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Coherent coupling between ferromagnetic magnon and superconducting qubit YUTAKA TABUCHI, SEIICHIRO ISHINO, ATSUSHI NOGUCHI, TOYOFUMI ISHIKAWA, REKISHU YAMAZAKI, KOJI USAMI, RCAST, The University of Tokyo, YASUNOBU NAKAMURA, RCAST, The University of Tokyo, CEMS, RIKEN — Coherent coupling between paramagnetic spin ensembles and superconducting quantum circuits is now widely studied for quantum memories and microwave-to-optical quantum transducers. Since those applications require strong coupling and sufficiently long coherence time simultaneously, collective excitation (magnon) in yttrium iron garnet (YIG), a typical ferromagnetic insulator, is an alternative promising candidate. The material is known to have a high spin density and a narrow ferromagnetic-resonance (FMR) linewidth. Recently, we achieved strong coupling between a 3D microwave cavity and the uniformly precessing spin mode. In this talk, we step forward to the control and measurement of magnons using superconducting circuits. We demonstrate coherent coupling between a magnon excitation in a millimeter-sized ferromagnetic sphere and a superconducting qubit, in which the interaction is mediated by a microwave cavity. We observe the coupling strength exceeding the damping rates, revealing that the system is in the strong coupling regime. Furthermore, we study a tunable coupling scheme using a microwave drive and the time-domain control of magnons. Our approach provides a versatile tool for control and measurement of the magnon excitations in the quantum regime.

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