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Probing spin waves using single electron spins

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Spin waves are elementary excitations of magnetic materials that may play a key role in future information processing. Spin waves can be probed via the magnetic fields they generate, but this requires a technique with high sensitivity and nanometer sensor-sample distances. We are using the excellent magnetic-field sensitivity of nitrogen-vacancy sensor spins in diamond to explore spin-wave physics in ferromagnets. We have developed techniques to detect localized spin-wave resonances and thermally excited spin waves, and recently achieved a breakthrough by detecting a spin-wave chemical potential. These results open up exciting possibilities for nanoscale imaging and control of spin transport in mesoscopic spin systems.