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Entangled magnetism: synthesis, detection, and potential applications

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I describe recent progress towards a radically different form of magnetism rooted in the phenomenon of entanglement with potential applications in energy and information technologies. In conventional magnetic materials atomic magnetic moments (spins) develop a static pattern when cooled below a critical temperature. However, by carefully selecting the crystalline and electronic structure, it is possible to stabilize a spin-liquid where spins correlate without developing fixed orientations. I shall describe neutron scattering experiments on such materials that probe quantum entanglement and provide evidence for emergent quasi-particles. These are stable interacting entities created as energy is imparted to the spin liquid. Entangled spin liquids may underlie high temperature superconductivity and their quasi-particles might eventuall be exploited for information processing.