

Spin Excitation Spectroscopy

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The energies and relaxation times of spin excitations are traditionally measured using the classic spin resonance techniques, Nuclear Magnetic Resonance (NMR) and Electron Spin Resonance (ESR). The measurement of spatial variations of spin relaxation times is of profound practical importance as they are often used as the primary contrast mechanism in magnetic resonance imaging. It has been an outstanding challenge to extend the spatial resolution of these spectroscopies to the atomic scale. We have developed a new kind of spin spectroscopy, *Spin Excitation Spectroscopy*, that achieves this goal. Through a combination of inelastic tunneling spectroscopy and pump-probe techniques, we have extended the capability of the scanning tunneling microscope to interrogate both the energetics and dynamics of spin systems on the atomic scale. We anticipate that this will have application in a broad range of studies concerned with nanometer-scale magnetic systems, how they may be understood, and how they may be engineered to have a desired functionality.

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