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 2024/2025



AR5 & DK1- Cavity quantum materials: from ab initio to models

Title of PhD Project	Cavity quantum materials: from ab initio to models
Туре	Theory
Supervisor(s)	Prof. Angel Rubio, Dr. Michael Ruggenthaler, Prof. Dante Kennes
Affiliation(s):	Max Planck Institute for the Structure and Dynamics of Matter
	RWTH Aachen University
Number of positions:	1
Abstract:	Recent experimental and theoretical results suggest [1] that quantum materials can be controlled by changing the mode structure of the electromagnetic environment within optical cavities. While this new control knob is a very promising addition to the control toolkit for quantum materials, it remains unclear to what extend common minimal models need to be adjusted to capture the arising effects. Recent considerations suggest that there can be an interesting interplay between macroscopic and microscopic degrees of freedom at play [2]. In this project we aim at developing problem-adapted models for quantum materials in cavities based on firstprinciples insights. A focus will be on bridging different energy and lengths scales and a combination of first-principles methods and tensor network approaches applied to these novel minimal models. [1] F. Schlawin, D. M. Kennes, and M. A. Sentef. "Cavity quantum materials." Applied Physics Reviews 9.1 (2022). [2] D. Sidler, T. Schnappinger, A. Obzhirov, M. Ruggenthaler, M. Kowalewski, and A. Rubio. "Unraveling a cavity induced molecular polarization mechanism from collective vibrational strong coupling." arXiv preprint arXiv:2306.06004 (2023).
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