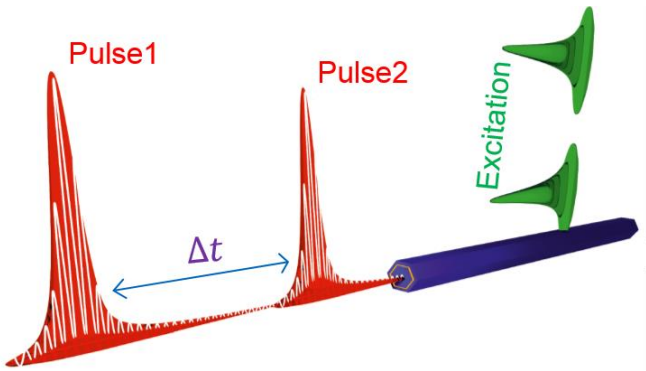
Master Thesis

Ultrafast Electron-Photon Dynamics in Nanowire Lasers

Wavelength-scale coherent optical sources are vital for a wide range of applications in nanophotonics ranging from metrology and sensing to nonlinear frequency generationand optical switching. Since precision metrology and spectroscopy is enabled by the ability to generate phase-stabilized trains of ultrafast laser pulses, it is of particular interest to realize such a technology on-chip. However, the complexity of conventional mode-locked laser systems has so far hindered their realization at the nanoscale. Recently, we demonstrated that subsequently emitted ultrafast laser pulses emitted from incoherently pumped GaAs-AlGaAs core-shell nanowire lasers remain mutually phase coherent over timescales that are approximately ten times longer than the emitted pulse duration. A deeper understanding of the factors governing the electron and photon dynamics of NW lasers is now crucial for further developments.

Goal of Thesis: In this project, you will, therefore, investigate the carrier relaxation and gain dynamics of novel quantum confined nanowire laser structures by employing ultrafast pump-probe spectroscopy. Thereby you will explore the influence of composition modulation and low dimensional gain media on the frequency and phase-dependent lasing characteristics. Further, you will have the option of extending the current pump-probe setup in order to study coupling and switching phenomena in NW-based silicon photonic circuits. In this thesis, you will be closely working with several other student members at WSI.



You will gain & learn:

- Solid understanding of the physics of semiconductor nanolaser
- Experience in performing state-of-the-art ultrafast spectroscopy at 300 K and low-temperature
- Experience in integrated nanolaser sources on integrated photonic circuits

Good knowledge in physics, especially optics, semiconductors, as well as previous experience with lab work related to nanophotonics or quantum optics are a benefit, but secondary to motivation and commitment. Applications should be sent to Gregor.Koblmueller@wsi.tum.de, Andreas.Thurn@wsi.tum.de, or Jonathan.Finley@wsi.tum.de. Please include your CV, and a transcript of records (Bachelor & Master).

Date: May 2019