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Anisotropic 2D diffusive expansion of ultra-cold atoms in a disordered potential

Transport in most materials is determined by a complex interplay of many ingredients, for instance the structure of the substrate, the interparticle interactions, and disorder. A primary effect of scattering on impurities is diffusion, which underlies the Drude theory of conductivity. Here [1], we present experimental results on the 2D diffusive expansion of an initially trapped ^{87}Rb ultra-cold gas, confined along the vertical direction, in the presence of an anisotropic disordered potential. Our experiment is a first step towards the study of other disorder effects in two dimensions, from anomalous subdiffusion [2] and classical trapping under the percolation threshold [3] to Anderson localisation [4]. After cooling by all-optical evaporation in the runaway regime [5], the atomic sample is confined in the horizontal plane between the two lobes of a TEM01-like blue-detuned beam. It expands in a disordered potential created by a blue-detuned speckle light-field. We observe an anisotropic diffusive behaviour, leading to non-Gaussian density profiles [6]. After long expansion times, diffusion coefficients are extracted from the experimental data and show a strong energy dependence, in agreement with numerical calculations.

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