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Ferromagnetism in vanadium oxide nanotubes spin-tuned by electron/hole doping

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An intrinsic feature of Mott insulators is that doping, i.e., changing the particle density, can dramatically affect their properties. I will report on our discovery of charge-doping controlled ferromagnetism at room temperature in self-assembled vanadium oxide nanotubes. By adding either electrons or holes, the initially spin-frustrated nanotubes develop a nearly identical nonlinear ferromagnetic spin response, demonstrating a novel unexpected electron-hole complementarity in the nanotube structures. The underlying picture is that, on doping, the Fermi level is swept through the Mott gap in this multiband strongly correlated system, removing the frustration responsible for the spin-gap. Itinerant carriers under spin control are produced in one vanadium Hubbard band which strongly interacts with other more localized vanadium spins. These findings show a path to new spin-aligned nanoscale building blocks, where the Fermi level sweep can be accomplished by applied voltage.