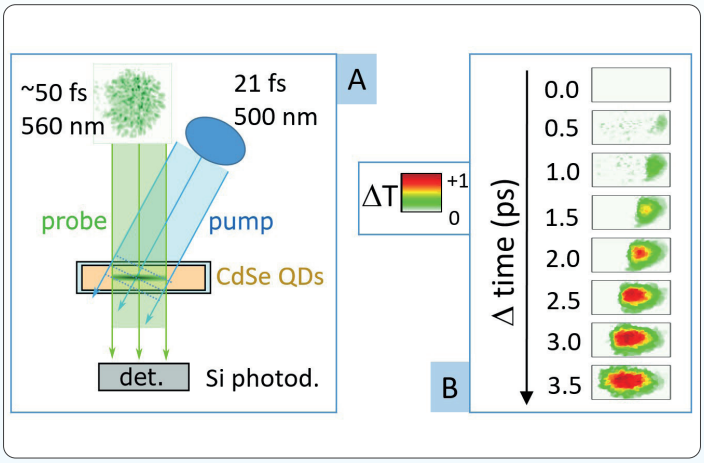
Project number:	ERC100431901
Provider:	Czech Academy of Sciences
Program:	ERC-CZ/AV-B
Realization period:	1st September, 2019 – 31st December 2020

Project name:

Random-Phase Ultrafast Spectroscopy (RUSH)

Ultrafast spectroscopy is a scientific field focusing on the research of extremely rapid processes, even on the femtosecond and picosecond timescales. This research is crucial, for instance, for photovoltaics or photosynthesis research. Tracking of very fast dynamics requires the use of correspondingly short laser pulses and these can be, due to basic physical principles, obtained only for laser sources with a broad spectrum, i.e., broadband lasers. However, attaining an ultrashort pulse is also conditioned by tuning the spectral phase of light, denoted as pulse compression. In the case of broadband pulses, pulse compression is a complex, alignment-intensive task, which needs to be undertaken for each modification in the experiment. Under certain conditions, such as multiple light scattering, the pulse compression cannot be obtained at all.

The RUSH project proposes a solution to these issues, which lies in the use of randomly modulated femtosecond pulses. Such pulses do not depend on pulse compression and are very robust against any modification of an experiment, including the application of broadband pulses. The central aim of the project is to create an entirely new approach to ultrafast spectroscopy, which will allow us to simplify measurements with broadband pulses. The goal is to enable ultrafast measurements in scattering materials or in samples with a significant light dispersion. Moreover, the use of random pulses has the potential to highly the most commonly used experiment, which is the pump-probe technique.



Project outcomes

Denk, O., Zheng, K., Zigmantas, D., & Žídek, K. (2019). Compressive imaging of transient absorption dynamics on the femtosecond timescale. *Optics express, 27(7)*, 10234-10246.

Junek, J., & Žídek, K. (2019, June). Luminescence Decay Measurement via Temporal Speckles. In *Computational Optical Sensing and Imaging* (pp. CW4A-7). Optical Society of America.

International collaboration

Department of Chemical Physics, Lund University, Sweden.

Within this collaboration we mainly investigate options to apply coherent excitation coding in ultrafast spectroscopy, which makes it possible to track processes in materials on the timescale of several femtoseconds (1 fs = 10-15 s). This collaboration has been also supported by "Laser Lab Europe".