LIGO - Seismic Platform Interferometer
by
Daniel Clark

The National Science Foundation (NSF) is currently supporting an upgrade of the Laser Interferometer Gravitational-wave Observatory (LIGO). Advanced LIGO will consist of three 4 km long Michelson interferometers tuned to detect gravitational wave root mean square spectral density strains on the order of $10^{-22} / \sqrt{\text{Hz}}$ at 100 Hz. Advanced LIGO is scheduled to be commissioned in 2014 and is expected to increase the sensitivity over Initial LIGO by an order of magnitude. In all, about 30 actively controlled, all degree of freedom internal vacuum isolation platforms are being installed. These platforms are one link in the seismic isolation chain that must provide about 10 orders of magnitude attenuation of the ground motion by the test mass optics at 10 Hz. The control of these platforms becomes increasingly difficult at low frequency when tilt can be incorrectly interpreted as translation by the horizontal feedback seismometers. One approach addressing the effect of tilt-horizontal coupling is to link adjacent platforms together at low frequencies through an auxiliary interferometer. This allows a gravitational wave to disturb the proof masses at higher frequencies in the science band while reducing unwanted disturbances. The Seismic Platform Interferometer (SPI) measures the differential displacement, pitch, and yaw between adjacent platforms. Feasibility has recently been demonstrated in the Stanford Engineering Test Facility (ETF) through the control of two active seismic isolation platforms. This indicates that the SPI can supplement the Advanced LIGO seismic isolation sensors helping to provide the isolation necessary for detection of gravitational waves.