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Numerical Study of an Atomic Delta Kicked Rotor Interferometer for Precision Measurements[1] R.A. HORNE, R.H. LEONARD, C.A. SACKETT, University of Virginia — The Atomic Delta Kicked Rotor (ADKR) consists of an otherwise free atom subjected to periodic standing wave laser pulses. It has been proposed that the ADKR system is well suited for metrology due to the sub-fourier scaling of its quantum resonances in the fidelity [1]. We have numerically investigated several different variations of fidelity-based interferometers, and studied applications to measurements of acceleration and recoil frequency. Sensitivity to errors such as fluctuations in the initial velocity, finite pulse duration, and laser amplitude noise were examined. In all cases considered, the sensitivity of the interference to the initial velocity presents a significant limit to the achievable resolution, even considering a condensate source with a velocity width limited only by the uncertainty principle. However, by using a small number of intense laser pulses, fairly high acceleration sensitivity ($10^{-5}g$) can in principle be obtained on a short time scale (10^{-4} s). This could be useful for measurements requiring fast response times.

[1] P McDowall et al., New J. Phys. 11 123021 (2009); I.Talukdar et. al. Phys. Rev. Lett. 105, 054103 (2010).

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