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A cryogenic quantum gas scanning magnetic microscope[1]

MATTHEW NAIDES, RICHARD TURNER, RUBY LAI, JACK DISCIACCA, BENJAMIN LEV, Stanford University — Atom chip trapping of quantum gases will enable single-shot, large area imaging of transport through strongly correlated and topologically non-trivial materials via detection of magnetic flux at the 10^{-7} flux quantum level and below. By harnessing the extreme sensitivity of atomic clocks and Bose-Einstein condensates to external perturbations, the cryogenic atom chip technology we have recently demonstrated [1] will provide a magnetic flux detection capability that surpasses other techniques, while allowing sample temperatures spanning $<$10 K to room temperature. We report on experimental progress toward developing this novel quantum gas scanning magnetic microscope [1] and describe our recent proposal [2] to image topologically protected transport through a non-ideal topological insulator in a relatively model-independent fashion.

[1] M. Naides, R. Turner, R. Lai, J. DiSciacca, and B. L. Lev, Trapping ultracold gases near cryogenic materials with rapid reconfigurability, arXiv:1311.2065 (2013).
[2] B. Dellabetta, T. L. Hughes, M. J. Gilbert, and B. L. Lev, Imaging topologically protected transport with quantum degenerate gases, Physical Review B 85, 205442 (2012).

[1]U.S. DOE, BES, Division of Materials Sciences and Engineering under award #DE-SC0001823

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