

# The Bose gas as a simulator of interacting gauge theories.

Patrik Öhberg

SUPA, Institute of Photonics and Quantum Sciences, Heriot-Watt University, Edinburgh  
EH14 4AS, United Kingdom.

## Abstract:

In this talk, we show how under proper conditions conveniently engineered laser fields similar to those employed in Refs. [1-3] can induce an effective density-dependent vector potential in a weakly-interacting ultracold Bose gas [4]. Such a gas constitutes the semiclassical limit of an interacting gauge theory for bosons. When the system is tightly confined such that it forms a quasi-one-dimensional gas, we show that the density-dependent gauge field leads to a number of counterintuitive consequences, including density-dependent persistent currents in ring geometries, drifts in the free expansion dynamics, and chiral solitons in a Bose-Einstein condensate (BEC).

## References:

1. Y.-J. Lin, R. L. Compton, A. R. Perry, W. D. Phillips, J. V. Porto and I. B. Spielman, Phys. Rev. Lett. **102**, 130401 (2009).
2. Y.-J. Lin, R. L. Compton, K. Jiménez-García, J. V. Porto and I. B. Spielman, Nature **462**, 628 (2009).
3. Y.-J. Lin, K. Jiménez-García, and I. B. Spielman, Nature **471**, 83 (2011).
4. M.J. Edmonds, M. Valiente, G. Juzeliūnas, L. Santos, and P. Öhberg, arXiv:1212.0445