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25 - Level Attraction and Synchronization in Hybridized Magnon-Photon Systems

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The recent emergence of cavity-spintronics [1] has garnered intense interest from both the quantum information and spintronics communities, the former inspired by the enhanced coherence rates of ferromagnetic systems and the latter motivated by new avenues for spin current control. Indeed myriad technological developments have already been revealed, such as novel memory architectures [2], microwave to optical frequency conversion techniques [3] and non local spin current manipulation [4]. These developments have all been based on the fact that, due to the hybridization between microwave cavity photons and magnetic excitations, cavity-spintronic devices act as excellent transducers. More specifically, spin-photon hybridization manifests itself as level repulsion due to electrodynamic phase correlation between the spin and photon subsystems, and is characterized by the emergence of a gap in the eigenspectrum [5]. Interestingly, in analogue cavity optomechanic systems another form of hybridization, level attraction, also exists [6], which is deeply connected to the physical ideas of exceptional points, PT symmetry and synchronization. In this talk I will discuss our recent observation of level attraction in a coupled spin-photon system [7]. This new form of coupling is characterized by synchronization-like behaviour of the hybridized modes, and originates in a novel cavity-Lenz effect which leads to a dissipative interaction. The cavity-Lenz effect occurs independently of dissipation rate or interaction strength and it is even possible to perform continuous in-situ tuning between level attraction and level repulsion. Therefore the discovery of level attraction in hybridized magnon-photon systems paves a new path for utilizing light-matter coupling in cavity-spintronic and quantum magnonic applications, while at the same time providing a new playground for the exploration of many intriguing physical ideas.

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