Abstract Submitted
for the APR13 Meeting of
The American Physical Society

Laser Frequency Noise Immune Gravitational Wave Detection

JASON HOGAN, SHENG-WEY CHIOW, SUSANNAH DICKERSON, PETER GRAHAM, TIM KOVACHY, SURJEET RAJENDRAN, ALEX SUGARBAKER, MARK KASEVICH, Physics Dept., Stanford University — Laser frequency noise is a dominant noise background for the detection of gravitational waves using long-baseline optical interferometry. Amelioration of this noise requires near simultaneous strain measurements on more than one interferometer baseline, necessitating, for example, more than two satellites for a space-based detector, or two interferometer arms for a ground-based detector. We describe a new detection strategy based on recent advances in optical atomic clocks and atom interferometry which can operate at long-baselines and which is immune to laser frequency noise [1]. Laser frequency noise is suppressed because the signal arises strictly from the light propagation time between two ensembles of atoms. This new class of sensor allows sensitive gravitational wave detection with only a single baseline. This approach also has practical applications in, for example, the development of ultra-sensitive gravimeters and gravity gradiometers. We show that a space-based detector based on such principles can operate at LISA sensitivity levels and below with just a single measurement arm. We will present recent data from our 10 m ground-based prototype instrument which supports the preliminary instrument design concept.

[1] P. Graham, et. al., arXiv:1206.0818.

Mark Kasevich
Stanford University

Date submitted: 17 Jan 2013 Electronic form version 1.4