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A position-sensitive detector for the Advanced LIGO suspensions

A simple optical displacement sensor consisting of an infrared LED source, a photodiode detector, and an occluding 'flag', has been investigated, for potential use in the Advanced LIGO gravitational wave detectors. A number of different commercially available LEDs and photodiodes were tried in the displacement sensor, and an optimal pair was found. A surprising geometrical effect was noted which allowed the residual noise level to be reduced at low frequencies, permitting a displacement sensitivity of ˜10-10 m/⊠Hz to be attained at a frequencies in the region of 2 Hz. A novel optical x2 linear displacement amplifier has also been constructed, suggesting that the displacement sensitivity might be further improved by this factor.

The work reported here was carried out in collaboration with the Institute for Gravitational Research at the University of Glasgow, the Department of Physics and Astronomy at the University of Birmingham, and the Rutherford Appleton Laboratory.

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