Robust orbital nanomagnets

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I discuss a new type of nanomagnet for which the dominant contribution to magnetization comes from orbital degrees of freedom, in contrast with usual systems. Here I discuss our proposal that nanoislands of quantum spin Hall insulators can host robust orbital edge magnetism whenever a single electron, as opposed to 0 or 2, resides at the highest occupied Kramers doublet upgrading the spin edge current into a charge current. The resulting orbital magnetization scales linearly with size, outweighing the spin contribution for islands of a few nm in size. This linear scaling is a specific of the Dirac edge states, different from Schrodinger electrons in quantum rings. Modelling Bi(111) flakes, whose edge states have been recently observed [2], we show that orbital magnetization is robust with respect to disorder, thermal agitation, shape of the island and crystallographic direction of the edges, reflecting its topological protection. I discuss the notion of spin amplification using this type of system, that would permit single spin readout .

[1] P. Potasz, J. Fernandez-Rossier, in preparation
[2] Ilya K. Drozdov, A. Alexandradinata, Sangjun Jeon, Stevan Nadj-Perge, Huiwen Ji, R. J. Cava, B. A. Bernevig, Ali Yazdani, Nature Physics 10, 663-669 (2014).

Short Bio: Joaquin Fernandez-Rossier is a researcher at the International Iberian Nanotechnology Laboratory (INL) and an associate professor at the University of Alicante. He works on the broad field of condensed matter physics with emphasis on nanoelectronics and nanospintronics on a variety of materials including graphene and other layered two dimensional materials, magnetic semiconductors and topological insulators. He is the coordinator of the Marie Curie ITN project on Spintronics in Graphene (www.spinograph.org). He has published more than 80 indexed research papers, including 1 Nature, 2 Nature Materials, 16 PRL, 38 PRB, cited more than 2100 times (h=26, Research ID C-3910-2009). He has graduated 4 PhD students.