# Ultrafast electron dynamics in semiconducting carbon nanotubes mediated by exciton and phonon coupling

**NTU[1], °Stefano Dal Forno[1], Marco Battiato[2]**

**E-mail: sdalforno@ntu.edu.sg**

Semiconducting single-wall carbon nanotubes (SWCNTs) are ideal one-dimensional materials that have attracted much attention in the construction of novel optoelectronic devices. Their exceptional properties arise from the tunability of the physical and geometrical degrees of freedom such as chirality, twist angle and diameter. In particular, due to the low dimensionality of SWCNTs and the relatively high dielectric constant, excitons in SWCNTs possess very high binding energy and large spatial extent.

In this work we study the role of phonons in the ultrafast dynamics of electrons, holes and excitons in (6,5) SWCNTs by theoretically modeling the experimental time-resolved absorption spectrum. The understanding of scattering processes in CNTs is notoriously complex due to the non trivial interplay of a large number of scatterings involving several quasiparticles. It is therefore critical to have a technique capable to address this numerically hard problem to allow for the exploitation of CNTs' properties in applications like low dimensional electronics or THz physics.

To achieve this, we study the coupling of electrons, photons, phonons and excitons in SWCNTs and solve the full Boltzmann transport equation explicitly. Our approach is capable of modeling strongly out of equilibrium populations and high order scatterings. We use a newly developed numerical algorithm that dramatically reduces the computational cost of the scattering integrals. Our results show excellent agreement with experiments and show the capabilities of our newly developed numerical approach to transport and scattering problems.