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Unconventional magnetic order stabilized by Kitaev interactions in the three-dimensional honeycomb polytypes of Li2IrO3

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Materials that realize Kitaev spin models with bond-dependent anisotropic interactions have long been searched for, as the resulting frustration effects are predicted to stabilize novel forms of magnetic order or quantum spin liquids. Here we explore the magnetism of the recently-synthesized iridates β- and γ-Li_2IrO_3, which have the topology of three-dimensional Kitaev lattices of inter-connected Ir honeycombs. Using single-crystal resonant magnetic x-ray diffraction we find in both cases a surprisingly complex, yet highly symmetric, incommensurate magnetic structure with non-coplanar and counter-rotating Ir moments [1,2]. Our experimental results combined with a theoretical analysis [3] of candidate spin Hamiltonians provide strong evidence that both β and γ-Li_2IrO_3 realize a spin Hamiltonian with dominant Kitaev interactions. [1] A. Biffin, R.D. Johnson, I. Kimchi, R. Morris, A. Bombardi, J.G. Analytis, A. Vishwanath, and R. Coldea, Phys. Rev. Lett. 113, 197201 (2014). [2] A. Biffin, R.D. Johnson, Sungkyun Choi, F. Freund, S. Manni, A. Bombardi, P. Manuel, P. Gegenwart, and R. Coldea, Phys. Rev. B. 90, 205116 (2014). [3] I. Kimchi, R. Coldea and A. Vishwanath, arXiv:1408.3640 (2014).