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Strong coupling of magnons in a YIG sphere to photons in a planar superconducting resonator in the quantum limit[1] RICHARD MORRIS, ARJAN VAN LOO, SANDOKO KOSEN, ALEXY KARENOWSKA, University of Oxford — Magnonic systems have been studied for more than half a century but until recently most experimental investigations have been done at room temperature with high signal powers. Over the last few years, interest has grown in observing their behaviour at very low temperatures, where the thermal population of magnons is negligible and it becomes possible to observe quantum phenomena. With a view to enabling new hybrid systems and tools for studying the quantum physics of magnons, we investigate coupling of a superconducting coplanar waveguide resonator (CPWR) to a sphere of yttrium-iron garnet at millikelvin temperatures. The non-uniform CPWR field allows us to excite a variety of magnon modes in the sphere, and we identify some of these modes based on their frequencies and relative coupling strengths. Strong coupling is observed to several modes, and the Kittel mode is seen even with, on average, less than one excitation in the CPWR. We also investigate the time response of the system to short square pulses, which shows oscillations at the mode splitting frequency. These results illustrate that planar superconducting components can be readily combined with magnonic systems, paving the way for new hybrid quantum devices.

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