## 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





AR7 - Pauli-Fierz quantum field theory and quantum-electrodynamical density-ful Dissipation and decoherence processes

Title of PhD	Pauli-Fierz quantum field theory and quantum-electrodynamical density-functional
Project	theory: Dissipation and decoherence processes
Туре	Theory
Supervisor(s)	Prof. Angel Rubio and Dr. Michael Ruggenthaler
Affiliation(s):	Max Planck Institute for the Structure and Dynamics of Matter
Number of	1
positions:	
Abstract:	Recent groundbreaking experiments have demonstrated that the quantized electromagnetic field can have a substantial impact on the dynamics and properties of molecules and solids even at ambient conditions. A detailed description of such situations necessitates the use of quantum electrodynamics (QED) in the non-perturbative low-momentum regime. It has been established that the resulting Pauli-Fierz quantum-field theory is mathematically similar to quantum mechanics and can be based on a self-adjoint and bounded-below Hamiltonian [1]. In this project the mathematical structure of the Pauli-Fierz Hamiltonian will be considered and the corresponding quantum-electrodynamical density-functional theory will be further developed. A specific focus is on the dissipative and decoherence properties of the quantum-field description. These properties arise because the matter subsystem is coupled to an infinite amount of photonic degrees of freedom. Moreover, the interplay of these properties with ultra-violet and infra-red regularizations will be investigated. [1] M. Ruggenthaler, D. Sidler, and A. Rubio Chemical Reviews, 123 (19), 11191-11229 (2023)
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the project:	











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Max Planck Institute for the Structure and Dynamics of Matter

Research Group	https://theory.mpsd.mpg.de/
Website:	











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