Seminar: Hard Condensed Matter Theory

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Room: Galilei Room (Staudingerweg 9)
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Magnons for Quantum Information

The advancements in the field of spintronics have provided technologies with vast resources for growth in several aspects of classical information manipulation such as data storage. It is now essential to study the widely unexplored avenues in spintronics for quantum information. Cavity optomagnonics is an emergent field which describes interaction of magnons with electromagnetic standing waves confined to cavities [1,2]. Magnons strongly interact with microwave (MW) photons thereby enabling classical and quantum information processing and storage applications with coherently manipulated magnons and up/down-quantum converters between both communication (optical fibers) and processing (superconducting qubits) units [3,4].

In this talk, we theoretically explore nonlinearities of ferromagnets in microwave cavities in the classical and quantum regimes and assess the resources for quantum information, i.e. fluctuation squeezing and bipartite entanglement [5]. We classify the steady state phase space using (semi)classical and quantum analysis of the anharmonic oscillator (Duffing) model for the Kittel mode when including all other magnon modes. We subsequently compute nonzero bounds for the distillable entanglement, as well as entanglement of formation for the bipartite configurations of the mixed magnon modes in the steady state. The predicted magnon entanglement is experimentally accessible in two distinct optical channels with yttrium iron garnet samples under realistic conditions.

[1] X. Zhang, C.-L. Zou, L. Jiang, and H. X. Tang, Phys. Rev. Lett. 113, 156401 (2014).
[2] Y. Tabuchi, S. Ishino, T. Ishikawa, R. Yamazaki, K. Usami, and Y. Nakamura, Phys. Rev. Lett. 113, 083603 (2014).
[3] A. Osada, R. Hisatomi, A. Noguchi, Y. Tabuchi, R. Yamazaki, K. Usami, M. Sadgrove, R. Yalla, M. Nomura, and Y. Nakamura, Phys. Rev. Lett. 116, 223601 (2016).
[4] Y. Tabuchi, S. Ishino, A. Noguchi, T. Ishikawa, R. Yamazaki, K. Usami, and Y. Nakamura, Science 349, 405 (2015).
[5] M. Elyasi, Y. M. Blanter, G. E. W. Bauer, Phys. Rev. B 101 (5), 054402 (2020).

All interested are cordially welcome!

The talk will be livestreamed using Adobe Connect, and will able to be viewed at:
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