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ABSTRACT

Gravitational waves are ripples of space-time predicted by Einstein's theory of General Relativity. The Laser Interferometer Gravitational-wave Observatory (LIGO), part of a global network of gravitational wave detectors, seeks to detect these waves and study their sources.

The LIGO detectors were upgraded in 2008 with the dual goals of increasing the sensitivity (and likelihood of detection) and proving techniques for Advanced LIGO, a major upgrade currently underway. As part of this upgrade, the signal extraction technique was changed from a heterodyne scheme to a form of homodyne detection called DC readout. The DC readout system includes a new optical filter cavity, the output mode cleaner, which removes unwanted optical fields at the interferometer output port.

This work describes the implementation and characterization of the new DC readout system and output mode cleaner, including the achieved sensitivity, noise couplings, and servo control systems.