

Angular Signal Amplification with a Coupled Cavity for Torsion-Bar Antenna

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Torsion-Bar Antenna (TOBA) 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 $10^{-19} / \sqrt{\text{Hz}}$ at 0.1 Hz in low frequencies (0.1 Hz – 10 Hz). TOBA can detect intermediate mass black hole binary mergers, Newtonian noise, 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 $10^{-15} / \sqrt{\text{Hz}}$ at 0.1 Hz. To achieve our target sensitivity, we need to measure the pendulum rotation precisely. We propose a coupled wavefront sensor (Coupled WFS) as an angular sensor for Phase-III TOBA. In our method, an auxiliary cavity is used to compensate Gouy phase of a main cavity and enhance the first-order TEM modes in the main cavity. The experimental demonstration was successfully performed in 2021. In this workshop, we will show the principle and demonstration results of a Coupled WFS.

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