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Atom-Interferometry Constraints on Dark Energy

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If dark energy is a light scalar field, it might interact with normal matter. The interactions, however, are suppressed in some 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. Using an atom interferometer, we have placed tight constraints on so-called chameleon models, ruling out interaction parameters $\beta_M > 4 \times 10^4$. This limit is improved by 2.5 orders of magnitude relative to previous experiments. We have already increased the sensitivity of our interferometer 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 out chameleons and other theories, such as axions, dark photons, symmetrons or $f(R)$ gravity.