Abstract Submitted
for the DAMOP17 Meeting of
The American Physical Society

Detecting continuous gravitational waves with superfluid helium SWATI SINGH, Williams College, LAURA DE LORENZO, Caltech, IGOR PIKOVSKI, ITAMP, KEITH SCHWAB, Caltech — We study the sensitivity to continuous-wave strain fields of a kg-scale optomechanical system formed by the acoustic motion of superfluid helium-4 parametrically coupled to a superconducting microwave cavity. This narrowband detection scheme can operate at very high Q-factors, while the resonant frequency is tunable through pressurization of the helium in the 0.1-1.5 kHz range. The detector can therefore be tuned to a variety of astrophysical sources and can remain sensitive to a particular source over a long period of time. For reasonable experimental parameters, we find that strain fields on the order of $h \sim 10^{-23}/\sqrt{\text{Hz}}$ are detectable. We show that the proposed system can significantly improve the limits on gravitational wave strain from nearby pulsars within a few months of integration time.

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Date submitted: 27 Jan 2017 Electronic form version 1.4