Strong magnon–photon coupling in layered antiferromagnet $NiPS_3$

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Strong coupling between electromagnetic cavity modes and collective spin excitations is a key ingredient of hybrid quantum systems and spin-cavitronics. Antiferromagnets are particularly attractive in this context due to their intrinsically high-frequency spin dynamics and the absence of a requirement for external magnetic fields. Here we report the observation of strong magnon–photon coupling in the layered antiferromagnet $NiPS_3$ in the terahertz (THz) frequency range. Using THz time-domain spectroscopy, we detect the formation of magnon–polaritons near 1.2 THz, persisting up to temperatures of approximately 80 K. A Fabry–Perot-type cavity is formed by the sample itself [1], with a thickness of about 300 μm. As the temperature changes, the magnon frequency decreases, and when it approaches the sixth cavity mode, an anticrossing is observed. The vacuum Rabi splitting reaches approximately 15 GHz, allowing for a precise determination of the magnon oscillator strength. We also characterize the THz dielectric properties of $NiPS_3$ and the temperature and magnetic-field dependence of the magnon modes in magnetic fields up to 9 T. Our results demonstrate $NiPS_3$ as a viable platform for terahertz spin-cavitronics and extend the range of materials exhibiting strong light–matter coupling to layered antiferromagnets.

References:

[1] M.Białek et al, Phys. Rev. B 101, 024405 (2020)

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