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Mechanical parametric feedback-cooling for pendulum-based gravity experiments

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Gravitational forces that oscillate at audio-band frequencies are measured with masses suspended as pendulums that have resonance frequencies even lower.
If the pendulum is excited by thermal energy or by seismic motion of the environment, the measurement sensitivity is reduced.
Conventionally, this problem is mitigated by seismic isolation and linear damping, potentially combined with cryogenic cooling.
Here, we propose mechanical parametric cooling of the pendulum motion during the gravitational field measurement.
We report a proof of principle demonstration in the seismic noise dominated regime and achieve a damping factor of the pendulum motion of 5.7.
We find a model system for which mechanical parametric feedback cooling reaches the quantum mechanical regime near the ground state.
More feasible applications we anticipate in gravitational-wave detectors.

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