From ultraslow to ultrafast. Analog simulation of Weyl fermions using ultracold atoms

Frédéric Chevy

Laboratoire Kastler Brossel, Ecole Normale Supérieure, CNRS, 24 rue Lhomond, Paris, France

Weyl fermions are solutions of Dirac's Equation describing massless particles and as such they constitue one of the cornerstones of the Standard Model of particle physics. Using a unitary transformation, it is possible to map the dynamics of harmonically trapped Weyl particles onto that of atoms confined in a magnetic quadrupole potential [1]. We show that even in the absence of interparticle interactions, the non-linearity of the single-particle Hamiltonian leads to a quasi-thermalization of an ideal gas of Weyl fermions towards a non-Boltzmanian state that we characterize using simple arguments. Finally, we suggest possible experimental pathways towards the experimental study of the peculiar topological features of Weyl fermions.

[1] D. Suchet, M. Rabinovic, T. Reimann, N. Kretzschmar, F. Sievers, C. Salomon, J. Lau, O. Goulko, C. Lobo, and F. Chevy, Europhys. Lett. 114 (2016) 26005