Towards an improved atom interferometer to constrain chameleon dark energy

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Atom interferometers have emerged as pivotal tools in many areas of modern physics, enabling high-precision measurements of fundamental constants, rigorous tests of physical laws, and ambitious tests to detect dark energy and gravitational waves. As we explore techniques to further increase the precision and accuracy of our measurements, we also find new sources of errors that must be characterized and eliminated. In this talk, I will describe our atom interferometer setup designed to probe for chameleon dark energy, the systematic errors we encountered due to wavefront diffraction and our associated simulation work. I will also discuss our work on developing a scheme using a combination of Raman-pi pulses and microwave pulses for large momentum transfer to enhance the sensitivity of the interferometer with minimal extra experimental complexity.