Towards Bragg-based gravimetry on compact devices: A readout delay free scheme for measuring phase shifts with spatial fringes matter-wave interferometry

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Matter-wave interferometry with Bragg transitions has significant potential for inertial sensing due to the prospect of multiphoton transitions with large momentum transfer and robustness to AC Stark shifts. However, a significant limitation of this technique, as compared to traditional Raman transitions, is the inability to distinguish between the output ports of the interferometer immediately after the final beam-splitter pulse. The established approach is to allow the clouds to spatially separate, resulting in a readout delay that reduces the total time that may be allocated to phase interrogation. Following our previous work [1,2], we present a measurement scheme that addresses this critical limitation by extracting phase information from overlapped spatial fringes. We demonstrate this technique can allow the monitoring of phase shift due to acceleration on compact devices without readout delay. This opens up avenues for future gravity measurements with large momentum transfer on compact inertial sensors using Bragg-based atom interferometry.

[1] P. B. Wigley, K. S. Hardman, C. Freier, P. J. Everitt, S. Legge, P. Manju, J. D. Close, and N. P. Robins. Readout-delay-free bragg atom interferometry using overlapped spatial fringes. Phys. Rev. A, 99:023615, Feb 2019 .

[2] KS Hardman, CM Freier, PB Wigley, NP Robins - US Patent App. 17/413,822, 2022.