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

AR1- Polaritonic Chemistry

Title of PhD Project	**Polaritonic Chemistry**
Type	Theory
Supervisor(s)	Prof. Angel Rubio, Dr. Dominik Sidler, Dr. Michael Ruggenthaler
Affiliation(s):	Max Planck Institute for the Structure and Dynamics of Matter
Number of positions:	1
Abstract:	Seminal experimental results have demonstrated that molecules can be strongly coupled to the (quantized) photon field of optical cavities. This can induce dramatic chemical changes, which may eventually provide unprecedented control of chemical reactions. Inspired by the early experimental advancements, the field of *polaritonic chemistry* has recently emerged. Our group together with international collaborators has pioneered the first ab-initio methods, which are based on non-relativistic quantum electrodynamics. However, despite these significant advances, the relevant driving mechanisms of polaritonic chemistry remain an open theoretical question of utter relevance. To unravel the mysteries of polaritonic chemistry not only established concepts form quantum chemistry, and quantum optics need to be revisited, but recent theoretical evidence also suggests a fundamental theoretical connection to the physics of a spin glass. This novel aspect introduces the concept of frustration with spontaneous symmetry breaking in polaritonic chemistry, and it also brings it closer to the theory of solid-state physics. All of which provides ideal ground to pursue cutting-edge interdisciplinary research. The PhD project can thus be tailored specifically to the background and interests of the applicant. It may involve fundamental theoretical questions, the development of novel algorithms and HPC code, as well as compelling applications.
Contact person for scientific questions about the project:	Prof. Angel Rubio: angel.rubio@mpsd.mpg.de Dr.Dominik Sidler: dsidler@mpsd.mpg.de Dr. Michael Ruggenthaler: michael.ruggenthaler@mpsd.mpg.de
Research Group Website:	https://theory.mpsd.mpg.de/research/project/detail/qed_chemistry/

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