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Decoherence Free Neutron Interferometry DMITRY A. PUSHIN, DAVID G. CORY, IQC, University of Waterloo, MICHAEL G. HUBER, NIST, MOHAMED ABUTALEB, MIT, MUHAMMAD ARIF, NIST, CHARLES W. CLARK, Joint Quantum Institute, NIST and the University of Maryland — A neutron interferometer (NI) is a unique example of the macroscopic quantum coherence and has been used to test fundamental principles of quantum mechanics. In practice, neutron interferometers are not widely used because of their extreme sensitivity to environmental noise which is in part due to the slow velocity (relative to light) of the neutron. We show that a neutron interferometer design can benefit from concepts of quantum information processing. We have machined a Decoherence Free (DF) neutron interferometer designed using a quantum error correction code,[1] and have shown it to be much less sensitive to mechanical vibrations than is the standard Mach-Zehnder (MZ) interferometer. Both the MZ and DF geometries are incorporated in one crystal, which allows direct comparisons to be made. We believe that our results and related quantum information approaches, such as "the power of one qubit,"[2] will enable a new series of compact neutron interferometers that can be tailored to specific applications in soft condensed matter and spintronics.

[1]D. A. Pushin, M. Arif, and D. G. Cory, Phys. Rev. A (http://pra.aps.org/abstract/PRA/v79/i5/e053635) 79, 053635 (2009)
[2]E. Knill and R. Laflamme, Phys. Rev. Lett. (http://prl.aps.org/abstract/PRL/v81/i25/p5672_1) 81, 5672 (1998)

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