TriPhase Wave Mechanics: Companion Paper Series

Christian R. Fuccillo
Magnetic Innovative Solutions LLC

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Overview

This package contains four companion papers presenting observational tests of TriPhase Wave Mechanics. The papers are designed to be read together, with each focusing on a specific domain of evidence.

Total: 155 pages across 4 papers, ∼176 peer-reviewed references

Papers in This Package

Paper I: CMB Acoustic Peaks (52 pages, ∼50 references)

File: `Paper_I_CMB_Acoustic_Peaks.pdf`

Derives CMB acoustic peak positions from three-phase vacuum geometry. Presents the complete crystallographic derivation, mode quantization framework, and full spectrum interpolation formula. Achieves sub-percent agreement with Planck 2018 data using only 3 free parameters (vs. ΛCDM's 6).

Key Prediction: $\ell_3/\ell_2 = 1.533$ from base geometric ratio 3/2 with mode coupling (observed: 1.533 ± 0.015)

Paper II: Dark Energy Equation of State (30 pages, ∼34 references)

File: `Paper_II_Dark_Energy_w0.pdf`

Derives the dark energy equation of state parameter $w_0 = -181/216 = -0.838$ from vacuum mode structure. Matches DESI 2024 BAO measurements ($w_0 = -0.83 \pm 0.06$) and addresses why observations deviate from ΛCDM's $w = -1$.

Key Prediction: $w_0 = -181/216 = -0.838$ (not -1)

Paper III: Local Laboratory Evidence (44 pages, ∼60 references)

File: `Paper_III_Local_Evidence.pdf`

Reviews laboratory-scale evidence for three-phase vacuum structure, including QED precision measurements ($g - 2$, Lamb shift), walking droplet pilot-wave analogs, and proposes a testable Casimir force prediction.

Key Prediction: Casimir force modified by factor 2/3 from mode density

Paper IV: Hubble Tension Resolution (∼24 pages, ∼35 references)

File: `Paper_IV_Hubble_Tension.pdf`

Addresses the Hubble tension by deriving the distance-redshift formula from wave packet slowing. The constraint $v_g \times v_\phi = c^2$ is the standard waveguide dispersion relation (Feynman, Jackson, Pozar), with the vacuum acting as a lossy dispersive waveguide. The derivation gives $H_0 = 71.48$ km/s/Mpc (from vacuum properties), which appears as 73.04 km/s/Mpc when measured locally due to a systematic bias factor $B(z) = z/\ln(1+z)$.

Key Prediction: $H_0^{\text{true}} = 71.48$ km/s/Mpc; SH0ES measures 73.04 due to formula bias (within measurement uncertainty)

Four Derived Predictions ΛCDM Cannot Make

1. **CMB Peak Ratio:** $\ell_3/\ell_2 = 1.533$ (from base 3/2 with mode coupling)
2. **Polarization Ratio:** $D^{EE}/D^{TT} = 1/32$ at high ℓ
3. **Dark Energy:** $w_0 = -181/216 = -0.838$
4. **Hubble Constant:** $H_0 = 71.48$ km/s/Mpc (addresses 5.8σ tension)

Framework Reference

These papers derive predictions from the TriPhase Wave Mechanics framework (V15), available separately on Zenodo:

- DOI: 10.5281/zenodo.14649498

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Contact

Christian R. Fuccillo
Magnetic Innovative Solutions LLC
Email: mis@misolutions.co.site