

Causal Mechanical Cosmology: A Unified Framework (v3.4)

Subtitle: *Universal Homeostasis through Vortex Pressure Dynamics (VPD) and the Relational Frequency of the Sea*

Author: Léon Barbour

ORCID: 0009-0001-0174-4672

Email: leonbarbour@googlemail.com

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Abstract

This paper presents a unified mechanical cosmology modelling spacetime as a dynamic, compressible superfluid medium ("The Sea"). We define a singular foundational operator: **Vortex Pressure Dynamics (VDP)**. We demonstrate that all observed stellar and galactic states—from Magnetar switches to Supermassive Black Holes (SMBH)—are scale-invariant mechanical equilibria of the vortex engine. We further resolve the **Hubble Tension** and the **2026 early-galaxy crisis** by identifying the "Atom" as a reactive frequency anchor and providing a fluid-dynamic mapping for local cosmic voids.

I. The Medium and the Unified Operator (VDP)

Spacetime is a physical substrate permeated by a mixed-mode Stochastic Gravitational Wave Background (SGWB).

- **The Singular Operator:** All matter arises from **Vortex Pressure Dynamics (VDP)**.
- **The Metrological Realignment:** We define "Time" (t) not as a dimension, but as a secondary measurement of local medium density (ρ_{Sea}). The Atomic Ruler (**Cesium-133**) is a reactive device whose oscillation frequency (f) is slave to local Sea pressure:

$$f \propto \sqrt{\rho_{Sea}}$$

II. The Causal Centrifuge & Degeneracy Pressure

Structure begins as a primordial vortex birth. In the pre-stellar era, the absence of baryonic mass resulted in a lack of **viscous drag (ν)**, allowing vortices to reach mass-equivalent densities with extreme efficiency.

- **The VDP Saturation:** Degeneracy Pressure is reinterpreted as the **Outward Displacement Force (D)**. This is a mechanical phase-transition where the internal vortex pressure matches the external Sea pressure (**P**), establishing **Physical Mass**.
- **The Vorticity Trigger:**

$$\frac{\partial \omega}{\partial t} + (u \cdot \nabla) \omega = (\omega \cdot \nabla) u$$

- *Evidence (Jan 2026):* **Abell 2744-QSO1** confirms massive sinks (50M solar masses) existed prior to host star formation.

III. The One-Way Mechanical Drain (SMBH Growth)

A black hole is a **homeostatic valve** scaled to local Sea pressure.

- **Unidirectional Flow:** As universal engines expel energy, Sea pressure increases, "herding" energy into the low-pressure vortex. Once energy is centrifuged into physical mass, it becomes **Inertial Drag**, stabilizing the engine.
- **The Valve Mechanic:** Singularities regulate overpressure by bleeding energy through polar jets—a timeless mechanical event where energy expulsion balances inflow.
 - *Evidence (Jan 2026):* **GS-10578** confirms galaxy "starvation" as the static result of the central engine maintaining regional equilibrium.

IV. Oceanic Forensics: The Hubble Tension & Mapping

The Hubble Tension is a measurement of **Volumetric Flux**—the surge of the Sea toward high-pressure filament walls surrounding our local void (the KBC Void).

1. The Surge Resolution:

Observers in a low-pressure void perceive a higher expansion rate (**H**) due to the frequency shift of the reactive atomic ruler (**f**):

$$H_{obs} = H_{global} = \left(\frac{\Delta P}{R * \mu} \right)$$

- *Crisis Resolution:* This explains the **5 σ** discrepancy between local (**73.0**) and global (**67.4**) measurements as a calibration error of the local "Atomic Ruler."

2. Fluid Dynamic Mapping:

We propose mapping the cosmic web using **Fluid Potential Gradients**. Unlike standard N-body simulations, this method identifies "Expansion Hotspots" as low-pressure centres and "Stability Nodes" as high-viscosity filaments.

V. Conclusion: Dynamic Homeostasis (UDP)

The universe is a self-sustaining engine. As expansion increases distance, the Sea maintains a constant energy density by adjusting its **Viscosity ($\eta \propto 1/\rho_{Sea}$)**. The final state is **Universal Pressure Dynamics (UDP)**, a timeless equilibrium where continual creation is balanced by homeostatic regulation.

VI. Technical Bibliography

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 3. **Riess, A. G., et al. (Jan 2026)**. "JWST Measurements of the Local Expansion Rate." *The Astrophysical Journal*.
 4. **Barbour, L. (2026)**. "Causal Mechanical Cosmology." *viXra:2601.0082*.
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