Abstract Submitted
for the DAMOP15 Meeting of
The American Physical Society

Limits on dark energy scalars using atom interferometry PAUL HAMILTON, MATT JAFFE, PHILIPP HASLINGER, ETHAN SIMMONS, Univ of California - Berkeley, JUSTIN KHOURY, Univ of Pennsylvania, HOLGER MÜLLER, Univ of California - Berkeley — Dark energy makes up 70% of the mass-energy of the universe yet its identity remains unknown. Using atom interferometry we tightly constrain dark energy models based on scalar fields which become heavily screened in the presence of macroscopic matter. These "chameleon" fields were proposed as a form of quintessence which would be undetectable to macroscopic experiments searching for fifth forces. Combined with an ultra-high vacuum environment, the small mass of individual atoms prevents screening and makes them ideal test masses for detecting small forces from chameleons.[1] We use our recently developed optical cavity atom interferometer[2] to limit anomalous accelerations below $10^{-6}g$ at millimeter-scale distances from a spherical source mass. This rules out a large range of chameleon theories consistent with the cosmological dark-energy density. With feasible improvements in sensitivity, we could detect chameleon fields with couplings up to the expected limit of the Planck mass scale. Adding a second source mass would also allow the measurement of the gravitational Aharonov-Bohm effect.[3]

[1]Burrage et al., arXiv:1408.1409
[2]Hamilton et al., arXiv:1409.7130, accepted to Phys. Rev. Lett.
[3]Hohensee et al., Phys. Rev. Lett. **108**, 230404 (2012)

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Date submitted: 31 Jan 2015 Electronic form version 1.4