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Email: contact via journal

December 10, 2025

Editorial Office
Classical and Quantum Gravity
IOP Publishing

Dear Editors,

I am pleased to submit the manuscript entitled "**Coherence-Dependent Backreaction in Semiclassical and Analog Gravity: Testable Predictions from Informational Stress**" for consideration as a Research Paper in *Classical and Quantum Gravity*.

Summary. This paper derives a testable prediction for analog gravity experiments: coherent phonon injection near a sonic horizon in a Bose-Einstein condensate produces density modulations $\delta\rho/\rho_0 \sim 10^{-6}$, while thermal phonon injection of identical energy produces no such effect. This coherent-versus-thermal signature—measurable with current BEC technology—constitutes a qualitative test absent in competing frameworks (Penrose-Diósi, stochastic gravity).

Key contributions:

- Explicit derivation of an informational stress tensor $\Theta_{\mu\nu}$ for Schwarzschild, FRW, Rindler, and acoustic geometries via variation of a coherence functional.
- Two independent derivations of the coupling constant κ (holographic and entropic).
- Demonstration that analog gravity systems provide 62 orders of magnitude enhancement in effective coupling, bringing predictions within experimental reach.
- Concrete experimental protocol with falsification criteria: a null result at $\delta\rho/\rho_0 < 10^{-7}$ would falsify the acoustic implementation.

Relevance to CQG. The manuscript addresses the interface between quantum information and spacetime geometry—a central topic for your readership. The framework extends semiclassical gravity by incorporating relative entropy as a dynamical player, while remaining consistent with established limits. The emphasis on falsifiable predictions and experimental feasibility aligns with CQG's interest in connecting theory to observation.

Novelty. The key distinguishing feature is the prediction that coherent and thermal quantum states of identical energy produce different gravitational responses. This signature is absent in standard semiclassical gravity, Penrose-Diósi models, and stochastic gravity, providing a clear experimental discriminant.

This manuscript has not been published elsewhere and is not under consideration by another journal. All work is original and properly cited.

I believe this work will be of significant interest to the CQG community, particularly researchers working on analog gravity, quantum fields in curved spacetime, and experimental tests of semiclas-

sical gravity.

Thank you for considering this submission.

Sincerely,

David Ahmann
Independent Researcher
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