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Atom Interferometry with Ultracold Quantum Gases in a Microgravity Environment JASON WILLIAMS, Jet Propulsion Laboratory, California Institute of Technology, JOSE D'INCAO, JILA, Department of Physics, University of Colorado, SHENG-WEY CHIOW, NAN YU, Jet Propulsion Laboratory, California Institute of Technology — Precision atom interferometers (AI) in space promise exciting technical capabilities for fundamental physics research, with proposals including unprecedented tests of the weak equivalence principle, precision measurements of the fine structure and gravitational constants, and detection of gravity waves and dark energy. Consequently, multiple AI-based missions have been proposed to NASA, including a dual-atomic-species interferometer that is to be integrated into the Cold Atom Laboratory (CAL) onboard the International Space Station. In this talk, I will discuss our plans and preparation at JPL for the proposed flight experiments to use the CAL facility to study the leading-order systematics expected to corrupt future high-precision measurements of fundamental physics with AIs in microgravity. The project centers on the physics of pairwise interactions and molecular dynamics in these quantum systems as a means to overcome uncontrolled shifts associated with the gravity gradient and few-particle collisions. We will further utilize the CAL AI for proof-of-principle tests of systematic mitigation and phase-readout techniques for use in the next-generation of precision metrology experiments based on AIs in microgravity. This research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

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