34) Téma: Prostorová modulace světla založená na termooptickém efektu.
Topic: Spatial light modulation based on thermo-optic effect

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Abstract: Thermo-optics effect occurs when a transparent medium is heated. The refractive index of the medium being sensitive to the temperature, the optical path of light propagating through the medium can be modified due to the change of refractive index. Thermo-optic effect in imaging system is often associated as side effects generating aberrations. Indeed, heat can induce mechanical drift or lens dilation, and macroscopic heating is intrinsically slow. On the other side, when using a microscopic heat source, the heat propagation can reach the microsecond regime. An example of an efficient micro/nanoscopic heat source is metal nanoparticles illuminated at their plasmon resonance. They can be used to shape temperature profiles at the microscale or as a thermal lens with variable focus.
We recently developed a novel spatial light modulator based on thermo-optics effect induced by gold nanoparticles having a non-sensitivity to polarization, a high transmission rate (>80%), a response time in the µs range, and great stability which is suitable for adaptive imaging applications. Combining it with an iSCAT microscope, we could perform phase imaging of microtubules and 3D tracking of microtubule-associated protein at the kHz rate.

Challenges and implementation:
The topic of the thesis relies on the development of the spatial light modulator and its applications. A part of the thesis will focus on the optimization of the spatial light modulator structure for improving its abilities such as the thermo-optic conversion, the response time, or the shape of the phase modulation. In parallel, the works will focus on studying biological phenomena at the nanoscopic scale using nanoscopic quantitative phase imaging. This topic is at the crossroads of several domains: optics, chemistry, biophysics, and thermodynamics. We are looking for a physicist candidate, which is interested in a multidisciplinary topic. The thesis will be in the Institute of Photonics and Electronics in Prague and is in collaboration with the University of Oxford.

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