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Design of Coupled Wave Front Sensor for Torsion-Bar Antenna

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TOBA (Torsion-Bar Antenna) is a ground-based gravitational wave detector using a torsion pendulum. The resonant frequency of torsional motion is ~ 1 mHz, therefore TOBA has good design sensitivity of 10^{-19} $\text{m}/\sqrt{\text{Hz}}$ at 0.1 Hz in low frequencies (0.1 Hz \sim 10 Hz). TOBA can detect intermediate mass black hole binary mergers and so on. A prototype detector Phase-III TOBA with a 35 cm-scale pendulum is under development to demonstrate noise reduction. The target sensitivity is set to 10^{-15} $\text{m}/\sqrt{\text{Hz}}$ at 0.1 Hz. To achieve our target sensitivity, we need to measure the pendulum rotation precisely. We propose a coupled wave front sensor as an angular sensor for Phase-III TOBA. In our method, an auxiliary cavity is used to enhance the first-order TEM modes in the main cavity. We will show the principle and experimental design of a coupled wave front sensor in this workshop.

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