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Giant antiferromagnetic response in a two-dimensional spin-orbit Mott insulator

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Antiferromagnetic (AFM) materials started to gain traction owing the advantages of reliability, ultrafast dynamics, etc. in spintronic applications. In this regard, Mott insulators can be an appealing candidate because of the robust AFM ground state due to the strong electron-electron correlation. Moreover, exploring AFM order is fundamentally important for understanding emergent phenomena, like high-Tc superconductivity and quantum criticality. In our recent work, we investigated AFM order in layered iridates, which is a newly established Mott system similar to cuprates but features a strong spin-orbit coupling. By building the spin-orbit Mott insulators as superlattices composed of perovskite SrIrO3 and SrTiO3, we gained controllability in the strength and sign of interlayer exchange interaction. This enables one to reach the two-dimensional limit of the antiferromagnet, where the ordering temperature is only governed by magnetic anisotropy. The two-dimensional antiferromagnet preserves a hidden SU(2) symmetry, which was first proposed in cuprates but never experimentally realized. More specifically, model analysis reveals that Dzyaloshinskii–Moriya interaction in the square-lattice magnet does not contribute to the spin anisotropy. The extremely strong two-dimensional critical fluctuations enable us to achieve giant AFM responses to sub-tesla uniform external fields. The observed field-induced logarithmic increase of the AFM ordering demonstrates a new pathway for designing efficient AFM spintronics. These results were recently published on Phys. Rev. Lett. [119,027204, (2017)] and Nat. phys. [14, 806–810 (2018)].