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Magnetotunneling spectroscopy: Imaging electron wavefunctions and measuring electron dispersion curves in GaMnAs- and GaAsN-based heterostructures

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Magnetotunnelling spectroscopy is a powerful tool for imaging the wavefunctions of electrons in quantum wires [1] and dots [2] and for measuring the energy-wavevector dispersion curves of holes [3] and electrons [4] in novel quantum well structures. It uses the effect of the Lorentz force to tune the in-plane momentum of a tunneling electron when it enters a quantum-confined structure [4]. This talk will describe recent work to spatially image the ground and excited state wavefunction of electrons confined in quantum dots in ferromagnetic GaMnAs tunnel diodes. These dots are formed by the electrostatic potential arising from clusters of charged Mn interstitial donors. It will also be shown how the fragmented conduction electron dispersion curves of GaAsN give rise to highly non-linear electron dynamics and a new type of negative differential conductivity effect.

[1] Beton et al, Phys Rev Lett **75**, 1996 (1995); [2] Vdovin et al, Science 290, 122 (2000) and Patane et al, Phys Rev B **65**, 165308 (2002); [3] Hayden et al, Phys Rev Lett **66**, 1749 (1991); [4] Endicott et al, Phys Rev Lett **91** 126802 (2003)