



Title of PhD Project	Real-time first-principles theory of light-driven superconducting pairing
Type	Theory
Supervisor(s)	Angel Rubio, Hannes Hübener, Umberto De Giovannini
Affiliation(s):	Max Planck Institute for the Structure and Dynamics of Matter
Number of positions:	1
Abstract:	Understanding how superconducting pairing evolves on ultrafast time-scales remains a major challenge in quantum materials. This project will develop a real-time first-principles framework to describe the dynamics of the superconducting condensate under optical driving. The aim is to investigate how light modifies the amplitude, symmetry and coherence of superconducting pairing, and how these dynamics appear in experimentally accessible observables. A time-dependent BCS/Bogoliubov–de Gennes method will be implemented in a Wannier-based active space coupled to first-principles real-time electronic-structure calculations. This will provide a controlled route from phenomenological pairing fields towards a fully self-consistent time-dependent superconducting density-functional description. The framework will also enable the study of superconductivity in driven and cavity-modified quantum materials.
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