Abstract Submitted
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Sub-picometer Laser Distance Gauge for Gravitational and Astronomical Instruments[1] JAMES D. PHILLIPS, DAN KAPLAN, Illinois Institute of Technology, ROBERT D. REASENBERG, UCSD and Harvard-Smithsonian Center for Astrophysics, TOM ROBERTS, Illinois Institute of Technology — The Tracking Frequency laser Gauge (TFG) can measure distances in the range 0.01-1000 m. We have demonstrated accuracy of 2 picometers (pm, 10ˆ-12 m) in 1 s, and 40 femtometers (fm, 10ˆ-15 m) in 30 s when using a resonant measurement interferometer with a finesse of 130. It is the world's most accurate laser distance gauge. The TFG can be the sensor for new tests of the equivalence principle, including a test with antimuons; and for optical trusses in demanding spaceborne astronomical instruments, such as telescopes with exoplanet coronagraphs and others using segmented or distributed apertures. The TFG locks a laser to the measurement interferometer. This architecture gives it substantial advantages over the traditional precision instrument, the heterodyne phase gauge (HPG). The TFG is free of an important source of cyclic bias that limits the HPG accuracy. The TFG's readout is a radio frequency derived from an optical heterodyne, not an RF phase as in the HPG. The TFG measures absolute distance (to μm precision) with little or no additional hardware. The TFG is now operating at the Illinois Institute of Technology (IIT), where we are refining and testing error models to increase reliability and improve accuracy.

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