TRR 142 Seminar  Coherent Spectroscopy for Quantum Control of Matter

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Abstract

Quantum control can be achieved in many atomic and chemical settings, for example to enhance product / byproduct branching ratios, direct photocurrent / photoionization channels and enhance mechanisms in photocatalysis. Quantum control primarily uses constructive and destructive interference of quantum pathways between initial and final states to select and controlled the desired process with the amplitude and phase of incoming light. In this talk, a simple quantum control scheme based on two harmonically related pulses is demonstrated to drive and direct photocurrents in bulk silicon and in topological insulator materials.

In practice, quantum control is often hindered by insufficient information about the target states. Calculation of the system’s Hamiltonian can even be impossible. In this talk, multidimensional coherent spectroscopy is used to acquire the Hamiltonian for potassium vapor. This method yields line centers and line widths for all the quantum pathways for a three-level atomic system, such that the full Hamiltonian can be modeled empirically. This result paves the way for multidimensional coherent spectroscopy to measure all the desired properties of any system in situ, prior to the implementation of a deterministic quantum control scheme.