

## Title

Quantum walk in momentum space with a Bose–Einstein condensate

## Abstract:

We present a discrete-time, one-dimensional quantum walk based on the entanglement between the momentum of ultracold rubidium atoms (the walk space) and two internal atomic states (the coin degree of freedom). Our scheme is highly flexible and can provide a platform for a wide range of applications such as quantum search algorithms, the observation of topological phases, and the realization of walks with higher dimensionality. Along with the investigation of the quantum-to-classical transition, we demonstrate the distinctive features of a quantum walk and contrast them to those of its classical counterpart. Also, by manipulating either the walk or the coin operator, we show how the walk dynamics can be steered or even time reversed.

## References:

S. Dadras, A. Gresch, C. Groiseau, S. Wimberger, G.S. Summy, Phys. Rev. Lett. 121, 070402 (2018)

A. Alberti and S. Wimberger, Phys. Rev. A 96, 023620 (2017)