N. Goldman: *Imaging Topological States in Ultracold Atomic Gases*

The recent experimental realization of synthetic magnetic fields and spin-orbit couplings for ultracold (neutral) atoms [1–4] opens the attractive possibility to engineer a wide family of topological quantum phases. In such arrangements, one indeed expects to create quantum Hall liquids [5, 6] and topological insulating phases [7–9], in a highly controllable and clean environment. However, measuring unambiguous signatures of these quantum phases, such as non-trivial topological order or the presence of current-carrying edge states, remains a fundamental issue for the cold-atom community. In this talk, I will review the topological phases that could be realized in cold atomic gases. I will discuss the possibility to measure topological properties in these systems through available observables [10]. In particular, I will present efficient methods allowing for the detection of topological edge states in optical lattices [11, 12].

[1] [1] J. Dalibard, F. Gerbier, G. Juzeliunas, P. Ohberg, Rev. Mod. Phys. 83, 15231543 (2011).
[2] Y.-J. Lin, R. L. Compton, K. J. Garcia, J. V. Porto, I. B. Spielman, Nature, 462 628 (2009).
[3] Y.-J. Lin, K. Jimenez-Garca, and I. B. Spielman, Nature 471, 83 (2011).
[4] M. Aidelsburger, M. Atala, S. Nascimbene, S. Trotzky, Y.-A. Chen, and I. Bloch, Phys. Rev. Lett. 107 255301 (2011).
[5] N. R. Cooper, Advances in Physics 57, 539 (2008).
[6] M. Hafezi, A. S. Sorensen, M. D. Lukin and E. Demler, Europhys. Lett. 81, 10005 (2008).
[7] T. D. Stanescu, V. Galitski and S. Das Sarma, Phys. Rev. A 82, 013608 (2010).
[8] N. Goldman, I. Satija, P. Nikolic, A. Bermudez, M. A. Martin-Delgado, M. Lewenstein and I. B. Spielman, Phys. Rev. Lett. 105, 255302 (2010).
[9] A. Bermudez, L. Mazza, M. Rizzi, N. Goldman, M. Lewenstein, and M. A. Martin-Delgado, Phys. Rev. Lett. 105, 190404 (2010).
[10] N. Goldman, E. Anisimovas, F. Gerbier, P. Ohberg, I. B. Spielman and G. Juzeliunas, New J Phys. 15 013025 (2013).
[11] N. Goldman, J. Beugnon and F. Gerbier, Phys. Rev. Lett. 108, 255303 (2012); Eur. Phys. J. Special Topics 217, 135 (2013).
[12] N. Goldman, J. Dalibard, A. Dauphin, F. Gerbier, M. Lewenstein, P. Zoller and I. B. Spielman, PNAS 110 (17) 6736-6741 (2013).