Engineering synthetic gauge fields, Weyl semimetals, and anyons

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Abstract. I will present two topics of research in our group related to synthetic topological quantum matter [1]: (i) topological phases in 3D optical lattices, more specifically a proposal for experimental realization of Weyl semimetals in ultracold atomic gases [2], and (ii) anyons [3,4]. I will present one possible route to engineer anyons in a 2D electron gas in a strong magnetic field sandwiched between materials with high magnetic permeability, which induce electron-electron vector interactions to engineer charged flux-tube composites [3]. I will also discuss intriguing concepts related to extracting observables from anyonic wavefunctions [4]: one can show that the momentum distribution is not a proper observable for a system of anyons [4], even though this observable was crucial for the experimental demonstration of Bose-Einsten condensation or ultracold fermions.

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[2] Tena Dubček, Colin J. Kennedy, Ling Lu, Wolfgang Ketterle, Marin Soljačić, Hrvoje Buljan, *Weyl points in three-dimensional optical lattices: Synthetic magnetic monopoles in momentum space*, Phys. Rev. Lett. 114, 225301 (2015).
[3] M. Todorić, D. Jukić, D. Radić, M. Soljačić, and H. Buljan, *The Quantum Hall Effect with Wilczek's charged magnetic flux tubes instead of electrons*, in preparation
[4] Tena Dubček, Bruno Klajn, Robert Pezer, Hrvoje Buljan, Dario Jukić, *Quasimomentum distribution and expansion of an anyonic gas*, arXiv:1707.04712.