Graphene nano-photonics and carrier dynamics
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Graphene, a two-dimensional sheet of carbon atoms, has recently emerged as a novel material with unique electrical and optical properties, with great potential for novel opto-electronic applications, such as ultrafast photo-detection, optical switches, strong light-matter interactions etc. In the first part of this talk, I will review recent experimental work on exploiting graphene as a host for guiding, switching and manipulating light and electrons at the nanoscale [1]. This is achieved by exploiting surface plasmons: surface waves coupled to the charge carrier excitations of the conducting sheet. Due to the unique characteristics of graphene, light can be squeezed into extremely small volumes and thus facilitate strongly enhanced light-matter interactions. Additionally, I will discuss novel types of hybrid graphene photodetectors [2] and recent findings on carrier dynamics and hot carrier multiplication in graphene. By studying the ultrafast energy relaxation of photoexcited carriers after excitation with light of varying photon energy, we find that electron-electron scattering dominates the energy relaxation cascade rather than electron-phonon interaction [3]. This solves a long-standing debate on the relative contribution of electron-electron scattering versus optical phonon emission.