Abstract Submitted
for the APR10 Meeting of
The American Physical Society

Decoherence Free Neutron Interferometery DMITRY PUSHIN, MIT, MICHAEL HUBER, MUHAMMAD ARIF, NIST, DAVID CORY, MIT, PI — Matter wave optics provide deep insights into quantum mechanics, and in particular matter wave interferometers have served as important examples of macroscopic quantum coherence. Here we show that matter wave optics can benefit from concepts of quantum information processing. We show that a Decoherence Free (DF) matter wave interferometer that was designed based on a quantum error correction code is much less sensitive to mechanical vibrations than is the standard Mach-Zehnder (MZ) interferometer. Matter wave interferometers in general are extremely sensitive to environmental noise, including vibrations, and as a result are only rarely used. The sensitivity to vibrations is a result of the slow velocities of matter waves. Just as neutron interferometer assisted in the development of our current understanding of foundational issues in quantum mechanics, it is well suited to leading the practical implementation of improved coherent control through quantum information theory. We foresee that these changes can make neutron interferometry more available and extend applications in important fields such as soft condensed matter and spintronics.

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Date submitted: 26 Oct 2009 Electronic form version 1.4