



## IMPRS UFAST Call for PhD applications 2020/2021



### Cavity-to-Floquet crossover in quantum materials

M. Sentef-1

<b>Title of PhD Project</b>	<b>Cavity-to-Floquet crossover in quantum materials</b>
<b>Type</b>	Theory - Areas of research: Condensed Matter Physics
<b>Supervisor(s)</b>	Dr. 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>Tuning and designing interesting properties of quantum materials by light-matter coupling is a frontier research topic. In this project, we will try to bridge two important parts of the field, namely cavity materials engineering and Floquet engineering. In Floquet engineering a classical laser pulse interacts with a material leading to photo-dressed bands and light-modified interactions as well as particle distributions. Light-induced topological states of matter [1] with magnetic properties [2] and electron-phonon coupling [3] are two examples that have been investigated here. On the other hand, cavity engineering employs the vacuum fluctuations of quantized photon fields, enhanced by a small mode volume in a cavity, leading for example to polariton formation which in turn affects materials properties such as electron-phonon coupling [4] and topology [5]. In this PhD project, the candidate will develop numerical techniques based on both exact diagonalization for small systems as well as Non-Equilibrium Green Functions (NEGF) for periodic solids to investigate systematically the crossover between the cavity and Floquet regimes, which can be achieved when the cavity is driven by a laser. The goal of the project is to explore novel opportunities for materials design by light-matter coupling and to predict potential pump-probe experiments to test these opportunities.</p> <p>[1] H. Hübener et al., Nature Communications 8, 13940 (2017)                  [2] G. Topp et al., Nature Communications 9, 4452 (2018)                  [3] M. Sentef, Phys. Rev. B 95, 205111 (2017)                  [4] M. Sentef et al., Science Advances 4, eaau6969 (2018)                  [5] X. Wang et al., Phys. Rev. B 99, 235156 (2019)</p>
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