Abstract Submitted
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Analytic Treatment of Bragg Diffraction Phases for Atom Interferometry[1] JAN-NICLAS SIEMSS, Institute for Theoretical Physics, Leibniz Universitaet Hannover, FLORIAN FITZEK, SVEN ABEND, ERNST M. RASEL, NACEUR GAALOUL, Institute of Quantum Optics, Leibniz Universitaet Hannover, KLEMENS HAMMERER, Institute for Theoretical Physics, Leibniz Universitaet Hannover — High-fidelity Bragg pulses operate in the quasi-Bragg regime in which no simple analytic description of the diffraction process exists. Whilst such pulses enable enabling an efficient population transfer essential for state-of-the-art atom interferometers, the diffraction phase and its dependence on the pulse parameters are currently not well characterized despite playing a key role in the systematics of these interferometers. We develop an analytic theory for such pulses based on the adiabatic theorem. We provide an intuitive understanding of the Bragg condition and derive a unitary scattering matrix in case of driving with adiabatic pulses in the sense of the adiabatic theorem. We find, that perturbations of the adiabatic solution are well described by Landau-Zener physics. Furthermore, we include the effects of linear Doppler shifts applicable to narrow atomic velocity distributions on the scale of the photon recoil of the optical lattice. As an illustration, with our comprehensive microscopic model we study diffraction phase shift fluctuations caused by laser intensity noise affecting the sensitivity of a Mach-Zehnder atom interferometer.

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