Max-Planck-Institut für Struktur und Dynamik der Materie

Max Planck Institute for the Structure and Dynamics of Matter

Wednesday, January 22nd, 2020 – 11:00 a.m.
CFEL Seminar room IV (Bldg. 99)

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Controlling superconductivity with the electromagnetic vacuum

Exploiting light-matter interactions to control collective quantum phenomena in solids is an ongoing broad research effort. In particular, it is known that superconductivity can be strongly modified using an external radiation [1-3]. In the absence of the latter, it is an interesting question whether superconductivity induced by conventional Cooper pairing may be also affected by coupling phonons to the electromagnetic field confined in a cavity with enhanced vacuum fluctuations [4,5]. Of particular interest is the strong coupling regime of cavity-QED, where the light-matter coupling strength exceeds the decay rates [6,7]. In this case, light and matter can exchange energy in a (quasi) reversible way and the eigenstates, called polaritons, feature an hybrid character with shifted frequencies. After having introduced different types of excitations that can be strongly coupled to the vacuum field in condensed-matter systems, I will discuss recent results showing a modification of superconductivity under strong light-matter coupling conditions [8].

[1] A. F. G. Wyatt *et al.*, Phys. Rev. Lett. **16**, 1166 (1966)
[2] D. Fausti *et al.,* Science **331**, 189 (2011)
[3] M. Mitrano *et al.*, Nature **530**, 461 (2016).
[4] M. A. Sentef, M. Ruggenthaler, A. Rubio, Science Advances **4** (2018).
[5] D. Hagenmüller *et al.*, ACS photonics **6**, 4 (2019)
[6] H.J. Kimble, Physica Scripta **T76**, 127 (1998)
[7] J.M. Raimond, M. Brune, S. Haroche, Rev. Mod. Phys. **73** (2001)
[8] A. Thomas *et al.,* arXiv 1911.01459 (2019)

Host: Michael Ruggenthaler, Angel Rubio

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