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Abstract

The LIGO project (Laser Interferometer for Gravitational Wave Observation) is run by the California Institute of Technology (Caltech) and the Massachusetts Institute of Technology (MIT) with the aim of directly detecting gravitational waves for the first time. Thermal noise within the interferometers limits the sensitivity and must be reduced in the frequency band where astrophysical sources should produce gravitational waves. Our research investigates a critical source of such thermal noise in the suspension subsystem of the LIGO interferometer. The suspension subsystem consists of suspended silica test masses which have the ability to move freely in response to a gravitational wave. The goal is to have a suspension subsystem with low mechanical loss and thus high, consistent, Q resonances, so that, by the Fluctuation-Dissipation Theorem, the thermal noise will be low. In particular, my work has focused on the thermal noise in the wires produced at the point the wire leaves the mirror, which in the LIGO detectors, is governed by a standoff. We have analyzed and tried to improve the Qs of the wire using different standoffs and a variety of techniques to situate the standoff on the test mass. The results from this research could potentially be very important for Enhanced LIGO, or even Advanced LIGO, which are the next generations of this federally funded project.

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