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Peer Review

Review of: "Emergent Newtonian Gravity from the Collective Acoustic Metric of a Logarithmic Superfluid Vacuum"

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This manuscript presents an emergent-gravity framework based on a logarithmic superfluid vacuum. The author argues that microscopic vortex-Gausson solitons collectively generate a Painlevé–Gullstrand (PG) flow and an acoustic metric that reproduces Newtonian gravity. The work is ambitious and original, but several central conclusions rely on assumptions, ansätze, dimensional arguments, and self-consistency conditions rather than derivations from the underlying field equations. Consequently, the manuscript requires substantial revision before it can be considered for publication in a mainstream theoretical physics journal.

Major Points

1. The central result for the effective gravitational constant, Eq. (24), is obtained only after introducing the single-soliton ansatz in Eq. (22). The manuscript explicitly states that Eq. (22) is an ansatz and that a derivation from the linearized Madelung–Hamilton–Jacobi system is deferred to future work. Since Eq. (24) depends entirely on Eq. (22), the derivation of the gravitational coupling remains incomplete.

2. The manuscript assumes a Newtonian potential in Eq. (23), derives the PG flow through Eqs. (16)–(19), and then argues that the resulting metric reproduces the assumed gravitational field. It is not sufficiently demonstrated that Newtonian gravity emerges independently rather than being implicitly encoded in the initial assumptions.

3. Equation (30) shows that the PG flow possesses non-zero divergence. Consequently, the steady-state continuity equation (Eq. (6)) is not satisfied unless additional source or sink mechanisms are introduced. The proposed resolutions (quasi-steady approximation, two-fluid counterflow, vortex-core absorption, and geometric redirection) remain speculative. Because the PG flow is central to the theory, this issue is

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fundamental rather than technical.

4. The derivation leading to Eqs. (27) and (28) depends on matching Eq. (24) to Newton's constant together with the condensate packing assumption of Eq. (26). Therefore, the emergence of Planck-scale quantities appears closer to dimensional reconstruction than to a parameter-free prediction.

5. The manuscript starts from the logarithmic Klein–Gordon equation (Eq. (1)), but the key gravitational results are obtained using Bernoulli arguments, dimensional analysis, and acoustic metric reasoning. A rigorous derivation connecting Eq. (1) directly to Eqs. (22)–(24) is absent.

Moderate Points

1. Numerical simulations primarily test fluid behavior rather than gravity. The simulations associated with Eq. (29) verify vortex stability and the stability of the PG profile, but they do not directly demonstrate the emergence of Newtonian gravity, Poisson's equation, or gravitational lensing.

2. Claims of uniqueness should be moderated. The statement that the PG flow is the unique self-consistent solution is not rigorously proven. The conclusion based on Eqs. (16)–(19) should be restricted to the assumptions adopted in the present framework.

3. The manuscript would benefit from a deeper comparison with alternative emergent-gravity approaches and related superfluid-vacuum models.

Minor Points

1. The notation involving ρ, $\tilde{\rho}$, $\rho 0$, and ρmass introduced around Eqs. (2)–(5) can be difficult to follow.

2. Several key references are the author's own preprints. Greater engagement with peer-reviewed literature would strengthen the presentation.

3. Expressions such as 'fails catastrophically' and 'uniquely selects' should be softened to maintain an objective scientific tone.

Questions for the Author

1. Can the single-soliton potential introduced in Eq. (22) be derived directly from the linearized field equations?

2. How is global mass conservation maintained in the presence of the PG flow given Eq. (30)?

3. Can Poisson's equation be derived without assuming the Newtonian potential of Eq. (23)?

4. Does the theory predict measurable deviations from General Relativity beyond the result $\gamma = 1$?

5. Can higher-order post-Newtonian parameters be calculated within the framework?

6. Can the cosmological implications discussed in Section 7 be derived dynamically rather than phenomenologically?

The manuscript contains interesting and potentially significant ideas connecting logarithmic condensates, acoustic metrics, and emergent gravity. However, the most important conclusions rely on Eq. (22), an unproven ansatz, and on a PG flow whose compatibility with the continuity equation remains unresolved through Eq. (30). Major theoretical development is required before the work can be considered mature.

Declarations

Potential competing interests: No potential competing interests to declare.