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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).