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Constraining Dark Energy in Table-Top Quantum Experiments

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If dark energy is a light scalar field, it might interact with normal matter. The interactions, however, are suppressed in the leading models, which are thus compatible with current cosmological observations as well as solar-system and laboratory studies. Such suppression typically relies on the scalar's interaction with macroscopic amounts of ordinary matter but can be bypassed by studying the interaction with individual particles.[1] Using an atom interferometer, we have placed tight constraints on so-called chameleon models, ruling out interaction parameters smaller than 2.3×10^{-5}, while $M \sim 1$ or larger would lead to conflict with macroscopic experiments.[2] In order to close this gap, we have already increased the sensitivity hundredfold and are expecting a new constraint soon. Purpose-built experiments in the lab or on the international space station will completely close the gap and rule out chameleons and other theories such as symmetrons or $f(R)$ gravity.

[1]C. Burrage, E. J. Copeland, E. A. Hinds, Probing dark energy with atom interferometry. J. Cosmol. Astropart. Phys. **2015,** 042 (2015).
[2]P. Hamilton, M. Jaffe, P. Haslinger, Q. Simmons, H. Müller, and J. Khoury, Atom-interferometry constraints on dark energy. Science **349,** 849 (2015).