Strong-field response of solids – From designing microscopes to photo-induced phase transitions

It is well known that the coupling of strong EM fields and electrons in gases or solids leads to new effects such as dressed states, multiphoton excitation, photo-dissociation etc. In the solid state, strong (or intermediate) fields can also be used to produce effects such as Floquet ladders, laser-induced topological phases and photo-induced phase transitions (PIPT). Many PIPTs have been experimentally observed including: insulator to metal [1,2], metal to superconductor, and paramagnet to ferromagnet transitions. Three ongoing projects in my group will be described: Generating and controlling ultrafast electron bunches [3,4]; electronic structure and the PIPT of TaS$_2$; a method for controlling ultrafast electronic response within tight-binding models.