artificial saturable absorbers will be investigated. The oscillator will be further used to build a rapidly wavelength-tunable source for SRS microscopy for leukemic diagnosis. The work will include experiments and numerical modelling.

Requirements:
- Master's degree in Physics or related field
- knowledge in the field of laser, fiber laser, optics, nonlinear optics, Raman spectroscopy, or related
- scientific curiosity
- strong motivation for research work, in particular for experimental work (experience in laboratory work will be appreciated)
- ability to work independently and in a team
- strong communication skills
- fluent English