EECS 598: Optics & Quantum Spectroscopy of Semiconductors

Instructor: Mack Kira (mackkira@umich.edu)

Term: Winter, 2017

Meeting time: MW 12:00 pm – 13:30 pm

Ever wondered what the future of technology will look like, and which unexpected answers enlightened quantum engineering could yield?

If yes, this theory lecture might be for you because it will build your insights into this topic – only enthusiasm and basic knowledge of quantum mechanics and electromagnetism is required!

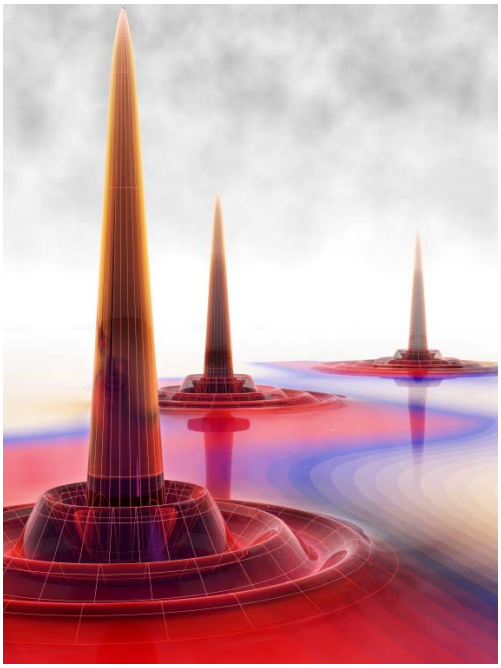

Illustration of dropletons, measured and computed through *quantum (optical) spectroscopy*.

Optoelectronic devices are already being revolutionized by the prospects of nanotechnology. At the same time, nanotechnology is facing the full complexity of quantum-interaction driven processes due to the small size and fast operation of nanocomponents. This lecture welcomes you to the central concepts of quantum engineering of semiconductors to explore optoelectronic, quantum-optical, and many-body processes, relevant for nanotechnology.

Rough Syllabus: This lecture will provide a pragmatic and brief introduction to solid-state theory, many-body formalism, and semiconductor quantum optics to explore pragmatic possibilities for nanotechology. As a central theme, the coupling of the quantized light field to electrons is investigated in detail, while the many-body Coulomb interaction of charge carriers is fully included. In this context, we will analyze which quantum effects and quasiparticles optical experiments can detect and control in terms of excitonic effects, plasmonics, quasiparticle accelerators, and ultrafast spectroscopy. To extend the quantum ideas further, we will follow how including quantum fluctuations of light to laser spectroscopy will transform it to quantum spectroscopy, a new realm where dropleton, entanglement, quantum memory etc. effects can be explored.

Textbook: M.Kira and S.W. Koch, Semiconductor Quantum Optics, Cambridge Univ. Press, 2012.