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Development Update for the TorPeDO Experiment - A Newtonian Noise Sensor for 3G Observatories

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Third generation gravitational-wave observatories extend their detection bands down to several Hertz. Enhancing sensitivity in this frequency regime will uncover higher mass black hole binaries, and provide earlier identification of multi-messenger astronomy events. Reaching astronomically relevant sensitivities, at these frequencies, requires overcoming technical and fundamental noise sources. One noise source is Newtonian noise; created by the gravitational force of local density fluctuations; both seismic and atmospheric. Techniques to measure or subtract atmospheric Newtonian noise are underdeveloped; representing a fundamental limit to the low frequency sensitivity of 3G gravitational-wave detectors. The Torsion Pendulum Dual Oscillator, TorPeDO experiment, is under development as an apparatus sensitive to Newtonian noise. Such a device will facilitate direct detection of Newtonian noise. With such a sensor, cancellation of Newtonian noise is possible; improving the sensitivity of gravitational-wave observatories. The TorPeDO consists of two torsion pendula, suspended perpendicularly, with a rotational frequency of 25 mHz. Optical cavities provide low noise readout of their differential motion. The project targets a sensitivity of 3e-15 m/rtHz at 0.1 Hz. We present results from the TorPeDO controls prototype, assembled at The Australian National University, including the current interferometric performance, and the pathway to reach the experiment's thermal noise limit.

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