Inversion of coherent backscattering with interacting Bose-Einstein condensates in two-dimensional disorder: a Truncated Wigner approach

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We theoretically study the propagation of an interacting Bose-Einstein condensate in a two-dimensional disorder potential, following the principle of an atom laser. The constructive interference between time-reversed scattering paths gives rise to coherent backscattering, which may be observed under the form of a sharp cone in the disorder-averaged angular backscattered current.

As is found by the numerical integration of the Gross-Pitaevskii equation, this coherent backscattering cone is inverted when a non-vanishing interaction strength is present, indicating a crossover from constructive to destructive interferences.

Numerical simulations based on the Truncated Wigner method allow one to go beyond the mean-field approach and show that dephasing renders this signature of antilocalisation hidden behind a structureless and dominant incoherent contribution as the interaction strength is increased and the injected density decreased, in a regime of parameters far away from the mean-field limit. However, despite a partial dephasing, we observe that this weak antilocalisation scenario prevails for finite interaction strengths, opening the way for an experimental observation with 87Rb atoms.

[1] Renaud Chrétien and Peter Schlagheck, Phys. Rev. A 103, 033319 (2021).