Max-Planck-Institut für Struktur und Dynamik der Materie

Max Planck Institute for the Structure and Dynamics of Matter

Monday, May 20th, 2019 – 14:00 pm
CFEL Seminar room IV (Bldg. 99)

Dominik Lentrodt

Max-Planck-Institut für Kernphysik, Heidelberg

Ab initio few-mode theories for quantum potential scattering problems

The concept of a single mode of the electromagnetic field interacting with matter has been a paradigm in the field of light-matter interactions. For example, the single mode Jaynes-Cummings model and its many generalizations have been indispensable tools in studying the quantum dynamics of various systems. In particular in cavity and circuit QED, where strong light-matter coupling is routinely achieved in experiment, such models have been tremendously successful [1].

Recently, however, various experimental platforms have emerged where multi-mode effects and the openness of the system constitute an essential part of the physics [1,2,3], and where the applicability of few-mode models has been debated.

In this talk, we will present "ab initio few-mode theory" [4], where these factors are treated systematically and which allows to include new physics into Jaynes-Cummings type models without abandoning their conceptual and computational simplicity. We will outline some implications, in particular for the new field of X-ray cavity QED.

From a practical perspective, our method connects the extensive toolbox of few-mode models to ab initio theory. From a more general perspective, it constitutes a non-perturbative expansion scheme that allows to extract the relevant degrees of freedom of quantized scattering problems [3]. As such, it may find applications in a broader context ranging from transport theory to open quantum dynamics.

[1] A. Frisk Kockum et al., Nat. Rev. Phys. 1, 19–40 (2019)
[2] G. Hackenbroich et al., Phys. Rev. Lett. 89, 083902 (2002)
[3] S. Rotter and S. Gigan, Rev. Mod. Phys. 89, 015005 (2017)
[4] D. Lentrodt and J. Evers, submitted, arXiv:1812.08556 [quant-ph]

Host: Angel Rubio

MAX-PLANCK-GESELLSCHAFT