

# Max-Planck-Institut für Struktur und Dynamik der Materie

Max Planck Institute for the Structure and Dynamics of Matter

IMPRS UFAST Call for PhD applications 2022/2023



## MS1- Designing quantum materials with quantum light: towards cavity-photomolecular superconductivity?

<b>Title of PhD Project</b>	<b>Designing quantum materials with quantum light: towards cavity-photomolecular superconductivity?</b>
<b>Type</b>	Theory
<b>Supervisor(s)</b>	Prof. Michael Sentef
<b>Affiliation(s):</b>	Max Planck Institute for the Structure and Dynamics of Matter
<b>Number of positions:</b>	1
<b>Abstract:</b>	<p>Cavity quantum materials [1] are a new research field at the boundary between quantum optics and nonequilibrium quantum materials science. Ideas include the control over superconductivity [2] via the formation of hybrid light-matter excitations (polaritons). In this project the PhD student will learn basic concepts of quantum optics as well as condensed matter theory, and will apply them to a hybrid boson-fermion system with a plasmonic resonance coupled to an electronic excitation. This will be applied to investigate the possibility of inducing long-lived superconducting states above the equilibrium critical temperature in organic molecular crystals (e.g., K3C60 [3]).</p> <p>Prerequisites: knowledge of condensed-matter theory and basic many-body methods (ideally many-body perturbation theory). Elementary programming skills in a language of your choice (C/C++, Python, Julia, Fortran, ...).</p> <p>[1] Cavity quantum materials, Applied Physics Reviews 9, 011312 (2022); [2] Cavity quantum-electrodynamical polaritonically enhanced electron-phonon coupling and its influence on superconductivity, Science Advances 4, eaau6969 (2018); [3] Evidence for metastable photo-induced superconductivity in K3C60, Nature Physics 17, 611 (2021)</p>
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