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Hybrid Quantum Systems for Quantum Transduction Based on Magnonic Materials

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Recent enormous progress in quantum computation is based on the use of cryocooled superconducting qubits with MW working frequencies. However, establishing high-fidelity and long-distance quantum networks needs the use of optical photons. This motivates research for hybrid quantum systems (HQS) for coherent quantum transduction of the MW and optical photons [1].

In our work, HQS concepts based on the use of magnonic material for the realization of quantum frequency conversion are presented. Yttrium iron garnet (YIG) is one of the best candidate materials due to its very low damping parameter and transparency [2]. For maximizing the conversion efficiency, strong coupling between the subsystems of the magnon HQS and, therefore, small-sized YIG crystals with high filling factor have to be used. There is also a strong need to increase the magneto-optical coupling between YIG and *optical* photons.

In this work, the state-of-the-art of strongly coupled MW-magnon systems is briefly reviewed and prospective approaches for construction of magnon-based HQSs are proposed. We have also shown that FEM simulations are adequate to model the magnon HQSs (with sizes larger than the exchange length).

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Reference list

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