Dynamical Center-Of-Mass Evolution of Coupled Diffraction Wavelets in a Matter-Wave Beam Splitter

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Atomic Bragg beam-splitters are integral devices for matter-wave interferometers. Interferometric measurements can be used for quantum metrology and inertial sensing or fundamental physics in space [1]. However, in typical experiments with Bose-Einstein condensates, one has a superposition of several wavelets that extend in the longitudinal x-direction over many optical wavelengths and are much smaller than the Gaussian laser waist in the transverse direction [2]. In this contribution, we analyze the dynamical center-of-mass evolution of the coupled diffraction wavelets in the non-separable Bragg interference potential [3]. The results are supported by (3+1) D simulations of the Gross-Pitaesvskii equation and experiments of QUANTUS Collaboration. Our findings highlight how the interplay between these motions leads to measurable shifts and contrast loss in quantum devices.

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References

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