

# 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 2023/2024

**ME2- Dissipative engineering of quantum materials via cavity QED**



<b>Title of PhD Project</b>	<b>Dissipative engineering of quantum materials via cavity QED</b>
<b>Type</b>	Theory
<b>Supervisor(s)</b>	Prof. Martin Eckstein
<b>Affiliation(s):</b>	UHH
<b>Number of positions:</b>	1
<b>Abstract:</b>	Using cavities to engineer the quantum electromagnetic field and its coupling to matter is a promising route to control properties of quantum materials. A recent experiment has revealed a gigantic cavity-induced shift of the charge-density wave transition temperature in the 2D material 1T-TaS <sub>2</sub> [Jarc <i>et al.</i> , arXiv:2210.02346, to appear in Nature]. The main aspect of the possible underlying mechanism, which we proposed within this work, is a cavity-induced modification of the dissipative environment (photon bath) in a way that is selective to certain degrees of freedom in the material. This can potentially lead to non-equilibrium stationary states with no analog in the equilibrium phase diagram, a mechanism for the cavity-control of materials that is different from proposals based on photon-mediated interactions or hybrid light-matter states. The aim of this PhD project is to further explore this pathway for various models (also in collaboration with experiment), using state-of-the-art numerical techniques to study non-equilibrium stationary states (non-equilibrium Green's functions, quantum Monte Carlo, tensor networks).
<b>Contact person for scientific questions about the project:</b>	Prof. Martin Eckstein: martin.eckstein@uni-hamburg.de

