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(I) Magnetic polaritons or strong photon-magnon coupling in arrays ferromagnetic nanowires

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Magnetic polaritons have been known and observed for decades in ferromagnetic resonance spectroscopy experiments. A revival of interest and reinterpretation of these classical experiments, over the last decade, have focussed on the strong interaction between microwave photons and the collective spin excitations of ferromagnetic specimens in resonant cavities. Some of these studies have brought new insights on strong coupling phenomena, along with developing a variety of emerging fields, such as: cavity electromagnonics, cavity spintronics, cavity optomagnonics, cavity magnomechanics, quantum magnonics and so on. These systems are very much like ensembles of paramagnetic objects strongly coupled to a microwave field, as studied in quantum electrodynamics, but with some major differences. The very dense population of exchange-coupled spins in ferromagnets collectively couples with microwave cavity fields with ridiculously high efficiencies, but collective magnetic excitation is degenerate with a sea of spin waves modes, leading to additional complexity. Understanding the effect of dipolar coupled ferromagnetic objects and collective resonance modes on the strong photon-magnon coupling is important in order to exploit these systems for new technologies. We built on our recent work on two dipolar coupled ferromagnetic spheres in a resonant cavity to investigate and explain the strong coupling exhibited in arrays of CoFeB ferromagnetic nanowires, measured at frequencies ranging from 26 to 110 GHz.

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