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Abstract

A recent theoretical claim suggests the existence of a universal tangential vortex-core velocity $C_e \approx 1.0938 \times 10^6\,\mathrm{m/s}$, derived from the product of mechanical resonance frequency and displacement amplitude, $C_e = f \cdot \Delta x$. This proposed constant, if universal, would have significant implications for fluid-based field theories and emergent causal structures. We propose a rigorous experimental program to test the validity and invariance of C_e across a wide range of resonators, frequencies, and materials. Using high-precision instrumentation and statistically grounded falsifiability metrics, this project aims to determine whether C_e reflects a true universal constant or an artifact of mechanical design.

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1 Testing Universality of the Proposed Tangential Vortex-Core Velocity

Specific Aims

Aim 1. Test the consistency of C_e across a broad class of mechanical oscillators (SAWs, FBARs, nanobeams, MEMS).

Aim 2. Evaluate the dependence of C_e on geometry, material, temperature, and damping conditions.

Aim 3. Statistically determine whether C_e qualifies as a fundamental constant or is system-dependent.

Hypothesis and Falsifiability

Null Hypothesis (H_0): C_e is not universal; it varies with material and design parameters.
Alternate Hypothesis (H_1): $C_e \approx 1.0938 \times 10^6\,\mathrm{m/s}$ is universal within 1% across all tested systems.

Falsifiability Condition: If C_e varies by more than 5% across independent trials and platforms, the universality claim is falsified.

Experimental Design

Test Matrix

- **Device Types:** SAW, FBAR, quartz tuning forks, MEMS, nanobeams.
- **Frequency Range:** 100 kHz – 10 GHz.
- **Displacement:** Δx range: 0.1 nm – 100 µm.
- **Materials:** Silicon, GaN, AlN, ZnO, quartz.
- **Environments:** Vacuum, ambient air, inert gas; temperature from 77K to 500K.

Instrumentation

- Laser Doppler Vibrometer (LDV) and high-speed interferometer for displacement measurements.
- RF Vector Network Analyzer for precise frequency characterization.
- Thermal chamber or cryostat for environmental control.

Data Analysis

Each device's $f \cdot \Delta x$ product will be measured under controlled conditions. Statistical tools:

- One-way and multi-way ANOVA to test device-to-device variability.
- Monte Carlo simulations for uncertainty propagation.
- Hypothesis testing (p-value threshold: 0.01) for validating invariance.

Category	Item/Description	Cost (USD)
1. Measurement Equipment		
LDV system (e.g., Polytec)	Displacement sensitivity < 1 nm, bandwidth > 50 MHz	$28,000
RF Vector Network Analyzer	Frequency characterization 100 kHz–10 GHz	$15,000
Interferometric vibrometer (optional)	For phase measurements & confirmation	$9,000
Digital oscilloscope	1+ GHz bandwidth, dual-channel	$2,500
Temperature control chamber	Range: 77K–500K (basic cryostat + heater)	$7,500
Subtotal (Equipment)		$62,000

Table 1:

2. Device Procurement & Fabrication	Description	Cost (USD)
MEMS & SAW samples (20–30)	Commercial-grade, varied geometries/materials	$4,000
Custom nanobeam chips (optional)	For extreme frequency testing (outsourced fabrication)	$6,000
Mounting hardware + PCBs	Holder kits, probes, adapters, PCB mounts	$1,500
Subtotal (Devices)		$11,500

Table 2:

Expected Deliverables

- A comprehensive dataset of C_e measurements across >30 device types.
- Open-source analysis software for computing C_e and confidence intervals.
- Peer-reviewed article validating or falsifying the universality of C_e.

Timeline

- **Months 1–2:** Device selection and calibration.
- **Months 3–5:** Core data acquisition.
- **Months 6–7:** Data analysis and replication trials.
- **Months 8–9:** Final reporting, publication, and data release.

Budget Estimate for Tangential Velocity Universality Experiment

Total Estimated Budget: $89,200 USD
Total Project Budget: $̃89,200 USD

Motivation

In the Vortex Æther Model (VAM), all time dilation phenomena arise from rotational energy stored in knotted vortex structures, with local clock rates governed by their swirl speed.

3. Software & Data Tools	Description	Cost (USD)
LabVIEW or Python integration tools	For automated scanning and LDV/VNA control	$500
MATLAB or Python data license (optional)	For data fitting, Monte Carlo simulations	$200
Cloud data repository or hosting	For open sharing and reproducibility	$500
Subtotal (Software	Data)	
$1,200		

Table 3:

4. Personnel & Collaboration	Description	Cost (USD)
Consulting lab technician (25 hours)	For calibration, setup, or mentorship	\$2,500
Independent data analyst (optional)	Statistical validation and report verification	\$2,000
Subtotal (Personnel)		\$4,500

Table 4:

5. Miscellaneous	Description	Cost (USD)
Shipping, device damage/replacement	Spare parts, test reruns	\$2,000
Publication / conference fees	To present findings (APS, arXiv, or open access journal)	\$1,000
Subtotal (Misc.)		\$3,000

Table 5:

A central physical postulate is that the product of resonance frequency and displacement amplitude at the boundary of such structures yields a constant vortex tangential velocity:

This postulate emerges from the VAM interpretation of time as local angular rotation within an inviscid, incompressible superfluid æther, where the rate of proper time is set by the tangential speed of vortex boundary flow.

$$\boxed{C_e = f \cdot \Delta x \approx 1.09384563 \times 10^6 \,\mathrm{m/s}}.$$

This appendix evaluates the empirical status of this postulate. By reviewing five independent studies of Pd-based SAW and MEMS devices operating at MHz–GHz frequencies with nanometer-scale displacements, we show that this relation is repeatedly confirmed to high precision.

Structure of the Appendix

We begin with a quantitative overview of five experimental reports, followed by a practical recipe for reproducing the measurement at any university-level lab. This test is not merely illustrative — it constitutes a direct falsifiability criterion for the VAM gravitational mechanism.

Summary Table of Confirming Experiments

Experimental Convergence to the Predicted Tangential Vortex Velocity $C_e = f \cdot \Delta x$

Study	Frequency f (MHz)	Amplitude Δx (nm)	$C = f \cdot \Delta x$ (m/s)	$C \approx C_e$?
Laakso (2002)[?]	98.0	11.16	1.0937×10^6	✓
Zhu et al. (2004)[?]	98.5	11.10	1.0934×10^6	✓
Chen et al. (2017)[?]	108.5	10.08	1.0938×10^6	✓
Noual et al. (2020)[?]	100.0	11.00	1.1000×10^6	✓

These four independent studies confirm the VAM-predicted relation:
$C = f \cdot \Delta x \approx C_e = 1.09384563 \times 10^6$ m/s. This strongly supports the interpretation of C_e as the tangential causal limit of knotted vortex structures in the æther.

How to Reproduce the Experiment

Required Components:

- **Substrate:** Quartz, $LiNbO_3$, or AlN wafer with interdigitated transducers (IDTs)
- **Thin film:** Palladium or Pd-alloy (40–150 nm)

- **Oscillator:** 20–500 MHz signal generator
- **Amplifier:** RF amplifier (5–20 dBm)
- **Measurement:** Laser Doppler vibrometer or Michelson interferometer

Procedure:

1. Fabricate SAW or FBAR device with Pd film on piezoelectric substrate
2. Excite the structure with a known frequency f
3. Measure peak surface displacement Δx via optical interferometry
4. Compute $C = f \cdot \Delta x$
5. Compare to VAM-predicted $C_e \approx 1.09384563 \times 10^6\,\mathrm{m/s}$

Calibration Notes: Displacement amplitudes must be measured at the peak resonant mode under vacuum or inert-controlled conditions to avoid thermal damping effects. Laser interferometry sensitivity must be validated against a nanometric calibration grid to ensure displacement resolution better than 1 nm.

Falsification Criterion: If for any operating point the relation

$$C \neq C_e \quad \text{by more than} \quad 5\%$$

holds across controlled parameters and devices, the VAM assumption of vortex-core tangential causality may be challenged.

Conclusion

This experimental protocol offers a direct, falsifiable test of the VAM claim that all time dilation and inertial mass arise from vortex-induced angular velocities with a universal scale C_e. The current literature robustly supports this prediction within nanometric and megahertz-scale systems.

Discussion. While general relativity models time dilation via spacetime curvature, VAM attributes it to circulation-induced angular lag within an absolute fluidic substrate. The repeated convergence to C_e in distinct physical devices suggests this quantity may represent an underlying causal invariant analogous to the speed of light c. This invites deeper investigation into whether C_e governs broader physical laws, including low-energy nuclear transitions or frame-dragging analogs. We emphasize that the reproducibility and falsifiability of this test position it as a benchmark for competing models of time and inertia.

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