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Progress towards Ultrasensitive Gravity Gradiometers using Macroscopically Delocalized Strontium[1] KENNETH DEROSE, NATASHA SACHDEVA, TEJAS MAKARAND, JAYAMPATHI KANGARA, YIPING WANG, JONAH GLICK, TIMOTHY KOVACHY, Northwestern University — Recent precision measurements based on torsion balances and pendulums disagree on the gravitational constant G by nearly 40 times the smallest reported uncertainty [1,2]. To address this discrepancy, it is important to measure G with a variety of different methods. Quantum sensors based on atom interferometry have proven to be a powerful tool for measuring G, with a different set of systematic errors than the classical techniques used in most measurements [2]. Here, we discuss progress toward a new atom interferometric measurement of G that will leverage recent advances in ultrasensitive atomic gravity gradiometers. We will detail our designs and progress toward the construction of a two-meter fountain capable of delocalizing atomic wavefunctions on a macroscopic scale by utilizing recent advances in large momentum transfer on the strontium transitions. We intend to test our gravity gradiometer with two large single-crystal silicon proof masses. The masses will translate on thick, level granite slabs between measurements where a high-resolution atomic phase readout will allow the determination of G. In addition, the apparatus will be used to test the gravitational inverse square law in order to search for new particles beyond the standard model. [1] A. Mann. PNAS 113, 9949-9952 (2016); Q. Li et al., Nature 560, 582-588 (2018). [2] G. Rosi, F. Sorrentino, L. Cacciapuoti, M. Prevedeli, and G. M. Tino, Nature 510, 518 (2014).

[1]NIST, Office of Naval Research

Kenneth DeRose
Northwestern University

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