Abstract Submitted
for the DAMOP19 Meeting of
The American Physical Society

Projection noise limited precision measurement in polar molecules with photofragment imaging[1] WILLIAM B. CAIRNCROSS, KIA BOON NG, TANYA S. ROUSSY, YAN ZHOU, YUVAL SHAGAM, TANNER GROGAN, MADELINE PETTINE, ANTONIO VIGIL, KEVIN BOYCE, JILA, NIST, and University of Colorado, Boulder, and Department of Physics, University of Colorado, TANYA ZELEVINSKY, Department of Physics, Columbia University, JUN YE, ERIC A. CORNELL, JILA, NIST, and University of Colorado, Boulder, and Department of Physics, University of Colorado — Molecules are increasingly used for precision measurements due to their high sensitivity to new physics, including permanent electric dipole moments and dark matter. However, molecules with high sensitivity often do not have optical cycling transitions for efficient fluorescence detection, limiting measurement precision. Photoionization and dissociation are versatile tools with high quantum efficiency, but often suffer from technical noise common to pulsed UV lasers. We demonstrate a new method for differential quantum phase measurement in polar molecules that overcomes this limitation by imaging the products of a molecular orientation-preserving photodissociation. We apply this method in HfF^+, along with efficient state preparation via optical pumping, to attain a projected statistical sensitivity to the electron's electric dipole moment of 2 x 10^{-29} e cm in one hour of integration time.

[1]This work was supported by NSF Award 1734006

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Date submitted: 06 Feb 2019 Electronic form version 1.4